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Volume 31, No. 1, January 1988

Staples Versus Sutures

Neurogenic Bladder-Outlet Reconstruction

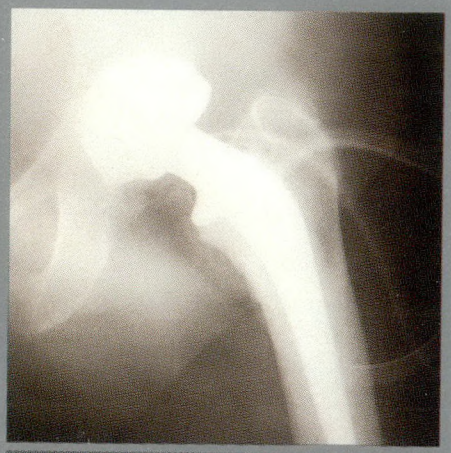
Cyclosporine in Liposomes Reduces Nephrotoxicity

The Canadian Journal of Surgery

Le journal canadien de chirurgie

MORE CONFIDENCE IN ANTITHROMBOTIC THERAPY

New Guidelines for Antithrombotic Therapy In Surgical Cases



The American College of Chest Physicians and the National Heart, Lung and Blood Institute recently issued new guidelines for antithrombotic therapy.[1] There were four Grade A recommendations for the use of warfarin (Coumadin®) in surgical cases. In each of these four (and other Grade A and B recommendations for Coumadin®) a PT ratio of 1.2-1.5 (rabbit brain) was emphasized for clinical efficacy and reduced side-effects risk.

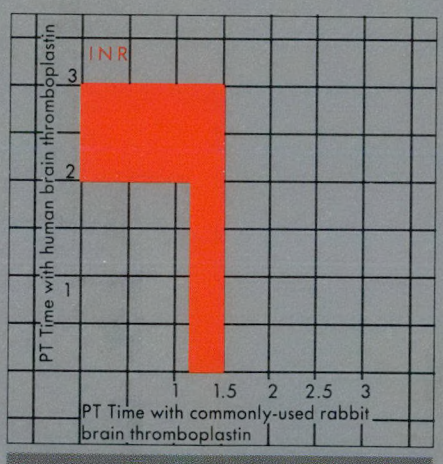
INDICATIONS: **Elective hip surgery / surgery for fractured hips.**

". . . patients undergoing elective hip surgery should be pretreated prophylactically with adjusted-dose heparin or moderate-dose warfarin sodium . . ."

". . . patients undergoing surgery for fractured hips should be treated prophylactically with moderate-dose warfarin.

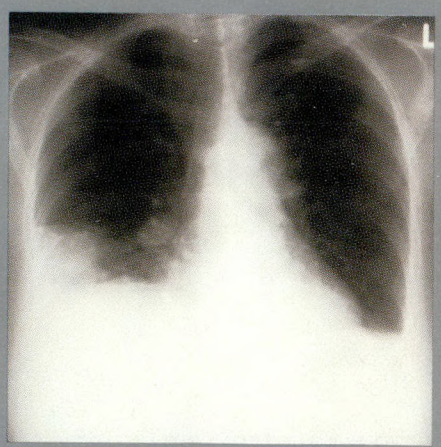
CONDITION: **Bioprosthetic heart valves.**

". . . all patients with bioprosthetic heart valves in the mitral position be treated for the first three months after valve insertion with less intense warfarin . . ."



INDICATION: **Prophylaxis of venous thromboembolism.**

"It is strongly recommended that the therapeutic range for prophylaxis . . . in high-risk medical or surgical patients should be equivalent to an INR of 2.0-3.0 (corresponding rabbit brain thromboplastin ratio 1.2-1.5)."



CONDITION: **Prophylaxis of venous thromboembolism.**

"It is recommended that anticoagulant therapy should be continued for three months using oral anticoagulants to prolong prothrombin time . . ."

"We believe these recommendations will be of value to practicing physicians."

James E. Dalen, M.D., F.C.C.P.; Jack Hirsh, M.D., F.R.C.P.C.; Co-Chairmen: ACCP-NHLBI Conference on Antithrombotic Therapy

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1. **Chest** 1986;89(2);1S-106S

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QUILL ON SCALPEL

This section provides a medium through which Canadian surgeons can declare themselves, briefly and informally, on the day-to-day affairs of surgery.

The Carotid Endarterectomy Study

Stroke remains the commonest cause of disability and the third commonest cause of death in our society, despite a 5% annual decline in deaths and occurrence since 1968.[1-4] Its changing natural history makes it imperative that we study the effects of stroke treatment in a scientific and logical manner. There are no well-designed controlled prospective trials proving the efficacy of carotid endarterectomy among patients with recent transient ischemic attacks. Despite this, carotid endarterectomy is a very commonly performed procedure. In the Division of Neurosurgery at the University of Toronto, approximately 360 carotid endarterectomies have been performed annually since 1980 (Table I). An audit of all carotid endarterectomies performed in this division in 1982, recently reported by the Toronto Cerebrovascular Study Group (headed by D. Rowed), reaffirmed that carotid endarterectomy could be performed safely and highlighted the need for a prospective study of this procedure.[5]

Recently, the National Institutes of Health in Bethesda have granted full funding by form for a randomized prospective clinical trial assessing the benefits of carotid endarterectomy. The principal investigators are H.J.M. Barnett and S.J. Peerless at the University of Western Ontario. The primary questions of the study are as follows:

- Does the addition of carotid endarterectomy to current medical care reduce stroke occurrence and stroke-related death in patients with recent transient ischemic attack or partial stroke and ipsilateral carotid stenosis?
- Which subgroups (severe versus moderate stenosis, presence or absence of ulceration) of patients will benefit most from carotid endarterectomy?

Table I—Carotid Endarterectomies in the Division of Neurosurgery, University of Toronto and in Ontario*

Year	Division Neurosurgery, University of Toronto	Ontario
1980	365	1125
1981	403	1221
1982	387	1311
1983	372	1352
1984	385	1346
1985	333	1274
1986	262	961

*Data supplied by Professor A.R. Hudson, Department of Surgery, University of Toronto and Dr. S.J. Kovacs, Ontario Health Insurance Plan, Toronto.

The secondary questions of the study are: does carotid endarterectomy change the functional status of patients? and what is the more cost effective, carotid endarterectomy with optimum medical therapy or optimum medical therapy alone?

The study will be limited to North American centres with a documented surgical morbidity and mortality of 6% or less in at least 50 patients consecutively accumulated in the 2 years before the trial. Individual surgeons will be required to report a morbidity and mortality less than 4%. Surgeons, neurologists and neuroradiologists at the participating centre will have to agree to randomize *all* patients who would now normally be considered for surgery and to maintain a log of all patients who undergo carotid endarterectomy whether or not they are included in the study. Patients consenting for the study must have had nondisa-

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1867 Alta Vista Dr.
Ottawa, Ont. K1G 3Y6
Tel.: (613) 731-9331

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Detailed instructions to contributors, in English and French, appear on page 69 of the January 1988 issue.

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bling stroke, transient ischemic attack, resolved ischemic neurologic deficit, amaurosis fugax or retinal infarction and ipsilateral operable carotid stenosis within the 4 months preceding randomization.

The angiographic imaging modality used will be left up to the participating centre, but all films will be reviewed by a central monitoring committee and their quality be deemed appropriate or not. The degree of stenosis will be calculated by a newly devised mathematical formula. Doppler or high-quality intravenous angiography will be used for follow-up at 1 month and 2 years postoperatively as well as for follow-up of any stroke or repeated transient ischemic attacks.

Randomization will be carried out by the computer at the central office in London, Ont. Approximately 3000 patients will be randomized during a 2-year entry period and will be followed up for 5 years.

The surgical procedure will be left to the discretion of the surgeon. Monitoring, shunting and patch grafting will be recorded on a surgical report form. Simultaneous coronary artery bypass or bilateral carotid endarterectomy will not be permitted. Patients with bilaterally symptomatic carotid disease will be randomized only once, and, if randomized to the surgical group, will undergo bilateral carotid endarterectomy. Surgery will be performed as soon after randomization as possible, preferably within 48 hours.

Medical therapy for both groups will consist of standard optimization of risk factors (hypertension, diabetes, hyperlipidemia, smoking, polycythemia) and 1300 mg of acetylsalicylic acid (ASA) daily. If the British ASA trial demonstrates that a lower ASA dose is as efficacious or better, the dosage of ASA may be altered.

Follow-up will be by an independent neurologist at 32 days and at 3, 6, 9 and 12 months. Thereafter, patients will be seen at 4-month intervals until a 5-year follow-up is completed. End-points in the study will be stroke and death from stroke.

It is hoped that we will define certain subgroups for which the procedure will prove efficacious and others that will derive no benefit from the procedure. Those of us in neurosurgical training programs are being taught to make clinical decisions as much as possible on scientific grounds. We therefore welcome this initiative of senior Canadian neuroscientists. I encourage all surgeons to support this scientific study and especially encourage all vascular and neurosurgeons to participate.

MICHAEL D. CUSIMANO, MD

Resident,
Division of Neurosurgery,
University of Toronto,
Department of Pathology,
St. Michael's Hospital,
30 Bond St.,
Toronto, Ont.
M5B 1W8

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CORRESPONDENCE

Contributions to the Correspondence section are welcomed. They should be typewritten and double spaced.

Algebraic Confusion

To the editors.—I write to correct an error in the formula for laminar flow as printed on the first page of Landow's article on perioperative hemodilution (*Can J Surg* 1987; 30: 321-325). Incorrectly placed brackets inevitably cause algebraic catastrophe.

The formula for flow printed on the first page should be

$$Q = \frac{\pi(P_1 - P_2)R^4}{8VL}.$$

Even someone who knows absolutely nothing about laminar flow and that it is proportional to the fourth power of the radius may recognize that the formula as printed is incorrect. The dimensions of items to be added or subtracted must be identical. Multiplying P_2 by $3.14R^4$ changes its dimensions and means it cannot be subtracted from P_1. It also makes basic common sense for Q to be proportional to $(P_1 - P_2)$, the pressure gradient.

A further suggestion relates to the use of 3.14 in the numerator, particularly when there is an 8 in the denominator. Why not divide the two and replace them with 0.39 in the numerator? The reason, of course, is the need to remind us of the theoretical basis for this number 3.14. Using $\frac{\pi}{8}$ tells it all?

JAMES C. FALLIS, MD, FRCSC

Director,
Emergency Medical Services,
The Hospital for Sick Children,
555 University Ave.,
Toronto, Ont.
M5G 1X8

[*Dr. Landow replied: "Dr. Fallis has correctly noted an obvious error in the Poiseuille–Hagen equation as printed in the article 'Perioperative hemodilution'."*]

Cholecystectomy for Asymptomatic Cholelithiasis

To the editors.—I congratulate Saade and his colleagues on their article "Should cholecystectomy be done *en passant* for asymptomatic cholelithiasis" (*Can J Surg* 1987; 30: 350-353) which confirms our beliefs.[1]

To avoid perpetuating an error I would like to point to an oversight made in Table V of the article, where Biggers and colleagues[2] are quoted as having done 242 concomitant cholecystectomies with colorectal surgery. The correct number is 81 concomitant cholecystectomies and colectomy.

H. SHENNIB, MD, FRCSC

Department of Surgery,
Mount Sinai Hospital,
600 University Ave.,
Toronto, Ont.
M5G 1X5

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2. BIGGERS OR, READY RL, BEART RW JR: Risk of additional intra-abdominal procedures at the time of colectomy. *Dis Colon Rectum* 1982; 25: 185-186

SURGEONS' UPDATE

What's new in surgery is the subject of this column. The short items are designed to let readers know who's doing what and why. Surgeons are interested in what other surgeons are doing in research, education, practice and administration. Surgery is a vibrant specialty, and, as its practitioners, you must be the source as well as the readers of this column.

The Future of Health Care in Canada

Canada has an effective health-care system, Jake Epp, the Minister of National Health and Welfare, told the Americas Society in a recent address in New York City, since it "provides excellent care to all our residents on a fully prepaid basis, imposes no upper dollar limits on coverage, and this is achieved at a cost the taxpayers and the country can afford". Increasing demands on the system, however, mean that "to ensure that we continue to provide quality care at reasonable costs...we must make some adjustments in certain areas".

The Minister outlined three factors that are putting a strain on the health-care system: the increasing number of elderly citizens (soon 1 in 10 Canadians will be over the age of 65 years) since this group utilizes health-care services disproportionately to its size in the general population; advances in medical technology, especially in areas such as neonatal care, transplantation and reproductive technology that have proven to be expensive; and new health hazards and diseases, such as acquired immune deficiency syndrome, which create challenges in the areas of research, care and treatment.

He made two proposals to meet the increasing demands, while at the same time containing costs. One is the use of alternative forms of health-care delivery which will help to relieve some of the burden on hospitals. He cited Quebec's community health centres and New Brunswick's "extramural hospital" concept, in which patients are provided hospital services in their own homes under a physician's care, as examples of alternatives to traditional hospitalization.

The second proposal is an emphasis on health promotion and disease prevention. Universal health care alone has not been sufficient to ensure equal levels of health among individuals since, said Epp, "a man in a high income bracket can expect to live some 6 years longer than a man with a low income". Since the early 1970s, he said, there has been success in encouraging people to adopt healthier life-styles by exercising, eating well and following physicians' instructions. The proposed ban of tobacco advertising would also be a continuation of this policy of combatting preventable disease.

The Ontario government is also promoting healthy life-styles. The Ministry of Health has established a new health promotion branch, a $2.5 million program of community health promotion grants has been implemented and materials will be left in the community enabling local organizations to carry out their own health promotion. Said the Minister of Health, Elinor Caplan, "people should be given the tools...to take more personal responsibility for their own health".

Computer Allows Patients to See the Results of Plastic Surgery

Nabil Fanous, FRCSC, assistant professor of otolaryngology at McGill University, is now able to show patients considering plastic surgery what they will look like after the procedure. He is one of the first in Canada using a new computer which, when attached to a camera, takes a picture of the patient's face and displays it on a television screen. The surgeon uses an electronic pen to alter the patient's features on the screen, allowing the patient "to visualize more readily what improvements are possible and what are not". With realistic expectations of the surgery's outcome, the patient is then able to make a decision on whether to proceed.

Ontario's Hospitals Are Increasingly Smoke-Free

The Ontario Hospital Association has released the results of its survey, conducted in May 1987, of smoking policies and practices in Ontario's hospitals. Of the 213 hospitals surveyed, 180 (85%) have prohibited smoking except in designated rooms or areas. This is a substantial increase since the last survey, in 1983, when 89 (50%) of the hospitals surveyed had a designated-area smoking policy. Four hospitals have imposed, since the 1983 survey, a total ban on smoking and seven have announced plans to do the same. Forty-seven percent of hospitals surveyed indicated that the ultimate goal of their smoking policy was a complete ban.

Heart-Drug Trial

Bruce Sussex, FRCPC, a cardiology specialist at Memorial University, St. John's, Nfld., will be one of the principal researchers in a 4-year trial of the heart drug Captopril. One-hundred patients who have had recent, moderate to severe heart attacks will participate in the Newfoundland part of the study, which will determine whether treatment with Captopril, when started soon after a heart attack and continued for several years, can prevent heart enlargement and congestive heart failure. A total of 4000 patients in 35 centres across Canada and the US will be involved.

LAUREL WILLIAMSON

Contributions to this column are welcome. Please send your material to: Mrs. Amy Chouinard, *Canadian Journal of Surgery*, PO Box 8650, Ottawa, Ont. K1G 0G8.

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INDICATIONS: The prophylaxis and/or treatment of venous thrombosis and its extension, pulmonary embolism, atrial fibrillation with embolization, and as an adjunct in the prophylaxis of systemic embolism after myocardial infarction. Some of the more common clinical disorders which may be associated with or predispose patients to the above indications are: Thrombophlebitis; Congestive heart failure; Surgical procedure or trauma associated with a high risk of thromboembolism; Myocardial infarction; Cerebral embolism. It may also be useful as an adjunct in the treatment of transient cerebral ischemic attacks due to intravascular clotting.

CONTRAINDICATIONS: Any localized or general physical condition or personal circumstance in which the hazard of hemorrhage might be greater than the potential clinical benefits of anticoagulation, such as: **Pregnancy:** COUMADIN® is contraindicated in pregnancy because the drug passes through the placental barrier and may cause fatal hemorrhage to the fetus *in utero.* Also, there have been reports of birth malformations in children born to mothers who have been treated with warfarin during pregnancy. Women of childbearing potential who are candidates for therapy should be carefully evaluated and the indications critically reviewed with the patient. If the patient becomes pregnant while taking this drug, she should be apprised of the potential risks to the fetus, and the possibility of termination of the pregnancy should be discussed in light of those risks. **Hemorrhagic tendencies or blood dyscrasias. Recent or contemplated surgery of:** 1. central nervous system; 2. eye; 3. traumatic surgery resulting in large open surfaces. **Bleeding tendencies associated with active ulceration or overt bleeding of:** gastrointestinal, genitourinary or respiratory tracts; cerebrovascular hemorrhage; aneurysms – cerebral, dissecting aorta; pericarditis and pericardial effusions; bacterial endocarditis. **Threatened abortion,** eclampsia and preeclampsia. **Inadequate laboratory facilities** or unsupervised senility, alcoholism, psychosis, or lack of patient cooperation. **Spinal puncture** and other diagnostic or therapeutic procedures with potential for uncontrollable bleeding. **Miscellaneous:** major regional, lumbar block anesthesia and malignant hypertension.

WARNINGS: The most serious risks are hemorrhage in any tissue or organ and, less frequently, necrosis and/or gangrene of skin and other tissues. Risk of hemorrhage is related to the level of intensity and duration of therapy. Hemorrhage and necrosis have in some cases been reported to result in death or permanent disability. Necrosis appears to be associated with local thrombosis and usually appears within a few days of the start of therapy. In severe cases of necrosis, treatment through debridement or amputation of the affected tissue, limb, breast or penis has been reported. Careful diagnosis is required to determine whether necrosis is caused by an underlying disease. Therapy should be discontinued when warfarin is the suspected cause of developing necrosis and heparin may be considered. Although various ones have been attempted, no treatment for necrosis has been considered uniformly effective. See below for information on predisposing conditions. These and other risks must be weighed against the risk of thrombosis or embolization in untreated cases. COUMADIN is a potent drug with a half-life of 2.5 days; therefore effects may become more pronounced as daily maintenance doses overlap. **It cannot be emphasized too strongly that treatment of each patient is a highly individualized matter.** Dosage should be controlled by periodic determinations of prothrombin time or other suitable coagulation tests. Determinations of whole blood clotting and bleeding times are not effective measures for control of therapy. Heparin prolongs the one-stage prothrombin time. When heparin and COUMADIN are administered concomitantly, refer to CONVERSION FROM HEPARIN THERAPY for recommendations. Caution should be observed when COUMADIN is administered in any situation or in the presence of any predisposing condition where added risk of hemorrhage or necrosis is present. Administration of anticoagulants in the following conditions will be based upon clinical judgement in which risks of therapy are weighed against the risk of thrombosis or embolization in untreated cases. The following may be associated with these increased risks: **Lactation. Severe to moderate hepatic or renal insufficiency. Infectious diseases or disturbances of intestinal flora** – sprue, antibiotic therapy. **Trauma** which may result in internal bleeding. **Surgery or trauma** resulting in large exposed raw surfaces. **Indwelling catheters. Severe to moderate hypertension. Known or suspected deficiency in protein C:** This hereditary or acquired condition, which should be suspected if there is a history of recurrent episodes of thromboembolic disorders in the patient or in the family, has been associated with an increased risk of developing necrosis following warfarin administration. Tissue necrosis may occur in the absence of protein C deficiency. It has been reported that concurrent anticoagulation therapy with heparin for 5 to 7 days during initiation of therapy with COUMADIN may minimize the incidence of this reaction. Warfarin therapy should be discontinued when it is suspected to be the cause of developing necrosis, and heparin may be considered. **Miscellaneous:** polycythemia vera, vasculitis, severe diabetes, severe allergic and anaphylactic disorders. Patients with congestive heart failure may become more sensitive to COUMADIN, thereby requiring more frequent laboratory monitoring, and reduced doses. Concurrent use of anticoagulants with streptokinase or urokinase is not recommended and may be hazardous. (Please note recommendations accompanying these preparations.)

PRECAUTIONS: Periodic determination of prothrombin time or other suitable coagulation test is essential. Numerous factors, alone or in combination, including travel, changes in diet, environment, physical state and medication may influence response to anticoagulants. It is good practice to monitor the response with additional prothrombin time determinations in the period immediately after discharge from the hospital, and whenever other medications are initiated, discontinued or taken haphazardly. The following factors are listed for your reference; however, other factors may also affect the anticoagulant response.

The following factors, alone or in combination, may be responsible for INCREASED prothrombin time response: ENDOGENOUS FACTORS: cancer, collagen disease, congestive heart failure, diarrhea, elevated temperature, hepatic disorders: (infectious hepatitis, jaundice), poor nutritional state, steatorrhea, vitamin K deficiency. EXOGENOUS FACTORS: alcohol,† allopurinol, aminosalicylic acid, amiodarone HCl, anabolic steroids, anesthetics, inhalation, antibiotics, bromelains, chloral hydrate,† chlorpropamide, chymotrypsin, cimetidine, clofibrate, COUMADIN overdosage, dextran, dextrothyroxine, diazoxide, diflunisal, diuretics,† disulfiram, ethacrynic acid, fenoprofen, glucagon, hepatotoxic drugs, ibuprofen, influenza virus vaccine, mefenamic acid, methyldopa, methylphenidate, metronidazole, miconazole, monoamine oxidase inhibitors, nalidixic acid, naproxen, narcotics, prolonged, pentoxifylline, phenylbutazone, phenytoin, pyrazolones, quinidine, quinine, ranitidine,† salicylates, sulfinpyrazone, sulfonamides, long-acting, sulindac, thyroid drugs, tolbutamide, trimethoprim/sulfamethoxazole, other medications affecting blood elements which may modify hemostasis. Also: dietary deficiencies, prolonged hot weather, unreliable prothrombin time determinations.

The following factors, alone or in combination, may be responsible for DECREASED prothrombin time response: ENDOGENOUS FACTORS: edema, hereditary coumarin resistance, hyperlipemia, hypothyroidism. EXOGENOUS FACTORS: adrenocortical steroids, alcohol,† antacids, antihistamines, barbiturates, carbamazepine, chloral hydrate,† chlordiazepoxide, cholestyramine, COUMADIN underdosage, diuretics,† ethchlorvynol, glutethimide, griseofulvin, haloperidol, meprobamate, oral contraceptives, paraldehyde, primidone, ranitidine,† rifampin, vitamin C. Also: diet high in vitamin K, unreliable PT determinations. Because a patient may be exposed to a combination of the above factors, the net effect on PT response may be unpredictable. More frequent laboratory monitoring is, therefore, advisable. Coumarins may also affect the actions of other drugs. Hypoglycemic agents (chlorpropamide, tolbutamide and glyburide) and anticonvulsants (phenytoin and phenobarbital) may accumulate in the body as a result of interference with either their metabolism or excretion.

ADVERSE REACTIONS: Potential adverse reactions may include: • Hemorrhage from any tissue or organ. This is a consequence of the anticoagulant effect. Signs and symptoms will vary according to the location and degree or extent of bleeding. Therefore, the possibility of hemorrhage should be considered in evaluating the condition of any anticoagulated patient with complaints which do not indicate an obvious diagnosis. Bleeding during anticoagulant therapy does not always correlate with prothrombin activity. (See SYMPTOMS AND TREATMENT OF OVERDOSAGE.) Bleeding which occurs when the prothrombin time is within the therapeutic range warrants diagnostic investigation, since it may unmask a previously unsuspected lesion, e.g. tumor, ulcer, etc. • Necrosis of skin and other tissues. (SEE WARNINGS). • Other adverse reactions are infrequent and consist of alopecia, urticaria, dermatitis, fever, nausea, diarrhea, abdominal cramping, a syndrome called "purple toes," cholestatic hepatic injury, and hypersensitivity reactions. • Priapism has been associated with anticoagulant administration, however, a causal relationship has not been established.

DOSAGE AND LABORATORY CONTROL: Administration: Administration and dosage must be individualized. Adjust the dosage according to results of the one-stage prothrombin time (PT) with commonly used rabbit brain thromboplastin. There is ample evidence that prolongation of the prothrombin time 1.2 to 1.5 times control is sufficient for prophylaxis and treatment of venous thromboembolism, minimizing the risk of hemorrhage associated with more prolonged PT values. Where the risk of thromboembolism is great, such as with recurrent systemic embolism, a PT of 1.5 to 2.0 times control should be maintained. A ratio greater than 2.0 appears to provide no additional therapeutic benefit in most patients and is associated with a higher risk of bleeding.

Table of Recommended Therapeutic PT Ranges*

Clinical State	Rabbit Brain PT Ratio**
Prophylaxis – venous thromboembolism	
High-risk surgery	1.2-1.4
Hip surgery	1.3-1.5
Treatment-deep vein thrombosis or pulmonary embolism	1.2-1.5
Prevention of systemic embolism in patients with:	
• atrial fibrillation,	
• tissue heart valves, or	
• acute myocardial infarction	1.2-1.5
Recurrent systemic embolism	1.5-2.0

*Modified from Chest, ACCP-NHLBI National Conference on Antithrombotic Therapy, volume 89, number 2, page 14S, 1986.

**For the three thromboplastins currently used in North America, a PT with rabbit brain thromboplastin of 1.3 to 2.0 is equivalent to an International Normalized Ratio (INR) of 2.0 to 4.0. For other thromboplastins the INR can be calculated as: INR = (observed PT).^{ISI} The ISI (International Sensitivity Index) is available from the manufacturers of thromboplastin.

INITIAL DOSAGE: Is commonly started above anticipated maintenance dosage levels. A commonly-used regimen is 10mg/day for 2 to 4 days, with daily adjustments based on the results of PT determinations. A large loading dose (i.e., 30mg) may increase the incidence of hemorrhagic and other complications, does not offer more rapid protection against thrombi formation, and is not recommended. Lower doses are recommended for elderly and/or debilitated patients and patients with increased sensitivity (see PRECAUTIONS). **Maintenance:** Most patients are satisfactorily maintained at a dose of 2 to 10mg daily. Flexibility of dosage is provided by breaking scored tablets in half. The individual dose and interval should be gauged by the patient's prothrombin response. **Duration of therapy:** The duration of therapy in each patient should be individualized. In general, therapy should be continued until the danger of thrombosis and embolism has passed. **Treatment During Dentistry and Surgery:** Management of patients who undergo dental and surgical procedures requires close liaison between attending physicians, surgeons and dentists. In patients who must be anticoagulated prior to, during, or immediately following dental or surgical procedures, adjusting the dosage to maintain the PT at the low end of the therapeutic range, may safely allow for continued anticoagulation. The operative site should be sufficiently limited and accessible to permit the effective use of local procedures for hemostasis. Under these conditions, dental and surgical procedures may be performed without undue risk of hemorrhage. **Conversion from Heparin Therapy:** Since the onset of COUMADIN's effect is delayed, heparin is preferred initially for rapid anticoagulation. Conversion to COUMADIN may begin concomitantly with heparin therapy or may be delayed 3 to 6 days. As heparin may affect the PT, patients receiving both heparin and COUMADIN should have blood drawn for PT determination, at least: • 5 hours after the last IV bolus dose of heparin, or • 4 hours after cessation of a continuous IV infusion of heparin, or • 24 hours after the last subcutaneous heparin injection. When COUMADIN has produced the desired therapeutic range or prothrombin activity, heparin may be discontinued.

SYMPTOMS AND TREATMENT OF OVERDOSAGE: Symptoms: Suspected or overt abnormal bleeding (i.e., appearance of blood in stools or urine, hematuria, excessive menstrual bleeding, melena, petechiae, excessive bruising or persistent oozing from superficial injuries) are early manifestations of anticoagulation beyond a safe and satisfactory level. **Treatment:** Excessive anticoagulation, with or without bleeding, may be controlled by discontinuing therapy and if necessary, by administration of oral or parenteral vitamin K_1 2.5mg to 10mg. (Please see recommendations accompanying vitamin K_1 preparations prior to use.) Use of vitamin K_1 reduces responses to subsequent COUMADIN therapy. Patients may return to a pretreatment thrombotic status following the rapid reversal of a prolonged PT. Resumption of COUMADIN administration reverses the effect of vitamin K_1, and a therapeutic PT can again be obtained by careful dosage adjustment. If rapid anticoagulation is indicated, heparin may be preferable for initial therapy. If minor bleeding progresses to major bleeding, give 5 to 25mg (rarely up to 50mg) parenteral vitamin K_1. In emergency situations of severe hemorrhage, clotting factors can be returned to normal by administering 200 to 500mL of whole blood or fresh frozen plasma, or by giving commercial Factor IX complex. Packed red blood cells may also be given if significant blood loss has occurred. Infusions of blood or plasma should be monitored carefully to avoid precipitating pulmonary edema in elderly patients or patients with heart disease.

DOSAGE FORMS: COUMADIN TABLETS are single-scored, and are imprinted as follows:

SIZE:	2mg	2.5mg	5mg	10mg
CODE:	0101	0201	0301	0401
COLOR:	lavender	orange	peach	white
IMPRINT:				
Side 1:	COUMADIN	COUMADIN	COUMADIN	COUMADIN
	bisected 2	bisected 2½	bisected 5	bisected 10
Side 2:	Du Pont	Du Pont	Du Pont	Du Pont

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†Increased and decreased prothrombin time responses have been reported.

Reference:

1. O'Reilly RA, Aggeler PM: Studies on coumarin anticoagulant drugs: initiation of warfarin therapy without a loading dose. Circulation 38:169-177, 1968.

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REVIEW ARTICLE

VAUGHAN BOWEN, MB, CH B, FRCSC; JANN JOHNSON, MD, FRCSC; JIM BOYLE, MD, FRCSC; CHARLES F.T. SNELLING, MD, FRCSC

Tetanus — a Continuing Problem in Minor Injuries

Tetanus is rare in North America because of highly effective specific immunization programs. Nevertheless, 15 patients with generalized tetanus were treated at the Vancouver General Hospital over a 20-year period; 10 of them were over 50 years of age. Two patients had no injury and 12 had suffered only minor wounds. None had received previous immunization and, even after wounding, prophylaxis was unsatisfactory in all cases. Nine patients required intensive care and two died. Positive cultures were obtained in only two cases.

Four recommendations are made to prevent tetanus: (a) all wounds should be considered "tetanus-prone", (b) an accurate history of immunization should be obtained, (c) more attention should be given to prophylaxis at the time of injury and (d) patients should record vaccinations.

Grâce à des programmes d'immunisation spécifiques très efficaces, le tétanos est devenu rare en Amérique du Nord. Néanmoins, sur une période de 20 ans, 15 patients souffrant de tétanos généralisé ont été traités au Vancouver General Hospital; 10 d'entre-eux avaient plus de 50 ans. Deux patients n'avaient subi aucune blessure et 12 n'avaient que des lésions superficielles. Aucun n'avait été préalablement immunisé et, après la blessure, le traitement prophylactique s'était avéré inefficace dans tous les cas. Neuf malades ont nécessité des soins intensifs et deux sont décédés. Deux cas seulement ont donné des cultures positives.

On formule quatre recommandations destinées à prévenir le tétanos: a) toutes les blessures doivent être considérées comme pouvant être une porte d'entrée pour le tétanos, b) on doit viser à obtenir des antécédents d'immunisation précis, c) une plus grande attention doit être accordée à la prophylaxie au moment de la blessure, et d) les patients devraient conserver un dossier d'immunisation.

Tetanus is a potentially fatal complication of wounds. The disease still represents a serious health problem in developing countries, but because of the widespread availability of highly effective immunization it has now become relatively rare in North America. Each new case is a cause for concern because the disease is so readily preventable and so often is caused by an otherwise trivial injury.

The aim of this report is to focus attention on the idea that minor wounds are just as tetanus-prone as major injuries and the finding that, despite widespread immunization, there are still people, especially those over 50 years of age, who are not immunized and are, therefore, at risk.

Patients and Methods

This paper reviews the hospital records of all 15 patients (8 men, 7 women) with a clinical diagnosis of tetanus managed at the Vancouver General Hospital over the 20-year period between 1961 and 1981. Isolation of *Clostridium tetani* or a previous injury was not necessary for inclusion in the series. The following factors were analysed: age, sex, immunization status, type of wound, bacterial cultures, presentation, clinical course and final outcome.

Findings

The ages of the 15 patients ranged widely but the majority were over 50 years old (Table I). Predisposing wounds

Table I—Injuries and Tetanus Prophylaxis in 15 Patients With Clinical Tetanus

Age, yr	Sex	Injury	Immunization status	Prophylaxis received
40	F	Surgical mid-tarsal fusion. Skin necrosis in cast	Unknown	None
81	M	Surgical excision of plantar warts	None	None
79	M	Forearm abrasion	None	None*
2	M	2nd degree burn to chest	None	None*
74	F	Leg abrasion	None	None*
50	M	Lacerated scalp	One injection†	None*
72	M	Fingertip injuries	None	1 ml ATT
34	F	Open fracture of toe	One injection†	None*
68	F	Puncture wound to foot	None	1 ml ATT
68	F	Puncture wound to foot	Unknown	1 ml ATT
64	F	Puncture wound to thigh	None	1 ml ATT 2 d later
57	M	Puncture wound to cheek	Unknown	1 ml ATT
30	M	Puncture wound to arm	One injection†	None*
67	F	None known	One injection†	None*
6	M	None known	None	None*

*Patient did not seek medical attention for wound.
†One injection many years ago.
ATT = antitetanus toxin.

From the Department of Orthopedic Surgery and the Division of Plastic Surgery, University of British Columbia and the Vancouver General Hospital, Vancouver, BC

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Reprint requests to: Dr. Vaughan Bowen, Department of Orthopedic Surgery, University Hospital, Saskatoon, Sask. S7N 0X0

varied, but 11 were only minor. In two patients there was no history or physical sign of a wound and two others had undergone elective surgery, one for excision of plantar warts as an outpatient. The patient's immunization status was recorded in only 12 cases. At the time of wounding, none of these patients had previously received adequate antitetanus prophylaxis. Even after injury, tetanus prophylaxis was unsatisfactory in all cases. Six patients sought no initial treatment for their wounds, two who underwent elective surgery were not protected at the time of operation, four were given their first dose of active immunization on the day of injury and one was given a first dose of active immunization 2 days after injury. No patient received passive immunization with human tetanus immune globulin.

Tetanus was generalized in all 15 patients. It presented with trismus and dysphagia in 13, dyspnea in 1 and coma in 1. In 9 of the 15 patients the tetanus was severe, and 7 of these patients were managed with intensive care, paralysis and ventilatory assistance. They remained in the intensive care unit for 20 to 74 days but all 7 survived. The other two patients with severe generalized tetanus died before reaching the intensive-care unit; one arrived in the emergency room moribund and could not be resuscitated and the other died of a cardiac arrest immediately after arrival at the hospital.

Cultures positive for *Clostridium tetani* were obtained in only 2 of the 15 cases.

Discussion

The clinical features and current methods of treatment of tetanus have been reviewed by Alfery and Rauscher.[1] They indicated that the majority of cases are generalized, that the diagnosis is usually made from clinical signs rather than laboratory investigations and that the best management is a team approach in the intensive-care unit.

Antitetanus immunization has been available since the 1940s. Its effectiveness prompted Furste,[2] in 1970, to express the hope that "by 1980 tetanus would be a disease of only historical significance in the United States of America". Unfortunately, this prediction has not been realized as cases are still being reported.

The sporadic cases that occur in North American hospitals are worrying because the death rate from generalized tetanus is still 45% to 50%[3] despite the widespread availability of respiratory assistance and intensive-care facilities which, together with an aggressive surgical approach,[4] have reduced the overall death rate.[5-7] Deaths, nowadays, usually result from cardiovascular instability.

Tetanus is common in underdeveloped countries because large populations are not immunized. Throughout North America and especially in Canada, immunization programs have been in place for many years, and yet tetanus is still seen. Why is this? Is it related to the wounds or to a failure of immunization?

The wounds themselves are an important factor and in this series were almost always minor in nature. Others[5,8-11] have documented this finding. That such a serious disease can follow otherwise trivial injuries is distressing, particularly when the condition is preventable and, theoretically, could be eliminated. Prevention immediately after wounding was not possible in half our patients as they did not seek medical attention, presumably because of the trivial nature of the injuries. Failure to seek medical advice and the emphasis on ensuring that large "tetanus-prone" wounds receive adequate prophylaxis in emergency departments has led to a situation where minor wounds have become the most tetanus-prone.

Tetanus prophylaxis has been studied extensively in various populations. Researchers have analysed serum antibody levels,[12-15] conducted immunization status surveys[16,17] and examined the adequacy of prescribing tetanus prophylaxis in hospital emergency rooms.[18] Others have discussed the necessity for reimmunization[14,19] and the problems of excess administration of antitetanus toxoid.[11,18,20,21] A study of cases seen in the US armed forces over more than 20 years has clearly documented the efficacy of a well-organized primary immunization program.[10]

Unfortunately these data apply only to people who have been immunized. None of our 15 patients had been given a primary course of immunization. Other recent studies of tetanus patients in countries with well-developed health-care systems also documented that the disease is seen in patients who are not adequately immunized.[3,5] Once immunized, a person's serum antibody level may decline with time,[13] but Canadian surveillance data[19] suggest that despite decreased antibody levels, immunologic memory remains good enough to prevent people moving from the immune to the susceptible category. Data from population surveys have demonstrated that a considerable number of people are not immunized against tetanus[15,17-22] and the opportunities to do so are missed. The prevalence of inadequate immunization status (not being immunized rather than declining serum antibody levels) is high in the older population and accounts for the prevalence of tetanus in this group.[9,17,23,24] Failure to receive an adequate primary course of immunization, therefore, is still the main cause of tetanus in North America despite the widespread availability of adequate immunization and prophylactic regimens being publicized by the American College of Surgeons.[25]

The problems of the gap in immunity in adults and vague immunization histories have been tackled in Czechoslovakia. Between 1973 and 1975, a vaccination campaign was carried out and, since 1973, immunization has been recorded on personal identification cards. In a subsequent report,[10] Mazar demonstrated not only a notable decrease in the incidence of tetanus but also that the identification cards were being used correctly, thus providing highly reliable and readily available vaccination records at the time of injury.

We have four suggestions to make that may help to prevent tetanus occurring, especially after trivial injuries.

- All wounds, however trivial and from whatever cause, should be considered tetanus-prone.
- A tetanus vaccination history should be taken from every patient seeking medical care for any reason. This history should determine: (a) if the patient ever had a complete primary vaccination series, (b) when the patient received the most recent booster. It has been suggested[11] that the best person to take this history and record the answers is the admitting clerk or receptionist, and it should be done at the time other details (e.g., name, address) are being recorded.
- Correct prophylaxis should then be prescribed by the attending physician either to initiate a primary vaccination series or as a booster according to the guidelines laid down by the American College of Surgeons.
- Patients should be encouraged to keep records of their vaccination status and to carry them with their hospital identity cards.

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NOTICES

University of Toronto — Continuing Education

The Faculty of Medicine of the University of Toronto has scheduled two courses to be presented this spring. The first will take place May 19 and 20, 1988, at the Mount Sinai Hospital and is entitled "Allografts in Orthopaedic Surgery — Banking and Clinical Applications". On May 31 and June 1 at the same location, a course entitled "Advances and Controversies in Vascular Surgery" will be held. Further information on both of these courses can be obtained by writing: Continuing Medical Education, Faculty of Medicine, University of Toronto, Medical Sciences Building, Toronto, Ont. M5S 1A8 or by calling: (416) 978-2718.

Eleventh Annual Conference on Shock

Fontana, Wisconsin will be the site of the Shock Society's 11th annual conference on shock, June 5–8, 1988. Symposia include such topics as "Organ Blood Flow and Metabolism in Shock" and "The Effects of Endotoxemia in Humans and in Experimental Septic Shock". The keynote speaker will be John J. Spitzer of the Louisiana State University Medical Center and workshops entitled "Animal Models That Simulate Circulatory Shock in Humans: Fact or Fantasy?" and "Use of Hypertonic Solutions for Shock Resuscitation" are planned. For further information, contact: Dr. Sherwood M. Reichard, Shock Society, Medical College of Georgia, Augusta, GA 30912, USA.

Extended Programs in Medical Education

The University of California in San Francisco is sponsoring a postgraduate course in general surgery, April 14–16, 1988. Further information can be obtained by writing: Extended Programs in Medical Education, University of California School of Medicine, Room 569-U, San Francisco, California 94143 or calling: (415) 476-4251.

International Symposium

Paris is the location of a symposium on therapeutic progress in urological cancers scheduled for June 29–July 1, 1988. For details contact: Dr. Gerald P. Murphy, Professor of urology, School of Medicine, State University of New York at Buffalo, 139 Parker Hall, Buffalo, NY 14214; telephone: (716) 831-2338.

Reviewers 1987

The Editors, on behalf of the Editorial Advisory Board of the Journal, acknowledge with thanks the services of the following reviewers of manuscripts for the past year.

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MARK E. BOYD, MD, FRCSC, FRCOG

Cesarean Section

Cesarean section has become a common operation, but its complexity should not be underestimated. Often it must be done as an emergency without skilled assistants; at the same time the surgeon must deal with the maternal disorder that prompted the cesarean section and ensure the well-being of the fetus. Of further concern is the operative blood loss, which can be massive, and the postoperative morbidity, which is often high. The operative technique has evolved from an intraperitoneal vertical incision on the body of the uterus (classical cesarean section) to a near-complete reliance on a retroperitoneal transverse incision (lower segment cesarean section). The historic reason for this change was the fear of peritonitis postoperatively. Present-day practice favours the lower segment operation and emphasizes the reduced operative blood loss and the more secure uterine scar as reasons for the choice. Operative complications (injury to the fetus, lacerations of the uterus and vagina) are the result of inadequate uterine incisions. The classical incision has the advantage of being easily extended and thus has a continued purpose. Postoperative febrile morbidity is attributed to endometritis; the mixed aerobic and anaerobic bacteria of the vagina are the causal organisms. Febrile morbidity can be prevented by antibiotics given prophylactically.

Bien que l'accouchement par césarienne soit devenu une opération courante, on ne doit pas sous-estimer sa difficulté. Il doit souvent être pratiqué en urgence sans le soutien d'assistants expérimentés; le chirurgien doit en même temps faire face au problème maternel qui aura provoqué la césarienne et s'assurer du bien-être du foetus. La perte de sang peropératoire qui peut être massive et la morbidité post-opératoire souvent élevée sont d'autres sources d'inquiétude. La technique opératoire a évolué: d'une incision intrapéritonéale verticale sur le corps de l'utérus (la césarienne haute), elle est devenue, dans presque tous les cas une incision rétropéritonéale transversale (césarienne basse). La crainte d'une péritonite postopératoire est à l'origine de ce changement. La pratique courante favorise la césarienne basse; elle s'applique à réduire les pertes de sang peropératoires et vise à obtenir une cicatrice utérine plus sûre. Les complications peropératoires (blessures du foetus, lacérations de l'utérus et du vagin) sont le résultat d'incisions intra-utérines inadéquates. L'incision haute présente l'avantage de pouvoir être élargie facilement et continue de la sorte à avoir une utilité. La morbidité fébrile post-opératoire est attribuée à l'endométrite. La flore bactérienne mixte, aérobie et anaérobie, du vagin en est à l'origine. La morbidité fébrile peut être prévenue par une antibiothérapie prophylactique.

In communities of less than 10 000 people, cesarean section is the fourth most common operation that general surgeons will be called upon to perform.[1] This paper will outline the concerns for the general surgeon at the time of cesarean section and explain the rationale governing the choice of operation, but will concentrate on operative and postoperative management. The objective is to demonstrate means of decreasing the two major complications — hemorrhage during the operation and infection postoperatively. Operative injury to the urinary tract is less common but will also be discussed. In Canada a recent consensus report has reviewed indications for the operation,[2] so these will not be considered.

Complications

In addition to the complications associated with the operative procedure, there are those inherent to the obstetrical problem itself. The fragile patient with pre-eclampsia who has a threatening cerebrovascular accident, reduced intravascular volume and possible platelet dysfunction has an increased operative risk. General anesthesia is dangerous, for the pregnant patient is more likely to vomit and runs a high risk of aspiration. The patient's position on the operating table is different; the table must be tilted laterally or a wedge fixed beneath one of the patient's hips, because when the woman is supine and not tilted the pregnant uterus markedly impedes venous return.[3] Fetal well-being is an added responsibility for the surgeon. The fetus is subject to operative trauma and blood loss. The likelihood of postoperative respiratory distress is increased if the cesarean section is done before term. When the cesarean section is elective, the gestational dates should be confirmed by ultrasonography performed in early pregnancy[4] or the onset of labour should be awaited.[5] The surgery itself may cause excessive blood loss and be associated with high morbidity. The average blood loss during cesarean section is 0.9 to 1.0 litres,[6] which is higher than that anticipated during most surgical operations, and the postoperative morbidity is even higher than that which may follow gunshot wounds of the abdomen.[7] The consequences of an inappropriate or poorly performed operation are such that a recent review demonstrated that nearly one-third of maternal deaths were associated with cesarean section.[8]

Choice of Operation

The classical cesarean section has been superseded by the lower segment operation, which has a number of advantages. One of these is reduced blood loss because of the lower segment's decreased vascularity and because the wound edges can be more accurately approximated. The resultant scar is less likely to rupture in subsequent pregnancies and, if so, only in labour. This is in contrast to the scar of the classical operation which may rupture before the onset of labour. The degree of risk between the two major inci-

From the Department of Obstetrics and Gynecology, Royal Victoria Hospital, Montreal, PQ

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Reprint requests to: Dr. M.E. Boyd, Gynecologist-in-chief, Royal Victoria Hospital, Women's Pavilion, 687 Pine Ave. W, Montreal, PQ H3A 1A1

sions has not yet been properly assessed and was subject to debate even when last documented 29 years ago.[9] The classical operation allows the continued seepage of blood and possibly infected uterine contents into the peritoneal cavity postoperatively with the concomitant danger of peritonitis. This risk is reduced with the lower segment operation because the uterine incision's placement behind the peritoneum stops the discharge. This was crucial in the pre-antibiotic era, but is less important now.[10]

There are, however, advantages of the classical cesarean section over the lower segment technique. In some circumstances, it will allow the child to be delivered with less risk to the mother and less trauma to the infant. The classical incision will not tear into the broad ligament causing hemorrhage and can safely be extended to allow easy delivery. Serious operative complications can be reduced by more frequent use of the classical cesarean section.[11-13]

The most common indication for the classical cesarean section is prematurity. The lower segment of the premature uterus is thick and vascular and only a few centimetres wide. Attempts to perform a lower segment cesarean section in this case can lead to trauma to the infant and uterine tears or extended incisions, often a vertical incision into the upper segment. An infant of 28 weeks cannot be delivered through a 1.0-cm-long lower segment.[12] Other indications for classical cesarean section include disease in the lower segment (adhesions or myomas), abnormal fetal presentation (transverse) or placenta previa.

Technique

Lower Segment Cesarean Section

A Pfannenstiel incision is generally used. The skin incision is traced with a marker, for with the patient in a lateral tilt and draped it will be difficult to ensure an even incision. On opening the peritoneal cavity, the uterus is often found twisted to the right. As a result, the uterine arteries, which are on the lateral aspect of the uterus, are brought into the operative field. The rotation need not be corrected but must be recognized so that the uterine vessels may be safeguarded.

The bladder is mobilized by first making an incision in the peritoneum of the vesicouterine fold between the round ligaments. The vesicocervical space is entered; it is a potential cleavage plane between the bladder and uterus, separating the veins on the uterine surface from those on the bladder. Dissection of the loose areolar tissue with a forefinger allows the gentle downward mobilization of the bladder for approximately 5.0 cm. The lateral margins of the bladder must be included in the mobilization. In cases of obstructed labour, mobilization can be overdone, displacing the bladder to such a degree that the subsequent incision may be made in the vagina rather than the uterus.[14] Blood loss will be excessive, delivery difficult and the inferior aspect of the incision may disappear behind the bladder, causing the upper portion of the incision to be mistakenly sutured to the bulging posterior uterine wall. On the other hand, the uterine incision can be made too high and too close to the peritoneal reflection, resulting in increased operative blood loss. A further disadvantage of a too-high incision is that, following reperitonealization, the uterine incision will lie immediately beneath the suture line (on the uterovesical peritoneum) and uterine contents may seep into the peritoneal cavity. The uterine incision should be placed so that it will be located 2.0 cm inferior to the peritoneal incision following closure.

A horizontal incision, 3.0 cm long, is then made starting at the midway point of the lower segment. To control bleeding, an assistant presses the uterine wall against the presenting part both above and below the site. If the incision is too short, funnelling of the side wall occurs and visibility is reduced. After each cautious stroke careful inspection and palpation can avoid serious fetal injury which may result from careless hurried incisions. The fetus is at risk both when the uterine wall is thick (bleeding obscures vision) and when the lower segment is thin and closely applied to the fetus. Incision is discontinued when the membranes bulge in the wound or when the fetal scalp is seen.

Traditionally, the incision was extended by tearing it laterally with the forefingers. Such a maneuver may result in uncontrolled tears of the lower segment, extending down behind the bladder or laterally through the uterine vessels. Deliberate cutting of the lower segment with bandage scissors allows a gentle convex incision which encourages any extension in a similar direction. With two fingers beneath the uterine wound to protect the infant, the cuts are made in a crescent fashion, first to the right, then to the left, stopping short of the uterine vessels. The opening must be adequate, for most of the problems encountered during delivery are associated with incisions that are too short.

The time from uterine incision to delivery of the vertex should if possible be no longer than 90 seconds,[15] but consideration of time should not be reason for hurried maneuvers. In obstructed labour the head is often deep in the pelvis and the lower segment wrapped tightly around it. Complications increase with the descent of the vertex.[16] There is clearly no room for the simultaneous accommodation of the whole hand and the fetal vertex in the lower uterine segment and extensive tears result from rough and rapid insinuation of the hand beneath the vertex. To avoid such damage, it has been suggested that an assistant, with a hand in the vagina push upwards on the head, or that the operator try a similar maneuver with a hand outside the lower segment. While most helpful, neither maneuver is essential. The delivery can be achieved by gently insinuating the fingers through the incision and beneath the vertex; this is surprisingly easy once the "vacuum" between the vertex and the lower segment has been broken. The key is gentle persistent effort.

Once the vertex is elevated to the level of the uterine incision, delivery follows. This is normally achieved by exerting fundal pressure, the uterine hand serving only as a guide. Delivery in this manner is not always straightforward. The operator's hand may impede progress through the uterine incision or the size of the fetus may be such that delivery does not follow fundal pressure. In such cases, delivery in a controlled fashion and without extension of the wound is accomplished with the use of obstetric forceps. Familiarity with forceps delivery allows for their easy use in difficult cases. The right hand is inserted into the uterus beneath the vertex and covers the posterior ear — the fetal head is usually in a transverse position — and the first blade is directed posteriorly. Both uterus and infant are protected by the surgeon's hand from inadvertent trauma. The anterior blade is then applied directly and easily. Delivery of the vertex now takes place in a controlled fashion.

The shoulders are most easily delivered by exerting traction with a finger in the posterior axilla and thus easing the posterior shoulder through the incision. The placenta and membranes are immediately removed manually. The uterus is now delivered onto the anterior abdominal wall. It used to be thought that this maneuver resulted in postoperative morbidity; this is not the case.[17] The advantages of the maneuver include control of uterine hemorrhage (by exerting traction on the uterus) and improved operative exposure, which allows easy and accurate approximation of the incision. In the meantime, oxytocin (Syntocinon; Sandoz Canada Inc., Dorval, PQ) 20 units/1000 ml is infused rapidly intravenously.

The inferior margin of the incision is identified by running the fingers from the upper to the lower segments, with one finger inside and the other outside the uterus. The inferior margin is then tagged by sponged forceps. Failure to identify this margin properly has led the inexperienced surgeon to suture the upper wound edge to the bulging posterior wall. Polyglycolic acid (Vicryl 00) is appropriate suture material — its tensile strength

is stronger than the pull-through strength of the uterine muscle and it is of sufficient calibre to prevent the suture from cutting through the muscle. A single full-thickness marker suture approximating the uterine wound edges is placed at the end of the incision closest to the operator. Care is taken to avoid the uterine vessels, which are just lateral to the end of the incision, and the sigmoid colon, which lies immediately behind the broad ligament. The placement of this suture may be difficult if the uterine vessels were torn during delivery and are bleeding profusely. In this case, two fingers are placed behind the broad ligament, lifting the lateral part of the uterus forward, thus compressing and elevating the torn blood vessels. Sutures can now be accurately inserted, bilaterally if necessary.

Closure of the uterine wound is now begun at the angle away from the operator. Present practice favours a full-thickness continuous suture, non-locking and not excessively tight. The sutures are somewhat farther apart (more than 1.0 cm) on the longer lower margin than on the shorter upper wound edge (1.0 cm).

A second layer, a vertical Lembert suture, is begun approximately 2.0 to 3.0 cm medial to the tagged lateral edge. Injury to the uterine vessels, which have apparently moved medially with further contraction of the uterus, is avoided by palpation and the medial placement of the second layer.

Finally, a third layer of polyglycolic (Vicryl 3-0) is used to approximate the thick well-developed fascia (De Lee's fascia) on the uterine wall over the second layer. With this final suture the uterine incision should be just visible. If hemostasis is not complete, further fine sutures are inserted; deep heavy figure-of-eight sutures through the full thickness of the uterine wall are both unnecessary and harmful in that they impede healing of the uterine incision.[18] When hemostasis is assured, the bladder is repositioned and the visceral peritoneum approximated with 3-0 Vicryl. The peritoneal cavity is cleansed of blood and amniotic fluid.

Classical Cesarean Section

Formerly, the incision was begun on the most prominent part of the uterine body and continued downward; now we advocate starting as low as possible on the anterior uterine wall and extending it upward. The bladder is first dissected off the lower uterine segment and a small vertical incision made in the middle portion of its inferior aspect. The level of the incision may be influenced by the presence of disease in the lower segment. The opening is then extended upward, using bandage scissors, to a level that will allow easy delivery. Although vertical lower segment cesarean sections are described, in practice the incisions must extend into the thick muscle of the upper segment and are in effect classical operations. The infant is often most readily delivered by extracting the upper pole first (i.e., the breech in vertex presentations). The placenta is removed manually. Closure of the uterine portion of the incision is less anatomic, more time-consuming and associated with more blood loss than the lower segment. Closure with 00 polyglycolic acid (Vicryl) is done in three layers — the first layer is continuous and includes the decidua and the inner third of the myometrium, the second layer is of interrupted sutures which include the remaining myometrium and the third continuous layer of fine hemostatic sutures beneath the serosa. The second layer sutures are tagged individually and not tied until they all are in place. The uterine serosa is then approximated with 4-0 Vicryl Lembert sutures. Hemostasis must be ensured. The bladder is pulled up and sutured to the uterine surface covering as much of the incision as possible and thus extraperitonealizing the wound.

Placenta Previa

Even the most experienced surgeon is challenged by the massive hemorrhage that may accompany cesarean section for placenta previa; its management, therefore, deserves special mention. Blood loss may result from the uterine incision, injury to the placenta, incomplete removal of the placenta as a result of its deep invasion into the myometrium (placenta accreta) or from post-delivery atony. Correct management lies in the use of the classical cesarean section with ready acceptance of the need for hysterectomy. With this technique, the placenta can usually be avoided, but if it is encountered it should be pushed aside, the membranes ruptured and the infant delivered. Incision of or tearing through the placenta is not encouraged, as marked fetal hemorrhage may result in addition to poor visibility and delayed delivery. If placenta previa occurs after a previous cesarean section it may deeply invade the attenuated uterine wall[19] and massive hemorrhage can accompany its attempted removal. Blood loss may only be controlled by hysterectomy, which is usually straightforward.[20] Care must be taken not to injure the ureters or bladder. The cervix should be removed, but may be left if the patient is in a precarious condition. If the uterus must be saved, the uterine arteries can be ligated at the lateral uterine margins with single large sutures that incorporate the myometrium. Another option is ligation of the internal iliac arteries, which should be combined with the ligation of the ovarian vessels, medial to the ovary and inferior to the fallopian tube.

Injury

During the course of cesarean section, injury to the bladder, ureter or large intestine is possible. Most injuries occur during efforts to control intraoperative hemorrhage, which usually results from poorly performed or ill-chosen lower segment operations.[21] A minority result from mobilization of the bladder in patients who have had previous cesarean section.

Injury to the bladder or ureter is serious only when not recognized at the time of surgery. If there is any suspicion of injury, the bladder should be inspected through a vertical incision in its dome to spot any damage or inadvertent suture placement. The ureters' integrity and patency may also be demonstrated at the time of cystotomy by observing the efflux of urine from the ureteric orifices or by their catheterization. Confirmation that the sigmoid colon has not been sutured is sought by inspecting the posterior surface of the broad ligament.

Infection

The morbidity that often accompanies cesarean section is mainly due to endometritis. Cesarean section performed on a patient who has had ruptured membranes and nonprogressive labour is associated with morbidity in 85% of cases.[22] If the operation is done by an inexperienced surgeon the rate may reach 100%.[23] Other identified risk factors include general anesthesia, obesity and anemia.[24] Endometritis follows uterine contamination by the normal vaginal flora — a mixed aerobic-anaerobic infection of two or three organisms. Inoculation of this sort must occur after every delivery, but in cesarean section the protective uterine decidua has been disrupted by an incision that contains traumatized necrotic tissue and foreign material (sutures).

To prevent spillage of uterine contents into the peritoneal cavity, extraperitoneal cesarean sections or ingenious modifications have been devised,[25] but these procedures are seldom used. Postoperative morbidity is controlled through the prophylactic use of antibiotics. They were first suggested 18 years ago[26] but only gained widespread acceptance recently following their success after vaginal hysterectomy. Antibiotics should be given to all patients who undergo nonelective cesarean section. They are started immediately after delivery of the fetus. First-generation cephalosporins have been effective but marginally better results have been reported[27] with cefoxitin, a second-generation cephalosporin. It has also been shown that there is some advantage in giving three doses rather than one.[28]

If an infection develops postoperatively, the antibiotic combination of choice is clindamycin with gentamicin. Results with this combination are better than those obtained with a first-generation cephalosporin[29] and equal those with third-generation cephalosporins.[30] Should diarrhea or other complications cause clindamycin-gentamicin to be discontinued, cefoxitin or ureidopenicillin are possible substitutes. Abdominal wound infection or the presence of resistant enterocci should be considered if there is no response to antibiotic therapy within 72 hours.

Summary

The safety of cesarean section depends on selection of the appropriate procedure and prevention of hemorrhage, infection and urinary tract injury. While the choice of the lower segment operation is most often correct, the classical incision is especially useful for delivery of a premature infant. Excessive operative blood loss is usually the result of an inadequate uterine incision which tears during delivery of the fetus. Control of postoperative infection depends on the prophylactic use of antibiotics. Urinary tract continuity is assured, if necessary, through the use of intraoperative cystotomy.

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ABSTRACT

Must be submitted to the Royal College, but the CAGS *must* be designated as the first choice for presentation. The abstract must be accompanied by a letter from the author confirming his or her status as a resident or a fellow and indicating that the work is submitted for the resident research contest.

DEADLINE

Mar. 4, 1988.

Inquiries should be sent to:

Dr. Charles J. Wright
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A section on surgical technique, supervised by Dr. N.M. Sheiner

GORDON S. FOX, MD, FRCPC

Epidural Morphine for Postoperative Analgesia

Generally, postoperative pain is poorly controlled by the intramuscular injection of narcotics, administered either at predetermined intervals or on patient demand. When given intramuscularly, plasma and brain concentrations of narcotic are unpredictable due to variations in the degree and rate of absorption. Furthermore, severe pain after major thoracic or abdominal surgery may require a dosage sufficient to depress respiration and necessitate ventilatory support.

Epidural opiates, first used clinically in 1979,[1] have rapidly become popular and are now used in many institutions for the relief of postoperative pain. Narcotics, given by either the subarachnoid or epidural route, act on the opiate receptors in the dorsal horn of the spinal cord rather than the opiate receptors of the brain.[2] Continuous, satisfactory analgesia, lasting from 8 to 24 hours without motor or sympathetic blockade, may be achieved with a single epidural injection of morphine. Local anesthetics injected into the epidural space produce analgesia accompanied by motor and sympathetic blockade leading to immobility of the patient and sometimes to hypotension. Comparison of the effects of the same drug administered epidurally, intramuscularly or intravenously has shown that patients who receive epidural opiates are more alert and consequently are capable of cooperating with the recovery room team and of communicating with their relatives early after operation.

Indications

A partial list of the indications for epidural morphine analgesia is noted in Table I. In our institution, it is used mainly after major abdominal and thoracic surgery to achieve adequate pain control in order that the patient can be extubated early and subsequently be maintained on oxygen by mask. It also permits cooperation in early postoperative breathing exercises and chest physiotherapy.

Technique

The rationale for epidural analgesia is explained to the patient during the preoperative visit by the anesthetist. In the operating room, after an intravenous infusion is established and before the induction of general anesthesia, a catheter is placed in the epidural space at the low thoracic or lumbar area. Then 5 mg of preservative-free morphine are injected through the epidural catheter approximately 1 hour before the anticipated completion of the operative procedure. If the time of administration is considered to have been too close to completion of the general anesthetic, 5 to 6 ml of 0.25% bupivacaine are injected through the epidural catheter when skin suturing is completed. The local anesthetic produces sufficient analgesia to bridge the gap between conscious emergence from the general anesthetic and the onset of the morphine analgesia. The endotracheal tube is removed when respirations are judged satisfactory after recovery from anesthesia and the antagonism of the muscle relaxant.

Patients are nursed in the head-up position in the recovery room to improve respiration and supplemental oxygen is supplied by face mask in all cases. Deep breathing is encouraged and incentive spirometers are used as early as possible, usually within 1 to 2 hours of operation. Arterial blood gases are monitored as required. The respiratory rate is counted every 15 minutes for the first 2 hours and every half hour thereafter. Patients are usually discharged from the recovery room the following morning after removal of the epidural catheter. Occasionally, an additional 1 to 2 mg of epidural morphine are required within 1 to 2 hours of operation to supplement analgesia and in 8 to 10 hours for pain relief during the night.

Complications

The side effects of this type of analgesia that the recovery room team should recognize include pruritis, especially of the face and thorax, nausea and vomiting, urinary retention and delayed respiratory depression.[3] Intravenous droperidol (0.5 to 1.0 mg) has been successful in managing the nausea and vomiting. After major abdominal or thoracic surgery many patients have indwelling urinary catheters which obviate the potential problem of urinary retention. Pruritis has not presented a problem in any of our patients.

The most serious complication is late respiratory depression, usually occurring within 6 to 10 hours of injection of morphine. Patients should be monitored over-

Table I—Indications for Epidural Morphine Administered for Postoperative Analgesia

Major orthopedic surgery
Major gynecologic surgery
Major urologic surgery
Major abdominal procedures
Pulmonary resection
Vascular surgery

From the Department of Anaesthesia, Sir Mortimer B. Davis-Jewish General Hospital, McGill University, Montreal, PQ

Accepted for publication May 4, 1987

Correspondence to: Dr. Gordon S. Fox, Department of Anaesthesia, Sir Mortimer B. Davis-Jewish General Hospital, 3755 Côte Ste-Catherine, Montreal, PQ H3T 1E2

night in the recovery room or in an intensive-care unit because of this potential problem. Respiratory depression, due to the morphine in the cerebrospinal fluid reaching the central respiratory centres, is characterized by an increasing arterial carbon-dioxide tension and a decreasing respiratory rate. Naloxone (0.4 to 0.8 mg intravenously) is effective in treating this complication without altering the degree of pain relief. Some investigators have advocated a continuous intravenous infusion of naloxone to antagonize the respiratory depressant effects. This serious complication has not occurred in our experience because the dose of epidural morphine we use is relatively low.

Future Prospects

The problem faced by anesthetists is that many patients must be discharged to the ward when they could obtain effective relief of pain from epidural analgesia for up to 48 hours. In the future, patients might be monitored in step-down recovery units or on the ward. The latter is feasible with the proper training of ward personnel. Furthermore, the safety of the procedure can be enhanced by using commercially available monitors with alarms activated when the respiratory rate declines below a preset limit.

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BOOK REVIEWS

CONGENITAL DISPLACEMENT OF THE HIP JOINT. John A. Wilkinson. 153 pp. Illust. Springer-Verlag New York, Inc., New York, 1985. $96. (US). ISBN 0-387-13947-8.

In this monograph on congenital displacement of the hip, Wilkinson presents a concise review of a difficult and diverse topic. The first four chapters discuss the experimental and clinical observations that have formed our current knowledge of the genetic and environmental causes and pathologic development of congenital hip displacement. Included is a review of the author's own extensive research in these areas. The description of abnormal hip development due to breech malposition is excellent. He emphasizes that when subtle moulding and postural deformities are present in the newborn, a diagnosis of associated congenital displacement of the hip should be suspected. He stresses the importance of associated familial joint laxity, which may make early diagnosis and management difficult.

The remaining four chapters review the diagnosis and management of congenital displacement of the hip from the newborn to the adult. Although there is discussion of other accepted treatments, the emphasis is on the author's preferred management and clinical results. Description of operative procedures is limited to the author's modifications of standard operations described in general orthopedic textbooks. He compares the various types of splints available for treatment in the newborn and the complications and causes of failure using these methods. It is generally accepted that the goal of any surgical management is to obtain and maintain a concentric reduction. However, he acknowledges that his methods of posterior arthrotomy, limbusectomy and capsulorrhaphy to achieve reduction are not yet advocated in North America. His discussion of residual bony incongruity in the 10-month to 3-year age group emphasizes pelvic rather than femoral osteotomies. A good review of the options in pelvic osteotomies is provided.

This monograph is a concise review for the orthopedist trained in the management of congenital hip displacement. For in-depth study, however, the reader should refer to more definitive texts.

JANET L. WALKER, MD

Clinical fellow,
Division of Orthopaedics,
Department of Surgery,
The Hospital for Sick Children,
555 University Ave.,
Toronto, Ont.
M5G 1X8

MANUAL OF GYNECOLOGIC SURGERY. 2nd ed. Comprehensive Manuals of Surgical Specialties. Edited by Byron J. Masterson. 379 pp. Illust. Springer-Verlag, New York, 1986. $209.75 (US). ISBN 0-387-96193-3.

This is a book that one likes to own for its own sake. The binding is solid, the paper substantial, the printing clear and the illustrations, most of which are in colour, are remarkable. Furthermore, the text is well written and there is something of interest in each chapter.

I have some ambivalence about recommending the book for purchase since it is unclear who the primary audience is. Although it is apparently aimed at "gynecology residents and practicing gynecologists" the editor has written a section for "all physicians involved in ambulatory gynecologic surgery" and a large portion is devoted to the general surgeon. The result is that there is too much for the inexperienced but not enough for the seasoned practitioner. For example, the management of a breast mass is described in a single page but 28 pages are devoted to radical vulvectomy and radical hysterectomy which will only be performed by a gynecologic oncologist who would not need this guide anyway.

The book is divided into three sections. The first is concerned with ambulatory gynecologic surgery, the second with vaginal surgery and the last with gynecologic abdominal surgery. There are many interesting points and the following are only some that caught my eye.

The description of endometrial biopsy in the ambulatory section is excellent, and the editor calls attention to the infrequent need for dilatation and curettage. The complications of this procedure are only briefly mentioned and he seems reluctant to state that curettage has little or no therapeutic value.

In this second edition, a new authoritative author describes laparoscopy in a chapter that is greatly improved over the original. The descriptions of use of local anesthesia for laparoscopy, direct insertion of the trocar and the management of incomplete placement of a Falope ring were new for me. On the other hand, I can't imagine how one is able to insert a Hulka uterine manipulator blindly.

Of the three sections, that on vaginal surgery is the weakest. Masterson has a longstanding interest in wound healing, suture selection and surgical instruments but the discussion on these subjects is unnecessary. Discourses on preoperative evaluation and the preparation for bowel surgery are also superfluous. In my experience, the danger of hemorrhage after conization of the cervix is after days 9 to 10; keeping the patient in hospital for the first 48 hours postoperatively as recommended is not helpful. The described entry into the peritoneal cavity during vaginal hysterectomy is unorthodox and the need for transfusion of 35% to 80%, supported by a reference that is nearly 30 years old, is unheard of today.

The editor correctly emphasizes the frequent ill effects of rectocele repair on subsequent sexual function. During the description of rectocele repair, the use of 0 chromic catgut is advocated. In an earlier chapter, the use of such sutures is stated to have "little justification when tissue strength, knot-pulled breaking strength and modern wound data are reviewed". Sacrospinous fixation is commended as the method of choice in managing vaginal vault prolapse; however, there is little in the text that would make me comfortable with such a selection.

The abdominal section opens with a first-rate

continued on page 69

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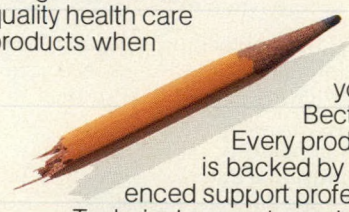

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SESAP V Question

Items 51-53

A 37-year-old woman has a one-month history of chronic intermittent abdominal pain, watery diarrhea, anorexia, and weight loss. She has developed a fever over the last 24 hours, and pain in the right lower quadrant has worsened. Examination reveals tenderness in the right lower quadrant, with a suggestion of a mass, but no peritoneal signs. WBC count is 18,000/cu mm. Chest and abdominal roentgenograms are normal. Contrast studies of the gastrointestinal tract show a cobblestone appearance of the ileum with rose thorn ulcerations, but no string sign. The purified protein derivative (PPD) is negative and the stool is negative for pathogens.

51. The most likely diagnosis is

(A) sarcoidosis
(B) regional enteritis
(C) tuberculous enteritis
(D) small bowel lymphoma
(E) Whipple's disease

52. Corticosteroid therapy is begun. The patient's condition deteriorates rapidly. Gross findings at celiotomy include a thickened cecum and ileum with enlarged lymph nodes and subserosal nodules. Because of these findings, the presumptive diagnosis is

(A) sarcoidosis
(B) regional enteritis
(C) tuberculous enteritis
(D) small bowel lymphoma
(E) Whipple's disease

53. The next step in the operation should be

(A) ileocecectomy with primary anastomosis
(B) ileocecectomy and ileostomy
(C) small bowel resection and anastomosis
(D) small bowel biopsy
(E) mesenteric lymph node biopsy

For the incomplete statements above, select the one completion for each that is best of the five given.

For the critique of Items 51–53 see page 68.

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JAMES H. ROTH, MD, FRCSC;* BRIAN H. WINDLE, MD†

Staple Versus Suture Closure of Skin Incisions in a Pig Model

The purpose of this study was to find out whether skin staple closure was a reasonable alternative to conventional nylon suture closure. Mechanical strength, histologic characteristics and time of closure were compared in skin incisions made on the backs of Yorkshire swine. The results showed that stapled and sutured wounds have similar mechanical strength up to 21 days. Stapled wounds are substantially narrower and are associated with less inflammation than sutured wounds. Staple closure is much less time-consuming than suture closure.

Le but de cette étude consistait à vérifier si les agrafes cutanées représentent une alternative valable aux sutures conventionnelles de nylon pour refermer les plaies. La force mécanique, les caractéristiques histologiques et le temps pour que se referme la plaie ont été comparés sur des incisions faites sur la peau du dos de porcs Yorkshire. Les résultats démontrent que jusqu'au 21e jour, les plaies refermées avec des agrafes ou de sutures ont la même force mécanique. Les plaies refermées avec des agrafes sont beaucoup plus étroites et elles sont associées à moins d'inflammation que les plaies refermées par des sutures. L'utilisation d'agrafes prend moins de temps que les sutures.

Surgical skin staplers are often criticized as having no advantage over nylon sutures for wound closure. The time-saving benefits of skin closure with staples has been well documented by Meiring and colleagues[1] who compared staple- and suture-closed elective laparotomy incisions in adults. They concluded that the cosmetic result was as good if not better than that with nylon sutures and that a time saving of 80% was possible with staples.

The purpose of this study was to determine whether there are histologic and mechanical advantages of skin staples over skin sutures and to determine whether skin staples are a reasonable alternative to sutures.

Materials and Methods

Four incisions 8 cm long and 0.5 cm deep were made on the backs of six pigs. Two wounds were closed with skin staples (Appose disposable skin stapler, Davis & Geck, Willowdale, Ont.) and two with 3-0 nylon sutures (Dermalon, Davis & Geck) on each pig (Figs. 1 and 2). The time taken to close each wound was recorded. Two pigs were killed at 5, 10 and 21 days after wound closure and autopsies performed. Eight 1-cm strips were cut from each wound perpendicular to and including the incision (Fig. 3); six strips were studied mechanically and two histologically. All tissue deep to the panniculus carnosus was excised using operating microscope magnification in the strips intended for mechanical testing in order to obtain a standard width and depth. Load-to-failure was determined with a loading rate of 2 mm/s as described by Forrester.[2] Mechanical testing was performed on a Material Test System (MTS Systems Corp., Minneapolis, Minn.) within 4 hours of death.

Specimens intended for histologic evaluation were fixed in 10% phosphate plus formalin and then embedded in paraffin. Subcutaneous tissue was left in place. Specimens were stained with standard hematoxylin and eosin and Movat's stains for light microscopy.

All histologic specimens were assessed by one examiner (B.H.W.) and given to the examiner blind. Wound width, the inflammatory process, epithelial response, degree of fibroplasia, collagen content and matrix organization were assessed for each specimen.

Results

Observation of the wounds showed good eversion of the edges in both stapled and sutured wounds. Staples did not cross the incision at its depth. Mechanical test-

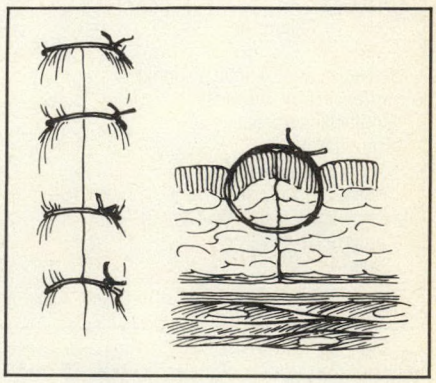

FIG. 1—Two wounds were closed with skin sutures positioned 1 cm apart. Technique was as illustrated.

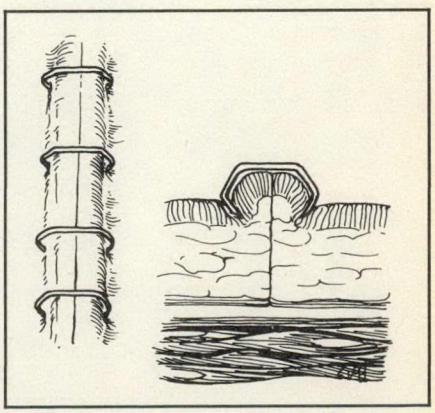

FIG. 2—Two wounds were closed with skin staples placed 1 cm apart.

From the Victoria Hospital, The University of Western Ontario, London, Ont.

**Clinical associate professor, Division of Orthopedics, The University of Western Ontario*

†Assistant professor, Division of Plastic Surgery, Case Western Reserve University, Cleveland, Ohio

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Reprint requests to: Dr. J.H. Roth, 345 Westminster Ave., London, Ont. N6C 4V3

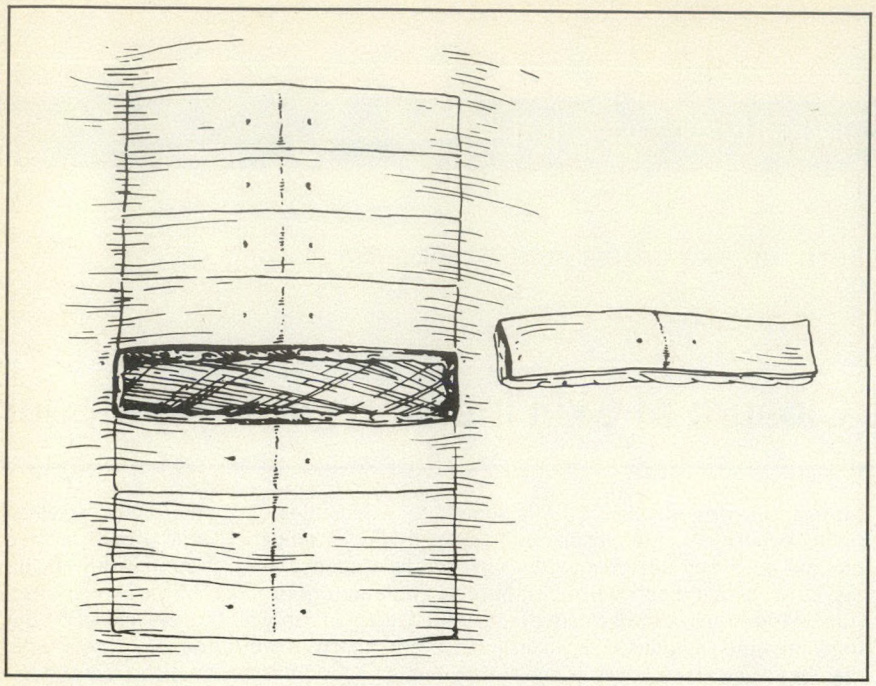

FIG. 3—Eight 1-cm strips perpendicular to and including incision were cut. Six strips were tested mechanically. Two were examined histologically.

Table I—Results

	Time, d					
	5		10		21	
Tests	Suture	Staple	Suture	Staple	Suture	Staple
Mechanical						
Load to failure, N (n=24)	5.69	3.92	19.22	23.05	59.82	64.72
Histologic, 0 – 4 (min to max)						
Inflammatory response	3	1	2	1	2	1
Epithelial response	3	2	3	2	2	2
Fibroplasia	4	4	3	3	2	2
Collagen content	0	0	2	2	3	3
Matrix organization	0	0	1	1	3	3
Mean wound width, mm (n=8)*						
Superficial	0.75	0.45	1.0	0.5	1.5	0.5
Deep	0.5	0.3	0.4	0.3	0.5	0.3

*Differences between the suture and staple groups were statistically significant ($p < 0.02$).

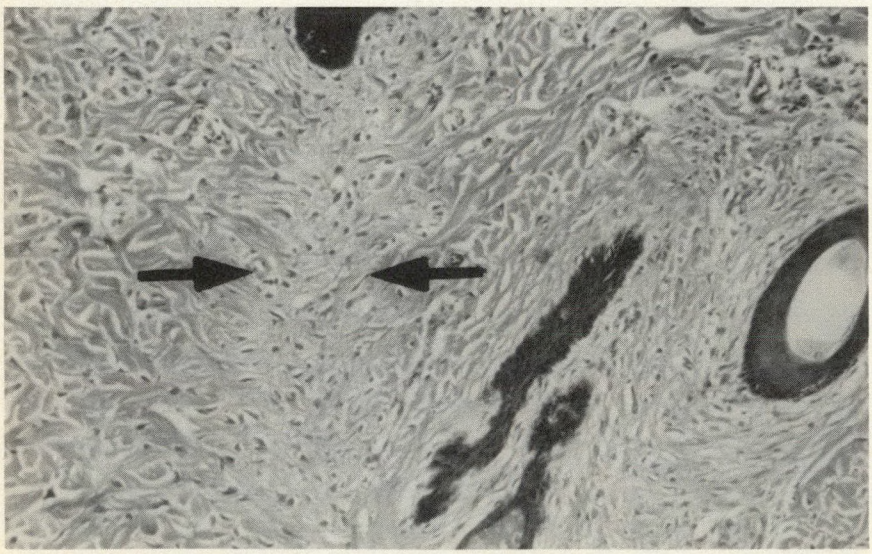

FIG. 4—Histologic features of sutured wound. Note width of wound (between arrows) (hematoxylin and eosin and Movat's stain, original magnification × 100).

ing (Table I) demonstrated that all wounds gained strength progressively and that there was no significant difference in the load-to-failure between wounds closed with skin staples and those closed with sutures. All sections failed through the incision.

Histologically, there was no difference in wounds closed with sutures and those closed with staples in terms of superficial epithelialization, fibroplasia, collagen content and matrix organization. However, the inflammatory response of the wounds was uniformly less in those closed with staples. The stapled wounds were consistently tighter at both the superficial and deep levels (Table I). The difference in wound widths between staples and sutures was statistically significant ($p < 0.02$) (Fig. 4). The mean closure time was significantly different ($p < 0.02$), being 6 minutes and 4 seconds for suture closure and 2 minutes and 35 seconds for staple closure.

Discussion

Our study shows that, in the pig model, stapled and sutured wounds have the same strength up to 21 days after closure.

Staples appear to be superior to sutures histologically with respect to inflammatory response and tightness of wound closure. Sutures, by way of suture tracks, allow deep epithelialization which crosses the incision line with resultant increased inflammatory reaction as compared to staples. Staple-closed wounds are tighter, which may mean greater resistance to bacterial contamination from the surface, resulting in a further decrease in inflammation.

The times taken for wound closure in this study correlate well with the clinical studies of Meiring and colleagues.[1] A shorter period of anesthesia is important and, in patients with large areas of split-thickness skin grafts, staples can greatly shorten the closure time.

Conclusions

In this pig model, stapled and sutured wounds have the same strength up to 21 days after closure. Stapled wounds are significantly tighter and have less inflammatory reaction than sutured wounds. Staple closure is significantly less time-consuming than suture closure. Skin staples are a reasonable alternative to sutures in the closure of wounds.

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FRANK NOFTAL, MD;* ALI MERSAL, MD;† YVONNE YASCHUK, ART;‡
JOHN WEDGE, MD, FRCSC;* WILLIAM ALBRITTON, MD, FRCPC‡

Osteomyelitis Due to *Kingella kingae* Infection

A case of osoteomyelitis due to *Kingella kingae* is presented to illustrate the insidious onset and indolent course typical of bone infections caused by this organism. The frequently negative result obtained with Gram's stain and the fastidious nature of the organism makes diagnosis difficult. Initial therapy with an aminopenicillin such as ampicillin in addition to antimicrobial drugs for *Staphylococcus aureus* should be effective in resolving bone and joint infections in children.

Un cas d'ostéomyélite due à *Kingella kingae* permet d'illustrer le début insidieux et l'évolution silencieuse typiques des infections osseuses causées par cet organisme. Les colorations Gram donnent souvent des résultats négatifs et la nature fastidieuse de ce microorganisme rend le diagnostic difficile. Le traitement initial avec une aminopénicilline telle que l'ampicilline et l'addition d'un antibactérien efficace contre *Staphylococcus aureus* devraient permettre de venir à bout des infections osseuses et articulaires chez l'enfant.

Kingella (Moraxella) kingae is a rare cause of infection in children.[1,2] In one of the first reports of osteomyelitis due to *K. kingae,* Davis and Peel[3] included 96 isolates reported by the Centers for Disease Control (CDC) in Atlanta, Ga., of which 75 had known sources — 35 from blood, 21 from bone and joint and 14 from throat.

We report a case of osteomyelitis of the distal right ulna due to *K. kingae* to bring to the attention of physicians the serious nature and indolent presentation of such infections.

*From the *Department of Orthopedics, †Department of Pediatrics and ‡Department of Clinical Microbiology, University Hospital, Saskatoon, Sask.*

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Reprint requests to: Dr. W.L. Albritton, Department of Microbiology, University of Saskatchewan, Saskatoon, Sask. S7N 0W0

Case Report

A 2½-year-old girl sustained minor trauma to the right wrist, after which she suffered mild pyrexia and, within a couple of days, swelling and discomfort in the area. X-ray films of the wrist, ordered by a local physician, appeared normal and no treatment was considered necessary. A few days later, because of persistent swelling, discomfort and self-protection of the wrist, more x-ray films were obtained and a cast was applied. Her temperature and erythrocyte sedimentation rate were normal.

Two weeks after the onset of symptoms she was admitted to the University Hospital, Saskatoon. On examination after removal of the cast, the wrist was found to be swollen and painful on palpation over the distal ulna but not the radius. There was a full range of passive movement. Lymphadenopathy was noted in the right epitrochlear and axillary areas but she was afebrile.

A repeat x-ray film (Fig. 1) was obtained and a technetium bone scan (Fig. 2) showed increased uptake over the distal ulna. Her leukocyte count was 8.3 × 10^9/L and erythrocyte sedimentation rate 20 to 30 mm/h. Gram's stain of the aspirate from the right ulna showed no bacteria, but a subsequent culture grew *K. kingae*, confirmed by the Laboratory Centre for Disease Control in Ottawa.

At the time of admission the child was started on cloxacillin (50 mg/kg daily) intravenously, later changed to ampicillin (300 mg/kg daily) when culture reports and sensitivities were available. She continued to receive ampicillin intravenously for 3 weeks and when she was discharged, ampicillin orally was prescribed for another 3 weeks. Follow-up showed continued improvement. At 2½ years, range of motion of the wrist was normal and repeat x-ray films showed no evidence of growth disturbance of the distal ulnar epiphysis.

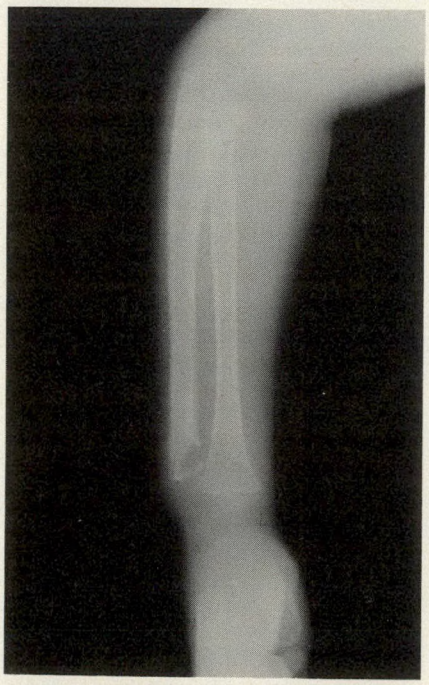

FIG. 1—Lytic lesions of distal ulna from which *Kingella kingae* was recovered.

Discussion

Kingella kingae is a fastidious, aerobic, gram-negative coccobacillus that occurs in pairs or short chains not seen consistently on stained smears of primary isolation material. It resembles *Moraxella* and *Neisseria* sp and has been mistaken for *Haemophilus* sp.[4,5] *Kingella kingae* can be differentiated from *Kingella denitrificans* by hemolysis, acid production from maltose and absence of nitrate reduction. It appears to be associated with serious infections much more frequently than *K. denitrificans.* Both organisms have been recovered from the oropharynx

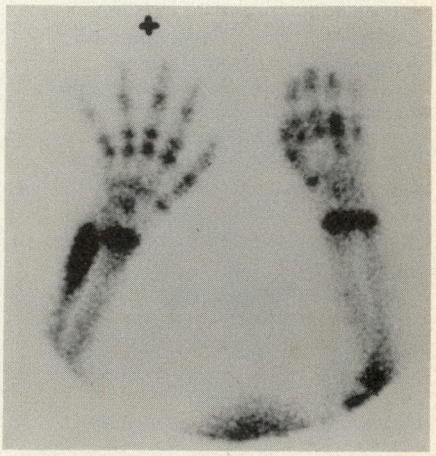

FIG. 2—Technetium bone scan showing increased uptake of isotope over distal ulna.

and the source of infection for *K. kingae* is probably the respiratory tract with hematogenous dissemination. Due to its fastidious nature, however, the actual number of infections due to *Kingella* may be much higher than those infrequently reported.

Our case demonstrated many characteristics of infection due to *Kingella*. The most frequently reported infections include endocarditis, osteomyelitis and septic arthritis, with the mean age of patients with bone and joint involvement being much lower than that for endocarditis.[1,2,6] Onset may be insidious with a milder course than that seen with the usual organisms responsible for such infections.[4,6,7]

Kingella kingae is uniformly sensitive to the aminopenicillins such as ampicillin or amoxicillin and, if recognized, should not present a management problem.

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HJALMAR W. JOHNSON, MD, FRCSC;* PAUL F. WECKWORTH, MD, FRCSC;* GERALD U. COLEMAN, MD, FRCSC;* WILLIAM J.D. ARNOLD, MD, FRCPC;† BONITA J. SAWATZKY, BPE;* PATRICK J. MOLONEY, MD, FRCSC;* DAVID STEWART, MD, FRCSC*

Bladder-Outlet Reconstruction in Neurogenic Bladder Due to Myelomeningocele

In a subgroup of children with myelomeningocele, urinary incontinence cannot be managed by clean intermittent catheterization and anticholinergic medication. The authors report on 24 such children who required bladder-outlet reconstruction. Twelve boys underwent the Young–Dees/Leadbetter procedure, 8 girls underwent the Burch procedure and the remaining 4 had a combination of the two. Augmentation cystoplasty was also carried out in seven girls and one boy.

Results were most favourable in the girls, with improvement in 92%, in contrast to the boys in whom only 58% were improved. Artificial sphincter placement may be a more beneficial alternative for boys.

Il existe un sous-groupe d'enfants souffrant myéloméningocèle chez qui l'incontinence urinaire ne peut être traitée par cathétérisme propre intermittent ou par médication anticholinergique. Les auteurs décrivent 24 cas de ce genre qui nécessitèrent une reconstruction de l'orifice vésical. Douze garçons subirent une opération de Young–Dees/Leadbetter, 8 filles eurent une intervention de Burch alors que les 4 dernières furent soumises à une association des deux. Une cystoplastie augmentative fut aussi pratiquée chez sept filles et un garçon.

Les meilleurs résultats furent obtenus chez les filles avec une amélioration chez 92% d'entre-elles, par rapport aux garçons dont seulement 58% furent améliorés. La pose d'un sphincter artificiel pourrait être davantage bénéfique pour les garçons.

*From the *Department of Surgery (Urology) and †Department of Pediatrics, University of British Columbia, Vancouver, BC*

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Reprint requests to: Dr. H. Johnson, Department of Surgery, University of British Columbia, 910 West 10th Avenue, 3rd Floor, Vancouver, BC V5Z 4E3

Primary management of urinary incontinence in children with myelomeningocele includes clean intermittent catheterization and anticholinergic medications to increase bladder capacity and reduce intravesical pressure. This regimen fails when urethral competence is reduced due to involvement of the nerve roots responsible for urethral and pelvic floor contractures. Urodynamically, urethral resistance and maximal urethral closing pressures are low, resulting in loss of urine before the potential bladder capacity is reached. Under these circumstances a bladder-neck reconstruction that lengthens the urethra and increases urethral closing pressure has been carried out.[1] In boys, a modification of the Leadbetter operation, omitting the ureteral reimplantation, has been used. Wedges of uroepithelium are excised from each side of the bladder neck leaving a strip of epithelium on the trigone, then the muscle of the bladder neck and trigone are overlapped to form a muscular tube.[2,3] In girls, a urethrovesical suspension (Burch procedure) was included to increase urethral resistance and improve continence.[4] In patients with small non-compliant bladders with reduced functional capacity, an augmen-

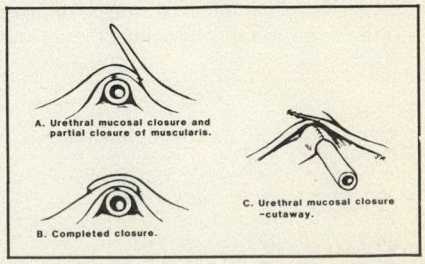

FIG. 1—Urethral luminal reduction and lengthening (modified Young–Dees/Leadbetter procedure).

tation cystoplasty has been performed.[1,5,6] While there are several reports of bladder-outlet reconstruction in epispadias, there are few published results for children with myelomeningocele.[1]

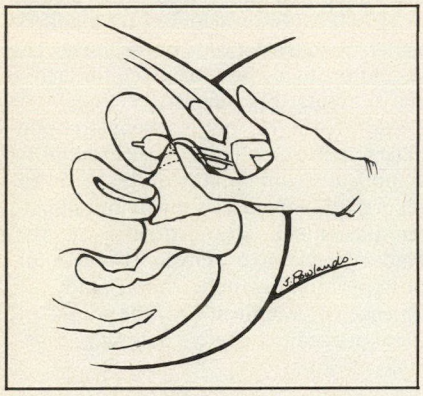

Fig. 2a

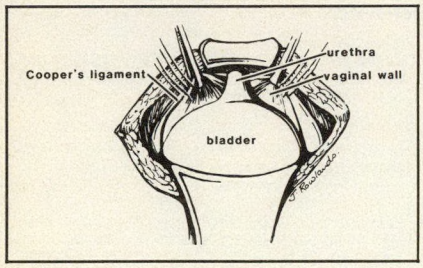

Fig. 2b

FIG. 2—Urethrovesical suspension (a) sagittal view and (b) anteroposterior view (Burch procedure).

Patients and Methods

The British Columbia Children's Hospital meningomyelocele clinic is currently following up more than 200 referred children. Between the years 1982 and 1985, 24 children with myelomeningocele, 12 boys and 12 girls, underwent bladder-neck reconstruction. Their ages ranged from 5 to 18 years (mean 10 years). The indication for outlet reconstruction included unacceptable incontinence while on an established program of clean intermittent catheterization and anticholinergic medication, a low or absent maximal urethral closing pressure and an initial bladder capacity greater than 100 ml. Augmentation cystoplasty was used in bladders with low capacity and compliance.

A modified Young–Dees/Leadbetter procedure was performed on each of the 12 boys (Fig. 1). After adequate exposure, a wedge of bladder and urethral mucosa was excised from the urethrovesical junction and a multilayered overlap was carried out over a no. 12 French Foley catheter (Fig. 1). In contrast to the Leadbetter procedure alone, ureteral reimplantation was done in only one of these patients.

The Burch urethrovesical suspension was performed in the 12 girls (Fig. 2). Four girls also underwent a modified Young–Dees bladder-neck reconstruction. Augmentation cystoplasty was carried out in eight patients, seven girls and one boy; in three this was done at the time of bladder-neck reconstruction and in five at a later stage. These five were seen early in the series. Now we perform this adjunctive procedure at the time of reconstruction as we recognize the value of increasing bladder capacity and compliance. Seven of these patients (five girls, two boys) underwent simultaneous undiversion.

The augmentation in all cases was by ileocystoplasty. A segment of ileum, isolated on its mesentery, is opened on the antimesenteric border and fashioned into a cup. The bladder is split from dome to trigone and the bowel anastomosed to fill the opening.

Urodynamic assessment was carried out in all patients to assess bladder capacity, cystometrics and maximal urethral closing pressure. Postoperative documentation was adequate for review in 14 patients. Postoperatively, continence was graded as follows: dry if wearing normal underwear, using clean intermittent catheterization and anticholinergics with minimal problems including occasional wetness. If, in addition, the child had to wear a minipad, the result was classed as improved. Treatment failure was defined as complete incontinence.

Results (Tables I to III)

Preoperatively, all children were in diapers or wore a collection device. It should be noted in Table II that girls

Table I—Bladder-Neck Reconstructive Procedure in Myelomeningocele and Its Results

Sex	Procedure	Augmentation cystoplasty	Complication	Other procedure	Result
F	Burch	Yes	–	–	Dry
F	Burch	Yes*	–	–	Dry
F	Burch	No	–	–	Dry
F	Burch	No	–	–	Dry
F	Burch	Yes*	–	Undiversion	Dry
F	Burch	No	–	–	Improved
F	Burch	Yes*	Pyelonephritis	Undiversion	Dry
F	Burch	Yes	–	Undiversion	Improved
F	Both	Yes	–	Undiversion	Dry
F	Both	No	–	Undiversion	Dry
F	Both	Yes	2nd reconstruction	AUS	Failure
F	Both	No	–	–	Dry
M	Young–Dees	No	–	AUS	Failure
M	Young–Dees	No	–	–	Improved
M	Young–Dees	No	–	AUS	Failure
M	Young–Dees	No	–	–	Improved
M	Young–Dees	No	–	Undiversion	Failure
M	Young–Dees	No	–	Undiversion	Dry
M	Young–Dees	Yes	Difficult catheterization	AUS	Failure
M	Young–Dees	No	–	–	Improved
M	Yound–Dees	No	Pyelonephritis	Nephrectomy	Improved
M	Young–Dees	No	–	–	Dry
M	Young–Dees	No	–	AUS	Failure
M	Young–Dees	No	–	–	Dry

*At the time of reconstruction.
AUS = On the waiting list for artificial urinary sphincter.

showed more improvement overall, with an acceptable result in 92%. One girl failed to improve and is awaiting placement of an artificial sphincter. The 12 boys who had modified Young–Dees/Leadbetter bladder-neck reconstruction did not respond as well. The acceptable continence rate was only 58%. One boy had an augmentation cystoplasty which may have improved the continence rate.

Maximal urethral closing pressure (MUCP) was adequately documented both preoperatively and postoperatively in 14 patients. The average increase in MUCP was 18 cm H_2O (range from 0 to 50 cm H_2O). Of the 10 children showing a marked increase in MUCP, 8 had improved continence and 2 were failures. Conversely, in four patients with no improvement in MUCP, two had improved continence that may be attributed to the effects of augmentation.

Augmentation ileocystoplasty was carried out in 8 of the 24 children. Six girls and one boy had acceptable continence, but one girl was a failure. The three who had it done simultaneously with the bladder-neck reconstruction were dry. Five had the procedure after the initial operation, when bladder compliance and capacity failed to improve (usually after undiversion); three were acceptably dry and benefited from the procedure.

Table II—Overall Results of Outlet Reconstruction

Result	Boys, no. (%)	Girls, no. (%)
Dry	3 (25)	9 (75)
Improved	4 (33)	2 (17)
Failure	5 (42)	1 (8)

Seven of the 24 patients underwent undiversion at the time of bladder-neck reconstruction. We recognize this presents a problem in assessing the results of reconstruction alone but all were considered to have incompetent outlets preoperatively and the diversions were initially carried out for incontinence. These children had low urethral closing pressure on urodynamic assessment and were incontinent with bladder cycling. Five of the seven were girls and in these urethropexy added little to the undiversion. Two of the boys had bladder-neck reconstruction and undiversion; one was dry and the other failed to improve.

Complications were minor. Two patients suffered from urinary tract infections and one had problems with catheterization.

Discussion

Approximately 12% of our 200 children with myelomeningocele who failed a program of clean intermittent catheterization and anticholinergic medication have unacceptable incontinence rates. The surgical approach in this group aims to increase urethral resistance and length or bladder compliance and capacity through augmentation cystoplasty. Augmentation cystoplasty either alone or complementing other procedures has proven to be clearly beneficial in patients with myelomeningocele.[5] Acceptable results in girls have been achieved by bladder-outlet reconstruction; boys, however, should probably be considered for artificial sphincter placement.

Any form of outlet reconstruction makes artificial sphincter placement more complicated and because of this we await reports of larger series involving sphincter placement after surgery on the bladder-neck area. Given the ease of postoperative catheterization and the absence of complications, the results of these procedures are encouraging, especially in girls.

Table III—Results of Procedures

Procedure	Result, no. (%)		
	Dry	Improved	Failure
Young–Dees/Leadbetter	3 (25)	4 (33)	5 (42)
Burch suspension	6 (75)	2 (25)	–
Combined	3 (75)	–	1 (25)

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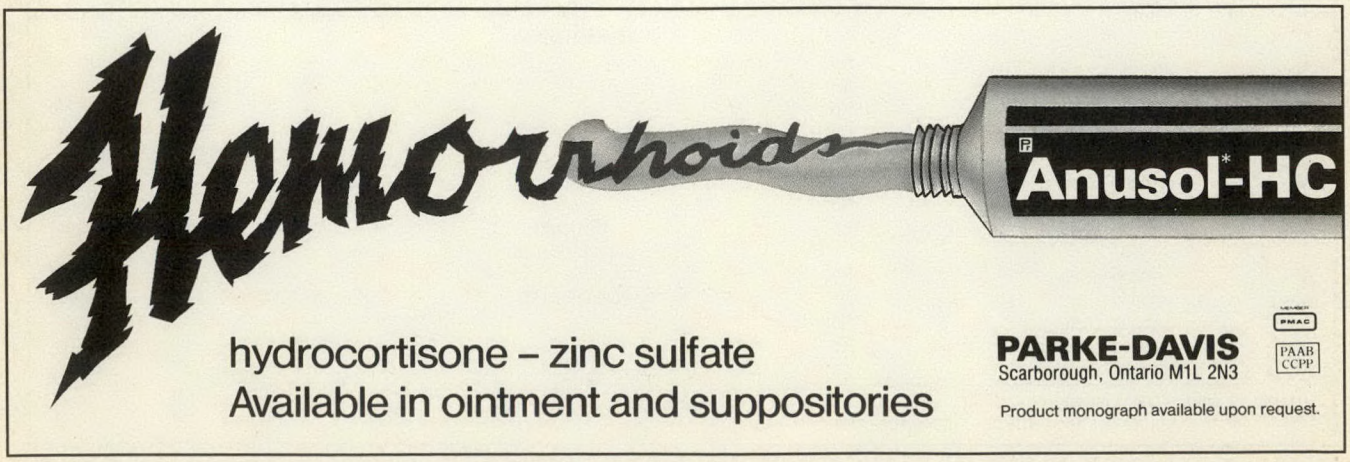

STANLEY MERCER, MD, FRCSC;* BRIAN MERCER, MD;†
MARY E.G. D'ALTON, MB, B CH, FRCSC;† PIERRE SOUCY, MD, FRCSC*

Gastroschisis: Ultrasonographic Diagnosis, Perinatal Embryology, Surgical and Obstetric Treatment and Outcomes

The embryology and onset time of gastroschisis are poorly understood. This paper reviews 22 cases of the condition seen at the Children's Hospital of Eastern Ontario between 1975 and 1986. Sixteen cases were judged to be of the perinatal and 6 of the early type. Ultrasonography revealed the actual time of development in one case and the probable time in another. In 20 cases the defect was closed primarily and in 2 by a staged procedure (Silon pouch). Nineteen infants (86.4%) survived. In all cases the umbilical vasculature was normal and all were right-sided. Other anomalies were rare and less important. Two clear examples of rupture of the umbilical ring are documented. Ultrasonography had been performed in 10 infants, usually for intrauterine growth retardation, and gastroschisis was diagnosed in 4 of these. Delivery was by cesarean section in six. Marked meconium staining occurred in 16 (73%), 7 of whom had subglottic aspiration of meconium. The average birth weight was 2480 g. Ultrasonography is recommended in all cases of intrauterine growth retardation with careful examination of the umbilical area to establish the presence and time of onset of gastroschisis. Vaginal delivery appears to be the route of choice for delivery.

On connaît mal l'embryologie et quel est le temps d'apparition d'un gastrochisis. Cet article passe en revue 22 cas qui ont été vus à l'Hôpital pour Enfants de l'Est de l'Ontario entre 1975 et 1986. Seize cas ont été jugés de type périnatal et 6 autres de type plus précoce. L'échographie a révélé le moment exact où est apparu le gastroschisis et le temps probable d'un deuxième cas. Dans 20 cas, la brèche a été refermée en première intention alors que dans les deux autres cas, ont eut recours à une opération en deux étapes (sac Silon). Dix-neuf enfants (86.4%) ont survécu. Dans tous les cas, le système vasculaire ombilical était normal et tous étaient du côté droit. Autres anomalies étaient rares et moins importantes. Deux exemples nets de rupture de l'anneau ombilical sont démontrés. Une échographie avait été faite pour 10 de ces enfants, habituellement pour retard de croissance intrautérine, et un gastroschisis avait été diagnostiqué dans 4 cas. Un accouchement par césarienne fut pratiqué dans six cas. Une coloration marquée du méconium est survenue dans 16 cas (73%) dont 7 avaient une aspiration sublinguale de méconium. Le poids moyen de naissance était de 2480 g. L'échographie est recommandée dans tous les cas de retard de croissance intra-utérine; un examen attentif de la région ombilicale devrait être fait afin de vérifier la présence et le moment d'apparition d'un gastroschisis. L'accouchement par voie vaginale paraît souhaitable.

*From the *Department of Surgery and †Department of Obstetrics and Gynecology, University of Ottawa, and the Children's Hospital of Eastern Ontario, Ottawa, Ont.*

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Reprint requests to: Dr. S. Mercer, Professor and chief of surgery, Children's Hospital of Eastern Ontario, 401 Smyth Rd., Ottawa, Ont. K1H 8L1

Both time of onset and mode of development of gastroschisis remain an enigma. The availability of skilled ultrasonography and the formulation of criteria for this examination will shed light on these two aspects. Close examination of the abdominal defect, the umbilical vessels and the herniated bowel can give more information on which to base a reasonable embryologic theory. Early and later perinatal types have been described and several embryologic theories proposed. These include rupture of the amniotic membrane at the base of the umbilical cord, between 5 and 10 weeks' gestation or at a later stage through an incompletely closed umbilical ring.[1] Abnormal involution of the right umbilical vein with breakdown of the abdominal wall at this site has been suggested by deVries,[2] who supported his thesis by describing two cases of left-sided gastroschisis associated with involution of the left umbilical vein. Hoyme and associates[3] suggested that occlusion of the omphalomesenteric artery is the primary cause, and Izant and associates[4] proposed as causes failure of the somatopleural mesenchyme of the lateral abdominal wall to differentiate and absorption of the overlying ectoderm. Few hard data are available to support any of these theories.

Using ultrasonography, we demonstrated that the development of gastroschisis could be timed exactly in one case and less exactly in another. In both, rupture of the umbilical ring was documented after birth. These cases at least date perinatal gastroschisis and strongly suggest a mechanism in this later group. We reviewed 22 consecutive cases of gastroschisis seen at the Children's Hospital of Eastern Ontario, Ottawa, between 1975 and 1986. We discuss their surgical and obstetrical treatment, outcome, findings on ultrasonography, the risk of meconium aspiration and probable cause of the perinatal type.

Patients and Methods

Boys and girls were equally represented in the study group. The average gestational age was 37 weeks and the mean birth weight 2480 g (including dressings). Eighteen of 22 infants were below the predicted 50th percentile.[5] The indication for ultrasonography, performed in 10 infants, was intrauterine growth retardation in 7. Although the umbilical area of the abdominal wall was not specifically examined for a defect, one was noted in four infants.

The earliest such diagnosis was made at 22 weeks' gestation, 13 weeks before delivery.

Surgical Management and Results

Body heat and fluid losses were carefully controlled with moist, warm dressings before arrival in the hospital and operating room. At admission, overhead heaters were used and dressings not

removed until anesthesia had been induced and the child was ready for surgery. In all cases, the abdominal opening was enlarged. Stretching of the abdominal wall was not always performed and was never vigorous. Silon pouches were considered necessary in two infants, both of whom died. Primary closure of fascia and skin was achieved in the remaining 20, 1 of whom died. Herniated viscera were identified and described with respect to the degree of adhesion and edema. Heavy matting was taken to be a mark of prolonged exposure to amniotic fluid. Lesser adhesions and easy separation of viscera were thought to represent a shorter exposure and thus a later onset.

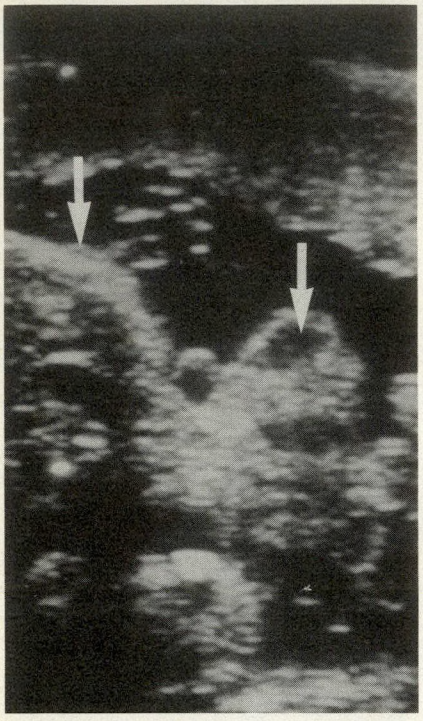

Fig. 1a

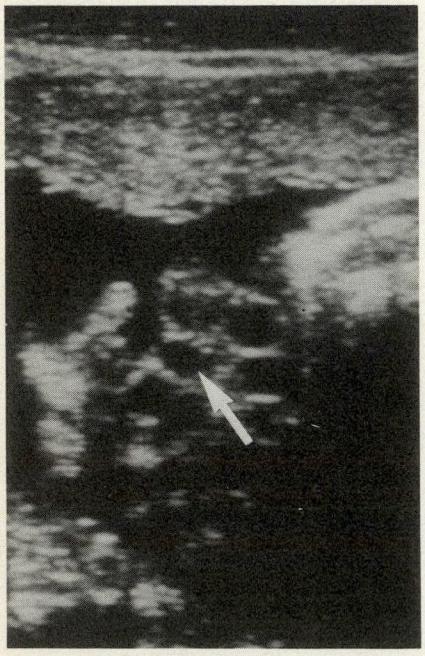

Fig. 1b

FIG. 1—Ultrasonography at 35 weeks' gestation. (a) Left arrow points to anterior abdominal wall. On its right are vessels of cord. Right arrow indicates eviscerated bowel. (b) Arrow points to eviscerated loops of bowel.

Obstetrical Technique

We have no evidence that cesarean section is superior to vaginal delivery. Fifteen infants were delivered vaginally and 13 survived. One died of sepsis within 15 hours of birth following prolonged hypothermia and the second (of 26 weeks' gestation) died of pulmonary complications. These results do not support those of Lenke and Hatch[6] who advocated cesarean section.

Meconium Aspiration

Meconium staining of the amniotic fluid and exposed viscera was seen in 16 cases; subglottic aspiration of meconium occurred in 7 of them. This is a much higher rate than that usually seen in infants admitted to intensive-care units. In the large series reported by Matthews and Warshaw[7] the rate was 7.4%.

Postoperative Management

Primary closure was associated with only minor respiratory problems, but respiratory paralysis appeared to be helpful and 15 of the 22 infants were kept paralysed for a variable time postoperatively with no general policy as to maintenance of paralysis. This reflects previously reported experiences.[8,9] The mean time of ventilatory support was 2.87 days. All infants were placed on total intravenous alimentation and nasogastric suction. The average time for full return of intestinal function was 13.4 days, which is less than in reported series where vigorous stretching was common and is comparable to that reported in the series of Canty and Collins[8] where stretching was minimal and primary closure the method of choice.

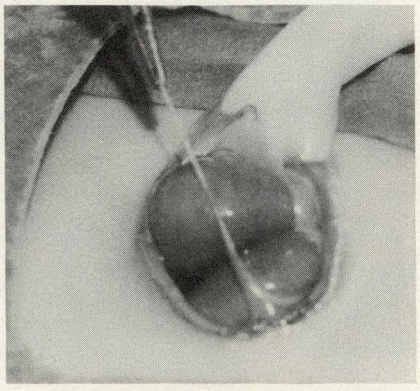

FIG. 2—Forceps hold remnants of umbilical membrane. Bowel has been reduced.

Ultrasonography and Embryology

Ultrasonography was performed in 10 of our cases, for intrauterine growth retardation. In four of these a diagnosis of abdominal wall defect was made, the earliest at 22 weeks' gestation. It is possible that the diagnosis was missed in the remaining six infants since the anterior abdominal wall was not specifically examined. In one patient, three scans, between 28 and 33 weeks' gestation, were performed without evidence of gastroschisis, although the umbilical area of the abdominal wall was visualized. Oligohydramnios was noted and the fetus appeared small for gestational age. At 35 weeks there was a marked increase in the amount of amniotic fluid and an obvious gastroschisis was present (Fig. 1). It would appear that gastroschisis developed between 33 and 35 weeks. At operation, the loops of bowel were minimally adherent and there was evidence of ragged tissue, suggesting rupture of the umbilical membrane. In a second infant, ultrasonography was performed at 28 weeks' and at 36 weeks' gestation because of intrauterine growth retardation. Gastroschisis was not seen at that time. At spontaneous vaginal delivery 4 days later, a large gastroschisis was present. The bowel was not adherent and there was a clear remnant of an umbilical membrane (Fig. 2). These two cases, at least, indicate the timing of the perinatal type of gastroschisis and the likely probability that rupture of the umbilical membrane is the mechanism. The umbilical vasculature was entirely normal on both gross and microscopic examination in these and all our other cases. This neither supports nor contradicts the theory of deVries. The value of repeated ultrasonography, especially between 33 and 37 weeks, is clear when there is retarded intrauterine growth, but only if the umbilical base is specifically examined. Without this a gastroschisis can easily be missed.

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A.E. MACNEILY, MD; A.M. GRAHAM, MD, FRCSC

Coagulopathy Induced by Aortoiliac Aneurysms

Diffuse intravascular coagulopathy (DIC) or consumptive coagulopathy is infrequently associated with aortic aneurysms. When the two coexist, they create a difficult clinical problem that requires optimal medical and surgical care. Two cases of coagulopathy associated with aortoiliac aneurysm are presented to exemplify the broad clinical picture that can be present. The definitive treatment of DIC is removal of the underlying cause. The following recommendations are made for the management of patients with aortic aneurysms and possible coagulopathy: preoperatively examine the patient for hematomas and ecchymoses; measure levels of fibrinogen, platelets and fibrin degradation products and the prothrombin and partial thromboplastin times; perform arteriography and check puncture sites for spontaneous bleeding afterwards; at aneurysm repair ensure meticulous hemostasis and compensate for excessive blood loss by high-speed autotransfusion.

Il est rare que l'on rencontre l'association d'un syndrome de coagulation intravasculaire disséminée (CID), aussi appelé coagulopathie de consommation, et d'un anévrisme de l'aorte. Ensembles, ils créent un problème clinique difficile à résoudre et exigent des soins médicaux et chirurgicaux de premier plan. On décrit deux cas de coagulopathie associée à un anévrisme aorto-iliaque afin d'illustrer les différentes facettes du tableau clinique qui peuvent exister. Le traitement définitif de la CID exige que l'on fasse disparaître la cause sous-jacente. Les recommandations suivantes sont offertes pour traiter les patients souffrant d'anévrisme de l'aorte et d'une coagulopathie possible: en préopératoire, rechercher la présence d'hématomes et d'ecchymoses, mesurer le taux de fibrinogène, les plaquettes et les produits de dégradation de la fibrine, ainsi que les temps de prothrombine et de céphaline; réaliser une artériographie et vérifier au point de piqûre la présence subséquente d'un saignement spontané; au moment de réparer l'anévrisme, s'assurer d'une hémostase parfaite et compenser les pertes excessives de sang par une autotransfusion à haute vitesse.

Diffuse intravascular coagulopathy (DIC) or consumptive coagulopathy is characterized clinically by excessive bleeding, ecchymosis and petechiae and by laboratory evidence of a decrease in the numbers of platelets and amount of fibrogen and an increase of fibrin degradation products with prolonged prothrombin and partial thromboplastin times. The disorder has often been reported after operative repair of lesions of the abdominal aorta,[1,2] aortic dissections[3] and peripheral aneurysms.[4] Scattered through the literature and in most busy vascular practices are cases of severe coagulopathy in patients with aortoiliac aneurysms. The cause of the coagulopathy is often questioned and also whether surgical excision and bypass of the aneurysm will reverse the hematologic picture or lead to an intraoperative disaster. We present two cases of coagulopathies in association with aortoiliac aneurysms that were successfully treated surgically with reversal of the coagulopathies. We review the literature and consider the pathogenesis and management of such coagulopathies.

Case Reports

Case 1

An 82-year-old farmer was referred to us because of a 2-year history of easy bruising over bony prominences and flanks and a painless abdominal mass. He was first investigated 4 months before admission for a large spontaneous ecchymosis of the inner part of the left thigh. At that time, hematologic studies revealed a hemoglobin of 66 g/L, platelet count of 95×10^9/L, a partial thromboplastin time of 43 seconds (control 30.3 seconds) and a fibrinogen level of 2.0 g/L (normal 2.0 to 4.0 g/L).

His history included bilateral inguinal hernia repairs and a motor vehicle accident, both many years earlier. Both events were complicated by excessive bleeding. He was taking no medications, denied acetylsalicylic acid consumption and gave no family history of bleeding disorders.

On admission, physical examination revealed a large, nontender pulsatile periumbilical mass. A large area of ecchymosis extended from the left groin down the inner thigh just distal to the knee. A small hematoma was also present over the right lateral thigh.

Laboratory findings on admission included a hemoglobin level of 107 g/L, a platelet count of 111×10^9/L, prothrombin time 13.6/11.6 seconds, partial thromboplastin time 38/34 seconds and a decreased fibrinogen level of 0.88 g/L. Levels of fibrin degradation products were positive at 1 in 20 dilution and at 1 in 40 dilution.

Abdominal ultrasonography revealed an infrarenal aortic aneurysm, measuring 8 cm in transverse diameter. Abdominal aortic angiography was unsuccessful from both the right and left femoral approaches because of marked tortuosity and dilatation of the iliac vessels. Both attempts were complicated by hematoma formation at the angiography entry sites, despite prolonged efforts at hemostasis. The clinical and laboratory findings suggested that the patient was suffering from a chronic consumptive coagulopathy from his aortic aneurysm. There was no other identifiable cause of the coagulopathy after complete assessment.

The patient received intravenous cryoprecipitate 8 hours before operation but did not receive any heparin. At operation, an 8-cm infrarenal aortic aneurysm was found with extension into the left iliac artery. This was replaced without complication by a preclotted woven Dacron bifurcated graft. Total operative blood loss was 4000 ml as the patient bled easily and diffusely throughout the procedure. All shed blood was replaced by use of an autotransfuser. Aggressive replacement of blood products including cryoprecipitate, platelets and fresh frozen plasma produced a normal coagulation state by the end of the procedure. Postoperatively, there were no bleeding

From the Department of Surgery, Royal Victoria Hospital, McGill University, Montreal, PQ

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Reprint requests to: Dr. A.M. Graham, Ste. S10.01, Department of Cardiovascular Surgery, Royal Victoria Hospital, 687 Pine Ave. W, Montreal, PQ H3A 1A1

problems and the patient's recovery was uncomplicated.

Hematologic measurements in the first few days after operation demonstrated low platelet counts at 60.0 to 70.0 $\times$ 10^9/L but a normal prothrombin time (9.9/11.3 seconds) and partial thromboplastin time (27/33 seconds). Fibrinogen levels rose to 47.8 g/L and fibrin degradation products were positive at 1 in 40 dilution but were negative at 1 in 80. One week postoperatively the platelet count was 117.0 $\times$ 10^9/L and the prothrombin time and partial thromboplastin time remained stable at 11.3/11.5 seconds and 31/33 seconds respectively.

Fibrinogen levels were normal and fibrin degradation product levels were negative, indicating complete resolution of his coagulopathy.

At a 6-month follow-up visit, there were no clinical signs of a hematologic problem and hematologic values were normal.

Case 2

A 50-year-old man was transferred to our institution in July 1986 from a peripheral hospital after a 2-week investigation of persistent left lower quadrant and left flank pain. Investigations at that time included a barium enema examination, retrograde pyelography and cystoscopy, all of which gave normal results. Intravenous pyelography revealed a shrunken right kidney and an enlarged left kidney with no evidence of obstruction. The patient was treated intravenously with antibiotics for a presumptive pyelonephritis, but relentless left lower quadrant pain, increasing somnolence and a progressive rise in blood urea nitrogen and serum creatinine levels prompted ultrasonography of the abdomen. This investigation revealed a possible dissection of the abdominal aorta extending distally into the left iliac artery. The proximal extent was not seen. The patient was transferred to the surgical service where, on examination, he was noted to be somnolent, dehydrated and afebrile. There was no evidence of peripheral ecchymosis or bleeding. Right peripheral pulses were normal, but only a weak left femoral pulse was palpable and no distal pulses were palpable in the left leg. No abdominal aneurysm was detectable on palpation. Results of laboratory investigations upon admission were as follows: serum urea nitrogen 18.9 mmol/L urea, serum creatinine 77.8 μmol/L, potassium 5.7 mmol/L, prothrombin time 51/16.4 seconds, partial thromboplastin time 88/32 seconds, hematocrit 0.39, leukocyte count 10.6 $\times$ 10^9/L, platelets 495 $\times$ 10^9/L, fibrinogen 5.56 g/L, fibrin degradation products positive at 1 in 40 dilution but negative at 1 in 80. After 1 in 1 dilution of the patient's blood with a control sample, the prothrombin and partial thromboplastin times corrected to 11.6/10.5 seconds and 35.9/30.3 seconds respectively, indicating a clotting-factor deficiency as the cause of his coagulopathy. Because of his coagulation-factor deficiency of unknown etiology and progressive renal failure secondary to dehydration or dissection of the aorta, the patient underwent hemodialysis and received fresh frozen plasma and vitamin K to reverse the coagulopathy. He received hemodialysis and seven units of plasma before undergoing angiography. With this treatment the prothrombin and partial thromboplastin times corrected to 11.1/11.3 seconds and 34/33 seconds respectively. Angiography failed to visualize the right kidney or its vasculature. A lobulated distal abdominal aortic aneurysm measuring 13.0 $\times$ 9.0 cm with either intraluminal thrombus or dissection extending to the level of the left renal artery was seen. The left common iliac artery was occluded.

At operation a large left iliac artery aneurysm, with two to three litres of hematoma dissecting up the left paracolic gutter was found. This had ruptured and been contained for some time. The proximal aorta and renal arteries were normal. A 16 $\times$ 8-mm preclotted bifurcated woven, double velour graft was used to replace the aneurysm. Blood loss was replaced with packed cells, and blood products were given to maintain a normal coagulation profile. The patient tolerated the procedure well and hematologic parameters as well as indices of renal function had all returned to normal by postoperative day 3. Subsequent recovery was smooth and at follow-up 6 months later he had no signs of any hematologic disorder. Twelve months after the aneurysm repair he underwent left femoropopliteal bypass for lower limb ischemia, without any complications.

Discussion

The pathogenesis of coagulopathies induced by arterial aneurysms is not clear. Exposure of subendothelial tissue in an aneurysm wall leads to the deposition of fibrin and platelets.[5] Extrinsic coagulation might follow release of thromboplastins from either the disturbed vascular endothelium within the atheromatous aneurysm or from breakdown products of hemolyzed erythrocytes and aggregated platelets.[6] Intrinsic coagulation could result from exposure of subendothelial surfaces and relative stasis of blood at the site of the aneurysm.[6] "Platelet consumption" within an aneurysm may represent excessive incorporation of platelets into developing mural thrombus. Mechanical destruction as blood flows over the thrombus may also play a role.[7] In fact, thrombocytopenia has been described as the major hematologic abnormality predisposing these patients to excessive hemorrhage perioperatively.[7]

Patients with arterial aneurysms have a dynamic balance of intravascular coagulation and secondary fibrinolysis on a continuous basis.[8] This "compensated" state of DIC may be recognized by laboratory evidence of consumption coagulopathy in the absence of clinically important bleeding.[5] Clinically apparent DIC, then, appears only when the destructive process overwhelms the productive ones due to an additional factor such as rapid aneurysm expansion or hepatic or renal insufficiency.[8]

Diffuse intravascular coagulopathy is characterized by two phenomena:[1] (a) impaired hemostasis secondary to consumption of platelets, clotting factors, activation of fibrinolysis and the presence of fibrin degradation products, which inhibit platelets and the coagulation mechanism; (b) widespread deposition of fibrin thrombi in the microcirculation, producing some of the clinical findings such as renal failure.

There are many causes of DIC including sepsis, hemorrhage, trauma, carcinoma, amniotic fluid embolus and giant hemangiomas. The condition was not described in association with arterial disease until 1967 when Fine and associates[9] described a coagulopathy in association with a type I dissecting aortic aneurysm (Table I[1-8,10,11]).

Satiani and colleagues[4] described two patients, one with an abdominal aortic aneurysm and the other a femoral aneurysm, who presented with a coagulopathy. These authors recommended preoperative control of the bleeding disorder with appropriate blood products, followed by surgical repair. Heparin therapy was considered rarely necessary and excessively dangerous.

Fisher and associates,[8] in a prospective study of 76 patients with abdominal aortic aneurysm, found that 40% of patients had alterations in levels of fibrinogen and fibrin degradation products, but only 4% of these had clinical evidence of petechiae, ecchymoses or thrombocytopenia. They also found that fibrinogen levels, measured preoperatively, were not good indicators of underlying excessive fibrinolysis or DIC. An isolated finding of an elevated level of fibrin degradation products before surgery did not correlate with the amount of blood lost perioperatively.

Thompson and colleagues[5] described one patient with an expanding abdominal aortic aneurysm and a coagulopathy, which improved with the administration of fresh frozen plasma and a continuous intravenous infusion of heparin, followed by surgical repair. At 3-month follow-up hematologic testing showed that coagulation was normal. Keagy and associates[11] reported a case of DIC, documented clinically and by laboratory data, in a patient with a stable abdominal aortic aneurysm. The coagulopathy resolved with heparin administration and subsequent aneurysmectomy.

Goto and associates[6] presented three cases of DIC accompanying abdominal aortic aneurysms. Following preoperative administration of heparin in an attempt to correct the coagulopathy, all three patients underwent repair. Two died of nonhemorrhagic complications and the third had a successful repair of the aneurysm. Postoperative follow-up 10 weeks later revealed a normal hematologic profile. These authors recommended giving low-dose heparin preoperatively, as it helped to control bleeding in two of their three patients.

Skepticism exists, however, concerning the actual existence of a coagulopathy induced by arterial aneurysms. Mulcare and colleagues[2] performed coagulation studies before and after operation on 32 patients who underwent elective abdominal aortic procedures. They found no significant abnormality in coagulation profiles preoperatively in 18 abdominal aortic aneurysms and 14 patients with aortoiliac occlusive disease. Postoperatively 20% had changes in the prothrombin and partial thromboplastin times and platelet counts, 60% had abnormal levels of fibrin degradation products and plasminogen. They concluded that elective grafting of the aorta *may* produce a low-grade intravascular coagulopathy. However, they were unable to find evidence that nonruptured abdominal aortic aneurysms or aortoiliac occlusive disease, in themselves, promoted a coagulopathy. Our patients certainly provide evidence to the contrary and there really is little doubt as to the coexistence of these clinical syndromes.

Siebert and Natelson[10] reported two patients with a chronic consumptive coagulopathy in conjunction with an abdominal aortic aneurysm and set forth four criteria to establish the aneurysm as the specific cause for a coagulopathy.

- A chronic acquired bleeding disorder.
- Laboratory evidence of a consumptive coagulopathy.
- Disappearance of the hemostatic defect after surgical repair.
- Maintenance of normal coagulation at least 3 months thereafter.

Neither of their patients met these criteria. One was found postoperatively to have an occult pancreatic carcinoma, which was thought to be responsible for the coagulopathy through the release of thromboplastic substances from the tumour. The second patient had severe liver disease and hypersplenism, promoting the coagulopathy. The authors concluded by advocating a healthy skepticism when arterial aneurysms and a coagulopathy are found to coexist and recommended another cause of the bleeding disorder be sought.

From our clinical experience, we concur with the recommendations by Fisher and colleagues[8] for the treatment of patients with aortic aneurysm and coagulopathies.

- Carefully examine aneurysm patients preoperatively for hematomas and ecchymoses.
- Measure levels of fibrinogen, fibrin degradation products and platelets, and prothrombin and partial thromboplastin times if there is any suspicion of DIC.
- Carefully monitor patients for 24 to 36 hours after arteriography, for spontaneous bleeding from puncture sites.
- Expect and compensate for excessive blood losses with the use of a high-speed autotransfuser.
- Ensure meticulous hemostasis intraoperatively.

The definitive treatment of DIC in any case is removal of the underlying cause. Intravenously administered heparin has been recommended as this interferes with the clotting process and may stabilize the coagulopathy, but others have avoided its use for fear that the retarded intravascular clotting might worsen bleeding.[4,8] Thompson and colleagues,[5] however, found that the preoperative use of heparin was a useful adjunct in controlling the bleeding diathesis.

Patients with a coagulopathy and aortic aneurysm should be assessed to rule out other causes of the hematologic problem. Following this the aneurysm should be resected using systemic heparinization.

Summary

The two cases presented identify the diffuse nature of coagulopathies associated with aortic aneurysms. In the first case a full hematologic and clinical picture of diffuse intravascular coagulopathy was present that was completely reversed by resection of the aneurysm. In the second case, a specific-factor consumptive coagulopathy was produced by a rapid expansion of an unrecognized aortoiliac aneurysm. This review is therefore important in reminding us of the coexistence of these clinical

Table I—Literature Review of Coagulopathy and Aneurysms

Series	No. of patients	Disease	Treatment	Outcome	Comments
Bieger and associates, 1971[3]	1	Femoral aneurysm	Preop heparin	Successful resection	Coagulopathy resolved with surgery
Mulcare and associates, 1974[1]	7	AAA	Heparinization for DIC	4/6 deaths with DIC	
Mulcare and associates, 1976[2]	32	Aortoiliac aneurysms	Resection	60% abnormal FDP and plasminogen levels. Postop 20% abnormal platelets, PT, PTT	No significant preop coagulopathy
Siebert and Natelson, 1976[10]	2	AAA	Preop heparin	Underlying diathesis	
Gétaz and Louw, 1977[7]	57	Unruptured AAA	Resection	5% mortality	28% incidence of preop thrombocytopenia. Post-resection spontaneous increase
	18	Ruptured AAA	Repair	70% mortality with coagulopathy	2 patients frank DIC. 50% low platelets
Satiani and associates, 1979[4]	2	AAA, femoral aneurysm	Platelets, FFP	Successful recovery	Spontaneous reversal of coagulopathy
Keagy and associates, 1981[11]	1	AAA	Resection	Resolution of coagulopathy	
Fisher and associates, 1983[8]	76 (3 DIC)	AAA	2 — operative repair, 1 — inoperable	Improved coagulopathy postop	40% laboratory evidence of preop coagulopathy, 4% clinical evidence
Goto and associates, 1985[6]	3	AAA	Preop heparin	1 — correction of coagulopathy, 2 — nonhemorrhagic deaths	Low-dose preop heparin recommended
Thompson and associates, 1986[5]	1	Expanding AAA	Continuous heparin and FFP preop	Resolution of coagulopathy postop	

DIC = diffuse intravascular coagulopathy, AAA = abdominal aortic aneurysm, FFP = fresh frozen plasma, FDP = fibrin degradation products, PT = prothrombin time, PTT = partial thromboplastin time.

syndromes and that aggressive medical and surgical treatment can produce a good clinical result.

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HUGH U. CAMERON, MB, CH B, FRCSC;* DONALD G. TURNER, MD, FRCPC;†
GERALDINE M. CAMERON, RN, B SC(N)‡

Results of Bone Grafting of Tibial Defects in Uncemented Total Knee Replacements

Bony defects of the articular surface are frequently encountered in total knee replacement. As an alternative to excising more tibia and using a thicker tibial component, autogenous bone grafts have been used to fill these defects. The authors have analysed 43 cases in which bone grafts were used in conjunction with an uncemented tibial component. The follow-up was 2 to 7 years. The results in these cases were compared with those in a similar group using uncemented components in which bone grafting was not required.

There were 15 central grafts and 28 edge grafts. All the edge grafts and seven large central grafts were fixed with screws. If the graft size was more than 1 cm^2, patients were not permitted to bear weight for 4 to 6 weeks. In the others, weight bearing was allowed immediately.

All grafts united, most within 6 months, and substantial collapse was not observed. Notable sinking of the tibial component occurred in one late case, in which a rotatory subluxation developed due to patellar dislocation.

Collapse of the graft in a recent case, however, suggests that when large grafts are used, a heavy central stem should be used on the tibial component.

Des lacunes osseuses de la surface articulaire sont fréquemment observées lors d'une arthroplastie par remplacement complet du genou. Plutôt que d'exciser une partie plus importante du tibia et d'utiliser une composante tibiale prosthétique plus épaisse, on a eu recours à des greffes osseuses autogènes pour combler ces lacunes. Les auteurs passent en revue 43 cas où des greffes osseuses ont été associées à la pose de composantes tibiales prosthétiques non cimentées. Le recul varie maintenant de 2 à 7 ans. Les résultats obtenus chez ce groupe sont comparés à ceux d'un groupe similaire chez qui on a utilisé des composantes non cimentées, mais sans qu'une greffe osseuse ne soit nécessaire.

Il y eut 15 greffes centrales et 28 greffes en bordure. Toutes les greffes en bordure et sept greffes centrales importantes ont été fixées avec des vis. Lorsque la surface de la greffe était supérieure à 1 cm^2, il était interdit au patient d'y faire porter son poids avant 4 à 6 semaines. Autrement, il était permis de le faire immédiatement.

Toutes les greffes se sont soudées, la plupart en moins de 6 mois, et aucun affaissement marqué n'a été observé. Dans un des derniers cas, on a noté un tassement appréciable de la composante tibiale prosthétique, alors qu'une subluxation due à une dislocation patellaire s'est produite.

Néanmoins, l'affaissement du greffon lors d'un cas récent, indique que quand une greffe importante est nécessaire, on doit utilisé une tige centrale forte pour la composante tibiale prosthétique.

From the Department of Surgery and Department of Radiology, Orthopaedic and Arthritic Hospital, Toronto, Ont.

**Assistant professor, Department of Surgery and Department of Pathology, University of Toronto. Staff orthopedic surgeon, Orthopaedic and Arthritic Hospital, Toronto, Ont.*

†Chief, Department of Radiology, Orthopaedic and Arthritic Hospital, Toronto

‡Research assistant

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Reprint requests to: Dr. H.U. Cameron, 318 – 43 Wellesley St. E, Toronto, Ont. M4Y 1H1

In total knee replacement the tibial component should sit on a flat bony surface. Initially, components were cemented in

place and minor deficiencies made good with cement. Large defects were built up by using screws to hold the implant out to a desired length until the cement had cured.[1] With the introduction of uncemented components[2] bone grafting has been used to fill these defects. As this procedure has been carried out routinely by one of us (H.U.C.) for about 7 years, we believed it was time to analyse our experience to determine when the grafts united and whether collapse occurred.

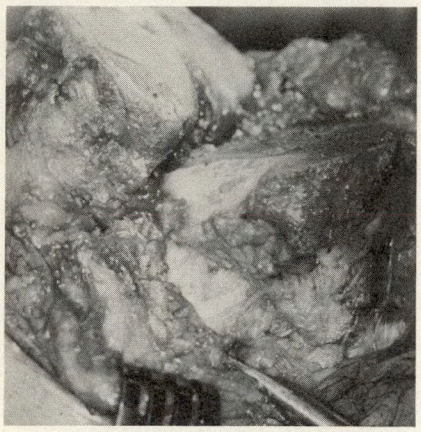

FIG. 1—Sloping edge defect in medial tibial plateau can clearly be seen.

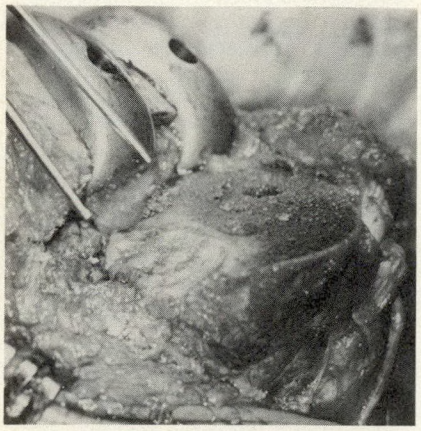

FIG. 2—Edge defect in Fig. 1 has been drilled and appropriate piece of cortical cancellous bone has been shaped to fit defect.

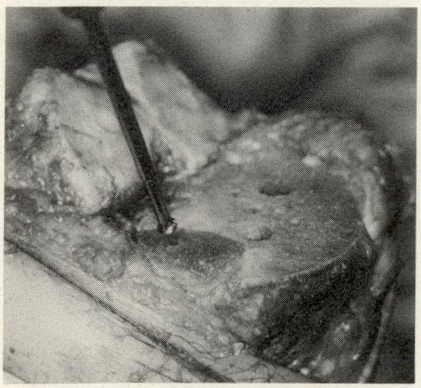

FIG. 3—Graft is attached with screws.

Methods

There are two basic defects of total knee replacement — central and edge defects. Central defects occur when a large cyst is present, usually in rheumatoid arthritis, or result from previous total knee replacement. As these defects are covered by the flat base of the tibial component, internal fixation is seldom required. The soft tissue is simply debrided and the defect packed with autogenous cancellous bone. Unless the graft is greater than 1 cm^2 immediate full weight bearing is allowed.

Edge defects occur in long-standing arthritis where the edge of the tibial plateau is badly eroded and the bone usually eburnated. Multiple 2-mm drill holes are made in the eburnated bone to encourage blood vessel permeation, and an autogenous contoured bone graft is screwed into position (Figs. 1 to 4). In cases in which the tibial component was entirely of plastic, A.S.I.F. scaphoid screws were used. When a porous cobalt chrome base plate supplemented tibial fixation, either cobalt chrome or titanium screws were used to prevent potential corrosion of the stainless steel (Fig. 5). Patients with grafts larger than 1 cm^2 were not allowed to bear weight for 4 to 6 weeks in order to allow a perimplant bone plate to develop.

All cases of uncemented tibial component grafting performed by the senior author between 1979 and 1984 were analysed and the results compared with equivalent procedures in which grafting was not required. The patients were reviewed every 6 months and rated using the Toronto knee rating system.[3] At the same time, radiologic analysis was carried out by an independent observer, using routine x-ray films, to determine when graft healing or "nonidentification" took place.

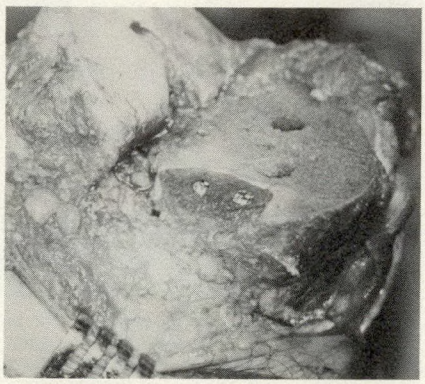

FIG. 4—Graft is firmly anchored to tibial plateau which is ready to receive tibial component. Holes drilled for plastic pegs can be seen. Care must be taken that graft screws do not invade anchoring holes so these must be drilled first.

Findings

The 43 patients reviewed (33 women, 10 men) ranged in age from 48 to 88 years (mean 68 years). The primary disease was osteoarthritis in 31, rheumatoid arthritis in 8 and avascular necrosis in 4. Eight patients had had total knee revision. The tibial components used were the ICLH (Protek Co., Switzerland) in 9, the Tricon P (Richards Surgical Company, Memphis, Tenn.) in 14, the Tricon P Revision in 2 and the Tricon M in 18.

The Tricon P and ICLH tibial components are constructed of polyethylene and held in place by ridged plastic pegs. The Tricon M is similar but includes a porous metal plate for additional fixation. The Tricon P Revision tibial component has a long central metal stem.

There were 15 central grafts of which 3 were extensive (2 being in knees that required revision and 1 in an old focus of

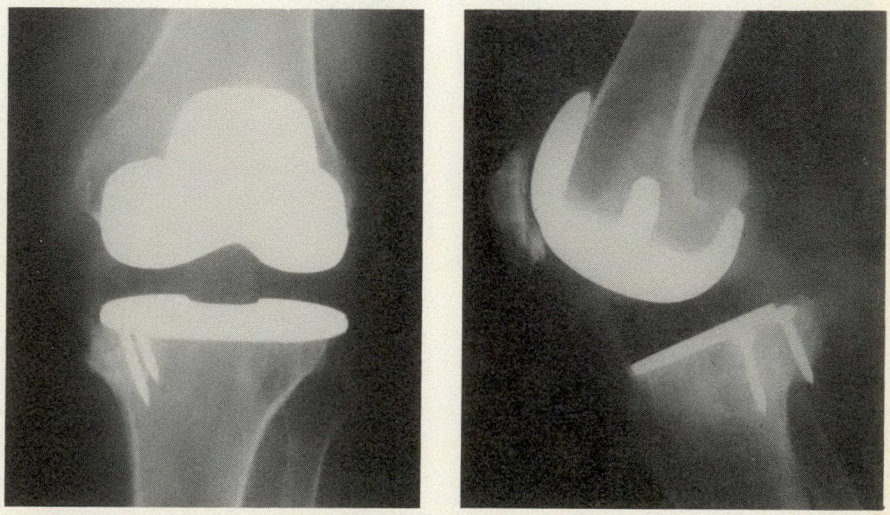

FIG. 5—Three months after grafting of severely deformed tibial plateau. Two cobalt chrome screws were used to hold graft in place as porous base plate of tibial component was cobalt chrome. Line between graft and underlying bone can still be seen.

septic arthritis). All edge grafts were held in place with screws, as were several large central grafts (Fig. 6). Of the central grafts, eight were smaller than 1 cm^2 and seven larger. They all appeared to heal, or at least were not recognizable by 6 months. The 28 edge grafts took longer to heal, but 18 of them were larger than 1 cm^2 and had mostly healed by 6 months. Ten smaller edge grafts had mostly healed by 1 year, but in many cases the site of union across the previously eburnated bone was visible years later (Fig. 7). Speed of graft incorporation was not influenced by the tibial component, whether it was entirely plastic or metal-backed.

Sources of bones were the excised portion of the knee (41) and iliac wing (2). There were no intraoperative problems but four late ones occurred. One patient had a lateral patellar subluxation which required a Hauser procedure. Two sustained undisplaced patellar fractures at 3 months and one had a supracondylar fracture 3 years later, treated by open reduction and internal fixation.

Results as rated at 2 to 7 years (mean 3.5 years) were 59.6% excellent, 29.9% good, 7.4% fair and 3.1% poor. These percentages were similar to those in a group of patients receiving the Tricon P and M prostheses but no bone grafting who were rated during the same interval (69% excellent, 23% good, 4% fair and 4% poor). Two patients with ICLH knee prostheses subsequently underwent revision, one for a sunken medial compartment at 5 years as a result of rotatory subluxation and one for lack of flexion. In both cases the grafted areas could not be recognized at the time of revision.

Although no problems were encountered in the series, one recent large medial compartment edge graft did collapse, leading to an angular deformity of the tibial component. It stabilized, but because of this the senior author believes that in cases of very large grafts the tibial component should be reinforced with an I-beam stem to give greater resistance to angular loads (Fig. 8).

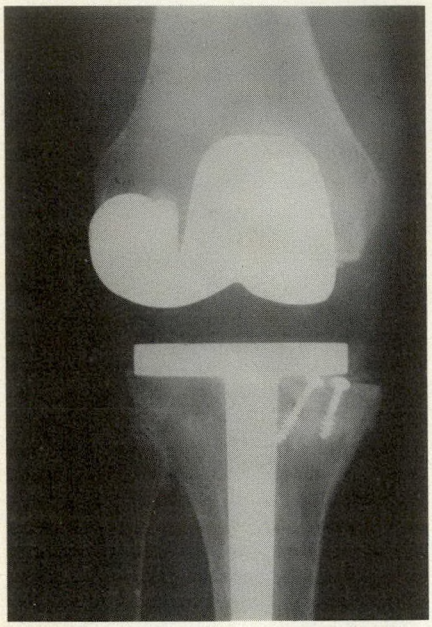

FIG. 6—Large central defect in patient who required revision and in whom Tricon P revision stem was used. Two screws were used to stabilize graft.

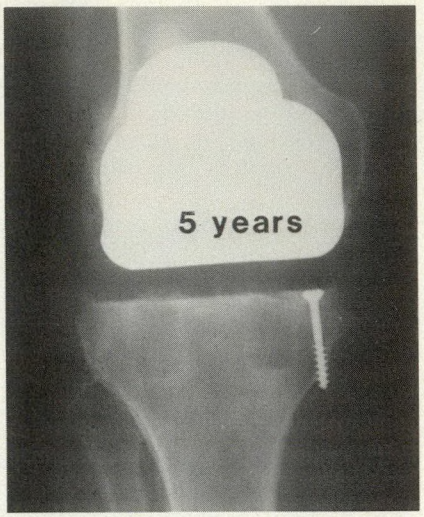

FIG. 7—Five years after insertion, medial tibial plateau edge graft can still be seen under ICLH knee prosthesis. Trabeculae cross scar line so that graft has healed, but eburnated bone scar is still visible.

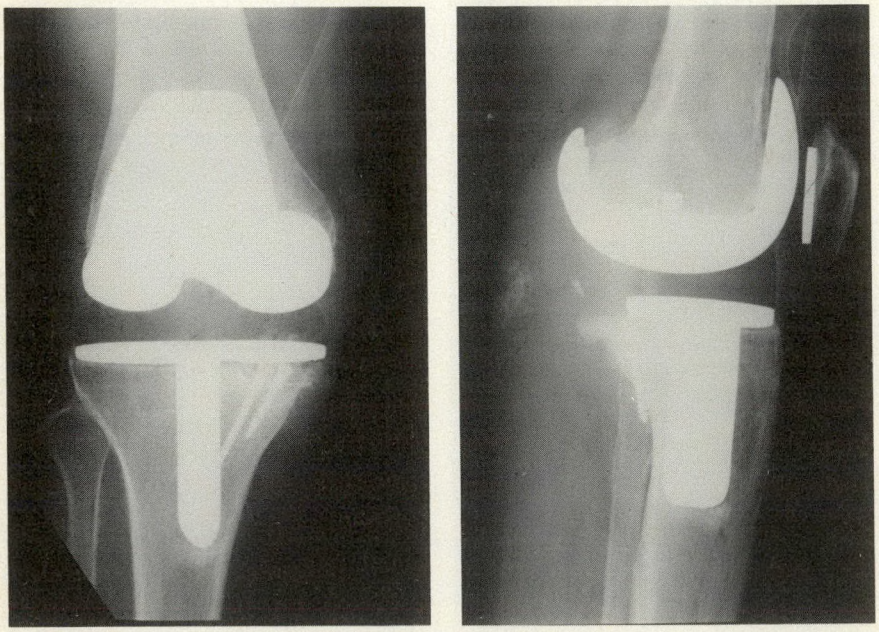

FIG. 8—Edge defect in this medial tibial plateau was large, so Tricon M tibial stem component was used to protect graft. Stem is wide in coronal plane to provide tilt resistance; thus immediate weight bearing was allowed.

Discussion

Knee replacement can be performed without bone grafting if the tibia is simply excised down to a level below the defect and a thick tibial component is used. The tibia, wedge-shaped proximally, narrows rapidly, and the bone softens likewise with increasing depth from the surface.[4] A thicker narrower implant is thus placed in poorer quality bone and is more likely to sink.

All bone grafts in the series united without significant or visible collapse. The size of the central defect did not seem to influence healing time. Being surrounded by bone, the graft was no doubt rapidly incorporated. The smaller edge grafts appeared to take longer to unite than the larger edge grafts, perhaps because the latter contained more cortical bone, permitting screw fixation. This is possibly a radiologic artifact related to the old eburnated bone scar.

Collapse of a large edge graft in a recent case led to a re-evaluation. We now believe that an edge graft of more than 1 cm^2 and 5 mm deep probably should be protected by a central stemmed tibial component. This is particularly true for medial edge defects, as the medial tibial compartment tends to be more heavily loaded than the lateral side. The stem should be wide in the coronal plane to provide resistance to medial tilt and should approach the posterior cortex, providing resistance to anterior sinkage.

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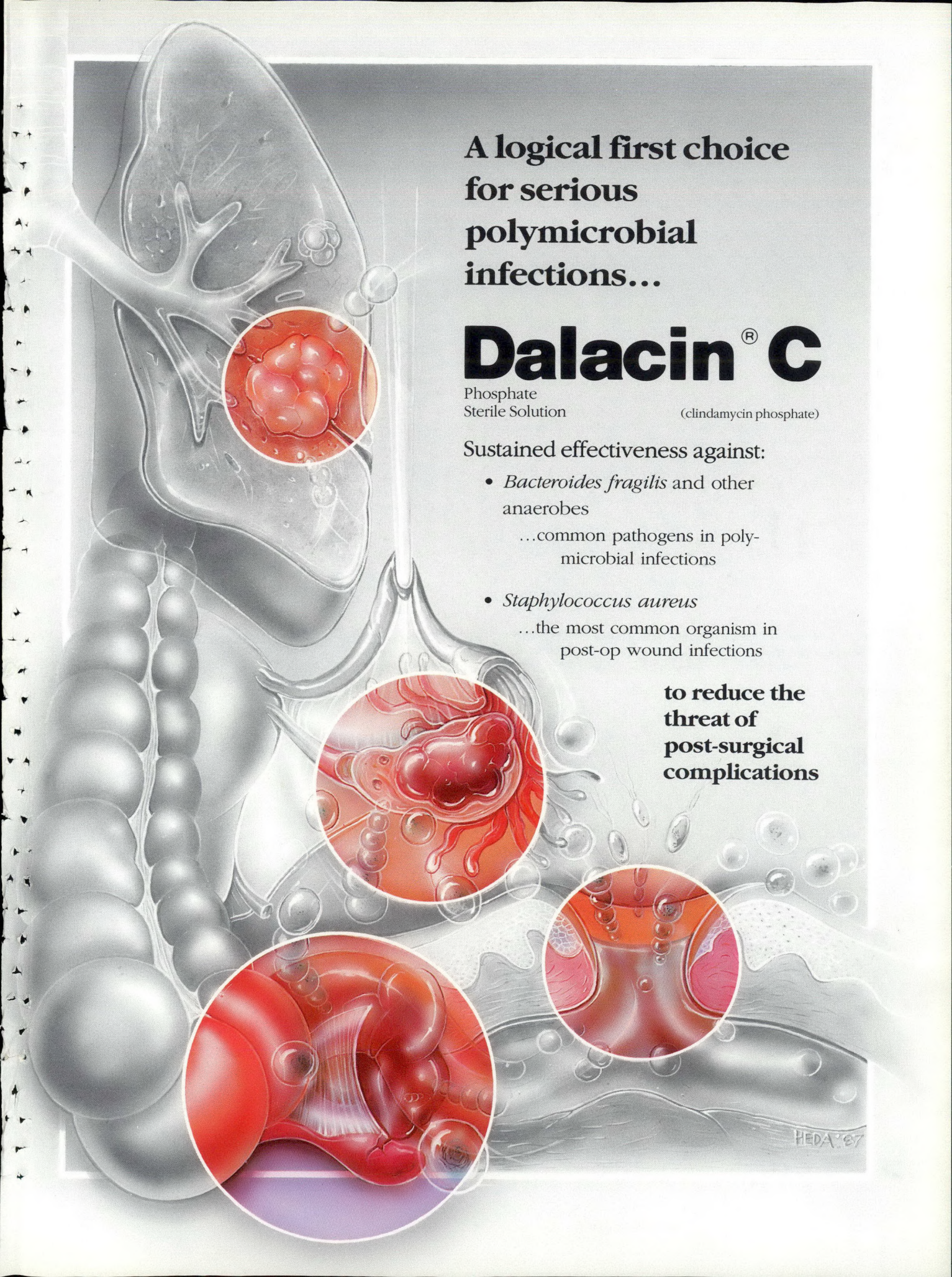
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Dalacin® C Phosphate Sterile Solution

(clindamycin phosphate)

Antibiotic

Recommended Applications

Action: Clindamycin exerts its antibacterial effect by causing cessation of protein synthesis and also by causing a reduction in the rate of synthesis of nucleic acids.

Indications: Dalacin C Phosphate (clindamycin phosphate) is indicated for the treatment of infections where the oral route is not indicated or feasible.

Dalacin C Phosphate is indicated in the treatment of serious infections due to sensitive anaerobic bacteria, such as Bacteroides species, peptostreptococcus, anaerobic streptococci, Clostridium species and micro-aerophilic streptococci.

Dalacin C Phosphate is also indicated in serious infections due to sensitive Gram-positive organisms (staphylococci, including penicillinase-producing staphylococci, streptococci and pneumococci) when the patient is intolerant of, or the organism resistant to other appropriate antibiotics.

Contraindications: The use of Dalacin C Phosphate (clindamycin phosphate) is contraindicated in patients previously found to be hypersensitive to this compound, the parent compound, clindamycin, or clindamycin palmitate. Although cross-sensitization with Lincocin® (lincomycin hydrochloride) has not been demonstrated, it is recommended that Dalacin C Phosphate not be used in patients who have demonstrated lincomycin sensitivity.

Until further clinical experience is obtained, Dalacin C Phosphate is not indicated in the newborn (infants below 30 days of age), or in pregnant women.

Warnings: Some cases of severe and persistent diarrhea have been reported during or after therapy with Dalacin C Phosphate (clindamycin phosphate). This diarrhea has been occasionally associated with blood and mucus in the stools and has at times resulted in acute colitis. When endoscopy has been performed, some of these cases have shown pseudomembrane formation.

If significant diarrhea occurs during therapy, this drug should be discontinued or, if necessary, continued only with close observation. Significant diarrhea occuring up to several weeks post-therapy should be managed as if antibiotic-associated.

If colitis is suspected, endoscopy is recommended. Mild cases showing minimal mucosal changes may respond to simple drug discontinuance. Moderate to severe cases, including those showing ulceration or pseudomembrane formation, should be managed with fluid, electrolyte, and protein supplementation as indicated. Corticoid retention enemas and systemic corticoids may be of help in persistent cases. Anticholinergics and antiperistaltic agents may worsen the condition. Other causes of colitis should be considered.

Studies indicate a toxin(s) produced by Clostridia (especially Clostridium difficile) may be a principal cause of clindamycin and other antibiotic-associated colitis. These studies also indicate that this toxigenic Clostridium is usually sensitive *in-vitro* to vancomycin. When 125 mg to 500 mg of vancomycin were administered *orally* four times a day for 5 - 10 or more days, there was a rapid observed disappearance of the toxin from faecal samples and a coincidental recovery from the diarrhea.

It should be noted that serious relapses have occurred up to one month after apparently successful treatment. A relatively prolonged period of continuing observation is therefore recommended.

Precautions: Dalacin C Phosphate (clindamycin phosphate), like any drug, should be prescribed with caution in atopic individuals. Dalacin C Phosphate must be diluted for intravenous administration. (See Dosage and Administration)

The use of antibiotics occasionally results in overgrowth of nonsusceptible organisms - particularly yeasts. Should superinfections occur, appropriate measures should be taken as dictated by the clinical situation.

As with all antibiotics, perform culture and sensitivity studies in conjunction with drug therapy.

Since abnormalities of liver function tests have been noted occasionally in animals and man, periodic liver function tests should be performed during prolonged therapy. Blood counts should also be monitored, during extended therapy.

Dalacin C Phosphate may be used in anuretic patients. Since the serum half-life of clindamycin in patients with impaired hepatic function is greater than that found in normal patients, the dose of Dalacin C Phosphate should be appropriately decreased. Hemodialysis and peritoneal dialysis are not effective means of removing the compound from the blood. Periodic serum levels should be determined in patients with severe hepatic and renal insufficiency.

Adverse Reactions: ***Local***

(a) *Intramuscular Injections:* Of 404 patients treated with Dalacin C Phosphate (clindamycin phosphate) intramuscularly (with a solution containing 150 mg/ml), six (1.5%) demonstrated local reactions as follows: Two complained of pain at the injection site, two demonstrated induration at the injection site and two developed sterile absesses.

(b) *Intravenous Infusions:* Of 192 patients treated with Dalacin C Phosphate by intravenous infusion, 14 (7.3%) demonstrated local reactions. Eleven patients developed superficial thrombophlebitis and one patient developed both superficial and deep thrombophlebitis. The majority of these cases developed in conjuction with the use of indwelling I.V. catheters and it is difficult to know how much the drug contributed to the irritation. Two patients developed localized erythema, swelling and pain at the site of the infusion.

Systemic Side Effects: Twenty-eight patients of 596 treated with Dalacin C Phosphate (clindamycin phosphate) by either the intramuscular or intravenous routes developed systemic side effects as follows:

	Number of Patients
Rash	7
Urticaria	1
Pruritus	1
Fever, Leucocytosis	1
Nausea, with or without vomiting	1
Diarrhea (See also under "Warnings")	4
Hypotension	1
Hypertension	1
Shortness of Breath	1
Superinfection*	4
Cardiac arrest**	1
Bad or bitter taste in mouth	5

* Superinfection is a complication of antibiotic therapy in general and is not necessarily a true side effect of clindamycin phosphate.

** Due to underlying myocarditis in this patient.

Clinical and Laboratory Findings: Patients treated during clinical trials of Dalacin C Phosphate (clindamycin phosphate) were followed with clinical laboratory tests, including complete hematology, urinalysis and liver and kidney function tests. Some of these tests were abnormal initially and returned to normal during therapy with Dalacin C Phosphate, while others were normal initially and became abnormal, during therapy. Overall evaluation of clinical laboratory values in these patients does not indicate that Dalacin C Phosphate therapy has a toxic effect on the hematopoietic, hepatic or renal systems. Transient elevations of serum transaminases have occured in some patients, but other liver function tests (alkaline phosphatase, serum bilirubin) have not shown any tendency to increase and there have not been clinical signs of drug-induced hepatic toxicity.

Symptoms and Treatment of Overdosage: No cases of overdosage have been reported. No specific antidote is known. Doses as high as 1200 mg every six hours (4800 mg/day) by infusion for five days have been given without adverse effects.

DOSAGE AND ADMINISTRATION

Adults

Intramuscular Injection: 600 mg/day in 2 equal doses.
Moderately severe infections: 600 to 1200 mg/day in 2 or 3 equal doses.
Severe infections: 1200 to 2400 mg/day in 2, 3 or 4 equal doses. Intramuscular injections of more than 600 mg into a single site are not recommended.

Intravenous Administration: Dalacin C Phosphate (clindamycin phosphate) must be diluted prior to I.V. administration to a dilution of 300 mg in 50 mL of diluent (6mg/mL) or more, and infused in not less than 10 minutes. Administration of more than 1200 mg in a single 1 hour infusion is not recommended. Dalacin C Phosphate should not be injected intravenously undiluted as a bolus.

Moderately severe infections: 900 to 1800 mg/day by continuous drip or in 2 or 3 equal doses, each infused over 20 minutes or longer.

Severe Infections: 1800 to 2700 mg/day by continuous drip or in 3 or 4 equal doses, each infused over 20 minutes or longer. In life-threatening infections, doses of 2700 to 4800 mg/day by continuous drip or in 3 or 4 equal doses each infused over 20 minutes or longer may be given.

Dilution and infusion rates:

Dose	*Diluent*	*Time*
300 mg	50 mL	10 min.
600 mg	100 mL	20 min.
900 mg	150 mL	30 min.
1200 mg	200 mL	45 min.

Alternatively, drug may be administered in the form of a single rapid infusion of the first dose followed by continuous I.V. infusion as follows:

To maintain serum clindamycin levels	*Rapid infusion rate*	*Maintenance infusion rate*
Above 4 mcg/mL	10 mg/min. for 30 min.	0.75 mg/min.
Above 5 mcg/mL	15 mg/min. for 30 min.	1.00 mg/min.
Above 6 mcg/mL	20 mg/min. for 30 min.	1.25 mg/min.

Children: (Over one month of age)

Intramuscular injection: 10 to 15 mg/kg/day in 2, 3 or 4 equal doses.
Moderately severe infections: 15 to 20 mg/kg/day in 3 or 4 equal doses.
Severe infections: 20 to 30 mg/kg/day in 3 or 4 equal doses.

Intravenous Administration:
Moderately severe infections: 15 to 25 mg/kg/day by continuous drip or in 3 or 4 equal doses, each infused over 20 minutes or longer.

Severe infections: It is recommended that children be given no less than 300 mg/day regardless of body weight. (Dilute Dalacin C Phosphate Sterile Solution in the same manner as for adults.)

Dilution and Compatibility:
4 mL (600 mg) Dalacin C Phosphate when diluted with 1000 mL of the following commonly used infusion solutions was found to be physically compatible and demonstrated no significant change in pH or antimicrobial potency over a period of 24 hours:

Sodium chloride injection
Dextrose 5% in water
Dextrose 5% in saline
Dextrose 5% in Ringer's Solution
Dextrose 5% in half-strength saline plus 40 mEq potassium chloride
Dextrose $2\frac{1}{2}$% in Lactated Ringer's Solution (Hartmann's Solution)

Dalacin C Phosphate was not stable when added to Dextrose 5% in water plus vitamins. Therefore it is not recommended that Dalacin C Phosphate be mixed with any infusion solution containing B vitamins.

Supplied:
Dalacin C Phosphate contains the following per mL of sterile solution:
Clindamycin phosphate equivalent to clindamycin base 150 mg
Benzyl alcohol 5 mg
Disodium edetate 0.5 mg
Water for injection q.s.

When necessary the pH is adjusted with sodium hydroxide and/or hydrochloric acid to maintain a pH range of 5.5 to 7.0.
Dalacin C Phosphate is available in 2 mL and 4 mL ampoules.

NOTE: Do not store below 15°C.

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Heparin-Induced Thrombosis (White Clot Syndrome) Secondary to Prophylactic Subcutaneous Administration of Heparin

As a reminder that thrombocytopenia may occur even with very small doses of heparin, the author describes the case of a 76-year-old man who was admitted for elective hip surgery and received "mini-dose" heparin prophylactically. Profound thrombocytopenia developed, followed by deep vein thrombosis and then arterial occlusion to the lower limb. Initially, the importance of the low platelet count was not recognized and a continuous infusion of heparin (35 000 units/d) was given. It was discontinued when the limb became cold, pulseless, paralysed and anesthetic, and an emergency aortogram demonstrated occlusion of the femoral artery. Removal of the thrombus, closed fasciotomies, infusion of Rheomacrodex in dextrose and administration of warfarin resulted in the patient's recovery of sensation and movement in the limb.

Afin de rappeler que la thrombocytopénie peut venir compliquer un traitement d'héparine à très faible dose, les auteurs décrivent le cas d'un homme de 76 ans qui fut hospitalisé pour une chirurgie non urgente de la hanche et qui reçut à titre préventif une "mini dose" d'héparine. Une thrombocytopénie profonde est apparue qui fut suivie d'une thrombose veineuse profonde, puis d'une occlusion artérielle du membre inférieur. Au début, l'importance du faible compte plaquettaire ne fut pas reconnue et une perfusion continue d'héparine (35 000 U/d) fut administrée. Elle fut interrompue quand le membre devint froid, exempt de pouls, paralysé et insensible; une aortographie d'urgence démontra l'occlusion de l'artère fémorale. L'enlèvement du thrombus, la réalisation de fasciotomies fermées, la perfusion de Rhéomacrodex dans un soluté glucosé et l'administration de warfarine permirent au patient de recouvrer les sensations et le mouvement du membre.

From the Fredericton Medical Clinic, Fredericton, NB

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Reprint requests to: Dr. J.A. Rankin, Ste. 505, Fredericton Medical Clinic, 1015 Regent St., Fredericton, NB E3B 6H5

The administration of heparin has, in a small number of patients, promoted major venous or arterial occlusion that threatened life or limb (white clot syndrome). The episodes were apparently the result of an immune-mediated platelet aggregation disorder. The following report describes the case of a patient who suffered profound thrombocytopenia during the prophylactic subcutaneous administration of heparin, then had major deep vein thrombosis and a limb-threatening arterial occlusion.

Case Report

A 76-year-old man with severe osteoarthritis was admitted to the Dr. Everett Chalmers Hospital, Fredericton on Feb. 5, 1986 for an elective right total hip replacement. There was no clinical evidence of past or present phlebitis, deep vein thrombosis or pulmonary embolism. The hemoglobin level and platelet count were normal. He had never received heparin. Because he was thought to be at risk for deep vein thrombosis postoperatively, a prophylactic regimen of heparin subcutaneously was planned.

The day after admission, a routine hip replacement was performed under epidural anesthesia. Heparin, 5000 units every 8 hours subcutaneously, was started 8 hours after the operation. For the next 11 days, his recovery progressed except for a persistently elevated temperature reaching as high as 38°C. Routine blood tests showed an expected fall in the hemoglobin levels but the platelet counts were normal. Eleven days after operation his right lower limb became markedly swollen with a 12-cm increase in circumference of the thigh and a 3.8-cm increase of the calf. A venogram revealed extensive deep vein thrombosis in the calf and thigh and possibly thrombosis of the iliac veins. The platelet count had now fallen to 29 × 10^9/L (Fig. 1), but the importance of this was not appreciated. The subcutaneous administration of heparin was discontinued, and with a 5000-unit bolus a continuous infusion of 35 000 units/d was started. A lung scan 4 days later showed three areas of pulmonary infarction. Three days after this his right limb suddenly became cold, pulseless, paralysed and anesthetic. Doppler ultrasonography failed to detect blood flow in the limb. The platelet count was 19 × 10^9/L. An emergency arteriogram showed occlusion of the right common femoral artery extending to the distal one-third of the superficial femoral artery. A diagnosis of heparin-induced thrombosis was made and the drug infusion discontinued.

During emergency surgical exploration, the right common femoral artery was found to be plugged with pale thrombus, which was moulded to the contours of the artery and did not appear embolic in origin. It is noteworthy that the patient's blood appeared to be adequately anticoagulated, since there was no evidence of propagation thrombus distal to the occlusion. The thrombus was removed. A second discrete thrombus was removed from the distal one-third of the superficial femoral artery by a Fogarty balloon catheter. Circulation was restored and closed fasciotomies were performed on the muscle compartments of the calf. Heparin was discontinued. An infusion of Rheomacrodex 40 in dextrose 5% (Dextran 40) (1 L/24 h) was started immediately postoperatively and acetylsalicylic acid, 325 mg twice daily, prescribed. On the following day sodium warfarin was administered and anticoagulation established over several days. The patient regained sensation and movement of the limb. No further complications occurred and he was discharged 3 weeks later. Warfarin was continued for 3 months.

Discussion

The rate of benign thrombocytopenia secondary to heparin administration has

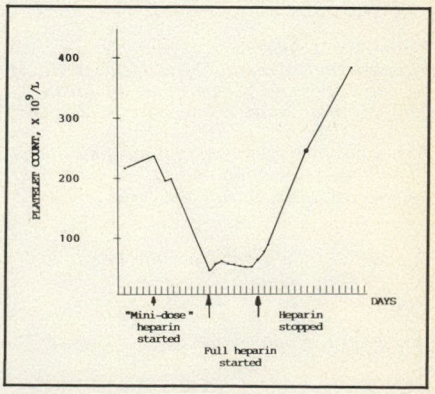

FIG. 1—Patient's platelet counts during administration of mini-dose and full-dose heparin.

been variously reported as being between 0% and 26%, with bovine heparin more often being incriminated than its porcine counterpart.[1] In the majority of cases, the fall in platelet count is less than 33%[2] and is innocent and transient. The white clot syndrome occurs only in 0.6% of patients receiving heparin,[3] and, in these, the fall in the platelet count is more profound (probably below an arbitrary figure of 100×10^9/L). The condition appears to be due to an antigen–antibody complex reaction leading to massive platelet aggregation, although, paradoxically, patients receiving full doses of heparin may appear fully anticoagulated. The onset is usually between 6 and 12 days after starting heparin therapy, or sooner if there has been prior exposure to the drug. The patients suffer either new onset of occlusion of large vessel veins or arteries or have exacerbations of pre-existing thrombosis.

Whether venous thromboembolic disease should be included in the syndrome has been questioned[4] on the grounds that deep vein thrombosis is common in hospitalized patients. Our patient was certainly at risk postoperatively, and the profound thrombocytopenia (29×10^9/L) that existed at the time the symptoms appeared does not necessarily imply a causal relation. The venous system was not surgically explored since the thrombosis had been established for 7 days and exploration was considered of questionable benefit.

In many of the reported cases the aorta has been the site of platelet aggregation. It is possible that the arterial platelet clot in this patient was embolic from the aorta, although clinically this did not seem to be so.

It is noteworthy that very low heparin dosage may create this syndrome. "Mini-dose" heparin given prophylactically[5] and even the tiny dose required to maintain an arterial line have been incriminated. The clinical syndrome may be recognized by measuring platelet counts regularly. Seriously ill patients have a variety of possible causes for thrombocytopenia, but platelet aggregation studies should prove diagnostic. Rapid conversion from heparin to warfarin therapy in less than 6 days offers a measure of protection. If the platelet count falls below an arbitrary level of 100×10^9/L, withdrawal of heparin is appropriate. Dextran and acetylsalicylic acid, as platelet inhibitors, may be indicated. Protamine sulfate has no effect on the immune reaction. Arterial embolectomy has been successful, especially since, in fully anticoagulated patients, extensive propagation thrombosis is absent. For this reason, there is also the intriguing possibility of a successful venous thrombectomy, although this has not been described.

Awareness of the high death rate (29%), amputation rate (21%)[1] and that even tiny doses of heparin may promote major platelet aggregation, should reduce the occurrence of this catastrophe.

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CHRISTIAN SMEESTERS, MD, FRCSC, FACS;* LISE GIROUX, MD, FRCPC;† BERNARD VINET, PH D;‡ RAYMOND ARNOUX, MD;* PATRICK CHALAND, MD;* JACQUES CORMAN, MD, FRCSC, FACS;* GILLES ST-LOUIS, MD, FRCPC;§ PIERRE DALOZE, MD, FRCSC, FACS*

Efficacy of Incorporating Cyclosporine Into Liposomes to Reduce Its Nephrotoxicity

A preparation of cyclosporine (CsA) in liposomes was tested in the rat to evaluate its effectiveness in reducing CsA nephrotoxicity.

The drug was injected intravenously in unilaterally nephrectomized Lewis rats at a daily dose of 25 mg/kg for 14 days, either in a cremophore solution (eight rats) or in a preparation of liposomes (eight rats). Another group of four animals received the cremophore solution alone.

Overall, rats treated with the CsA-liposome preparation had reduced toxicity, exhibiting better survival rates and less weight loss than those treated with the CsA-cremophore. Incorporating CsA into liposomes induced a statistically significant ($p < 0.05$) reduction in the otherwise progressive increase of serum creatinine during week 2 of the experiment. Following administration of CsA-liposome preparation, epithelial cells of the proximal renal tubules appeared morphologically normal, without evidence of vacuolization. which is characteristic of CsA nephrotoxicity and was seen in the CsA-cremophore group.

Although the exact mechanism is not clearly understood, it is likely that the tissue distribution of CsA, when incorporated into liposomes, is modified in favour of the reticuloendothelial cells, thereby sparing highly sensitive, but non-target organs such as the kidneys.

Une préparation de cyclosporine-liposomes (CsA) a été testée chez le rat afin d'évaluer son efficacité sur la réduction de la néphrotoxicité liée à la CsA.

La CsA a été injectée par voie intraveineuse chez les rats Lewis, ayant subis une néphrectomie unilatérale, à la dose de 25 mg/kg par jour pour 14 jours consécutifs, soit en solution dans du crémophore (huit rats), soit incorporée dans des liposomes (huit rats). Un autre

*From the *Department of Surgery, †Department of Pathology, ‡Department of Biochemistry and §Department of Medicine, Hôpital Notre-Dame, Montreal, PQ*

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Reprint requests to: Dr. Christian Smeesters, Department of Surgery, Hôpital Notre-Dame, Pavillon L.C. Simard, CP 1560, Station C, Montréal, PQ H2L 4M1

groupe d'animaux a reçu le crémophore seul (quatre rats).

Comparativement aux rats traités à la CsA-crémophore, ceux ayant reçu la préparation de CsA-liposome ont montré une toxicité systémique réduite, de par une survie améliorée et une perte pondérale moindre. L'incorporation de CsA dans des liposomes a entraîné une élévation significativement ($p < 0.05$) moins importante de la créatinine sérique dans la deuxième semaine de l'expérimentation. De plus, après administration d'une préparation liposomale de CsA, les cellules épithéliales des tubules rénaux proximaux furent dépourvues de lésions vacuolaires caractéristiques de la néphrotoxicité à la CsA, telles qu'observées dans le groupe traité à la CsA-crémophore.

Bien que le mécanisme exact ne soit pas clair, il est vraisemblable que la distribution tissulaire de la CsA, après incorporation dans des liposomes, soit modifiée en faveur des cellules réticulo-endothéliales, épargnant ainsi des organes sensibles mais non visés, comme les reins.

Nephrotoxicity is one of the most common complications of cyclosporine (CsA) therapy in organ transplantation.[1] Modifying the cellular distribution of CsA by the use of an appropriate carrier could reduce this toxicity.

The use of "lysosomotropic" drugs has effectively reduced undesirable toxic side effects of a wide variety of drugs, at the same time maintaining or even enhancing their therapeutic effectiveness.[2,3] Among these, macromolecular complexes, such as the Adriamycin-DNA complex, have reduced free drug-induced cardiac[4,5] and renal toxicity[6,7] without loss of immunosuppressive activity in experimental renal allografts.[8,9] Such drug linkages are limited and other lysosomotropic carriers searched for have included liposomes.[10,11]

Because of the highly hydrophobic property of CsA, the drug can be easily entrapped in the lipid layer of liposomes. We therefore decided to evaluate the efficacy of a CsA-liposome preparation in reducing drug-induced nephrotoxicity in a rat model.

Materials and Methods

Male Lewis rats (Charles River Breeding Laboratories Inc., Wilmington, Mass.), weighing between 300 and 450 g, were used. A left nephrectomy was performed on day 0 under ether anesthesia.

Cyclosporine-liposome preparations were obtained by evaporation of a chloroform solution of phosphatidylcholine, cholesterol and CsA, in the respective weight proportions of 5 to 1 to 2.5, followed by suspension in a tromethamine-sodium chloride buffer, sonication and centrifugation. The preparations were tested, by high pressure liquid chromatography, for CsA concentration and percentage incorporation of CsA.

Drugs were injected intravenously through the tail vein under light ether anesthesia. Three groups of animals were studied. Group 1 (eight rats) received a CsA-cremophore preparation (Sandoz Canada Inc., Dorval, PQ) at a daily dose of 25 mg/kg for 14 days. Group 2 (eight rats) was treated with the CsA-liposome preparation using the same CsA dosage. Group 3 (four rats) received the cremophore solution alone in an amount equivalent to that in the first group.

Blood samples were taken before CsA or cremophore administration and three times a week for blood chemistry analysis. Autopsies were performed on day 14 after sacrifice of the animal or earlier if the rat died before the end of the experiment. Kidneys were processed for microscopic and ultrastructural examination.

The data were subjected to statistical analysis using a multiple regression test. A p value of < 0.05 was considered significant.

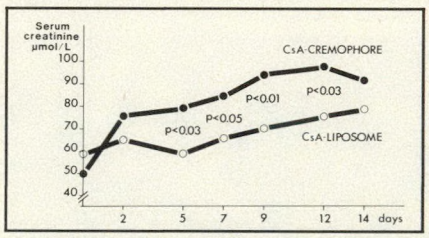

FIG. 3—Serum creatinine concentrations in rats after intravenous administration of CsA in cremophore- and liposome-treated groups.

Results

Group 1 rats had a higher death rate. Two of the eight rats of this group died within 14 days, whereas all animals in group 2 survived (Fig. 1).

Weight loss was significantly ($p < 0.03$) less pronounced during the second week of the experiment in group 2 compared with group 1 (Fig. 2), suggesting an overall reduced toxicity. Furthermore, incorporation of CsA into liposomes

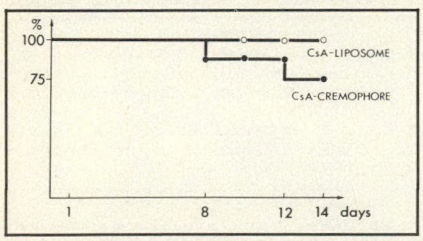

FIG. 1—Survival rate of rats after intravenous administration of cyclosporine (CsA) in cremophore- and liposome-treated groups.

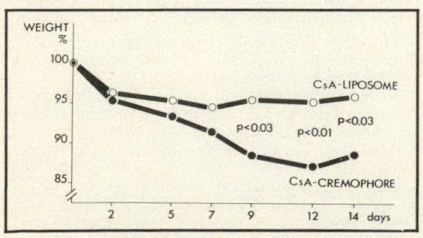

FIG. 2—Weight loss of rats after intravenous administration of CsA in cremophore- and liposome-treated groups.

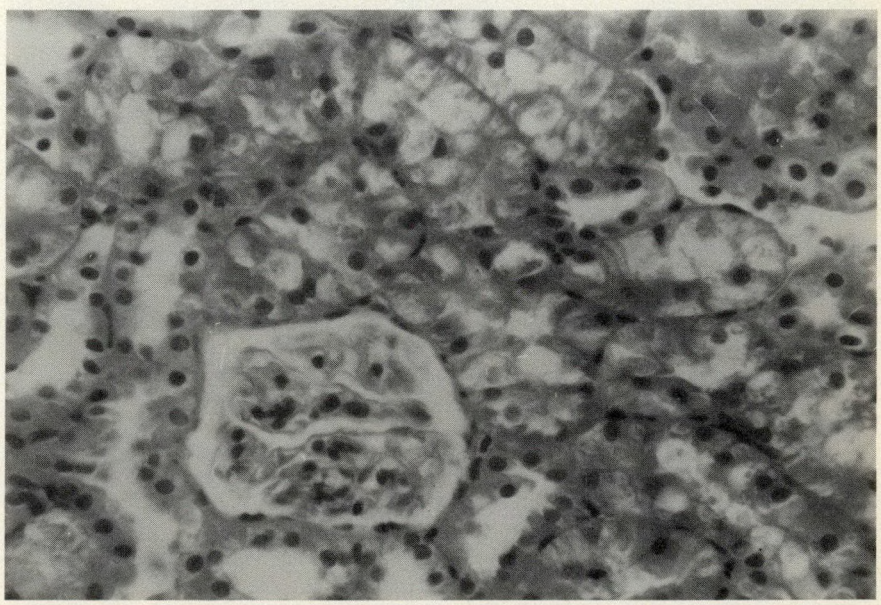

FIG. 4—Kidney of rat treated with CsA-cremophore and killed on day 14. Most proximal tubular epithelial cells show clear vacuoles of various sizes within their cytoplasm (hematoxylin-phloxine-saffron stain, original magnification × 400).

induced a statistically significant ($p < 0.05$) reduction in the progressive increase of serum creatinine levels (Fig. 3).

Cyclosporine trough plasma levels were not affected by the vehicle used ($18.2 \pm 6.1 \times 10^3$ ng/ml in group 1 and $18.5 \pm 12.5 \times 10^3$ ng/ml in group 2).

Microscopic examination of the kidneys in group 1 rats revealed clear vacuoles in the cytoplasm of numerous renal proximal tubular cells (Fig. 4), as described by Mihatsch and colleagues.[12] In contrast, a marked reduction of these toxic lesions was noted when CsA was incorporated into liposomes (Fig. 5).

Group 3 rats, receiving the cremophore solution alone, showed normal weight gain (Fig. 6) and no significant modification of renal function (Fig. 7). The vacuolization process noted in group 1 was not detected in group 3 animals, but ultrastructural studies revealed crystalloid structures similar to those described by Verani.[13]

Discussion

If the use of CsA as a potent immunosuppressive agent in organ transplantation is to be continued, every effort should be made to reduce its nephrotoxicity, one of its most harmful side effects.

Liposomes, which are biodegradable and nontoxic lipid vesicles, appear to be promising as drug carriers to reduce undesirable toxic side effects while maintaining or even enhancing the therapeutic efficacy of the drugs. Water-soluble as well as lipid-soluble drugs can be trapped in liposomes, in the internal aqueous space and in the lipid layer respectively.[10,11]

Incorporating drugs such as CsA into liposomes allows the formation of slow-release derivatives. Furthermore, by potentially altering the normal distribution and binding of CsA in blood and tissues, one may expect to increase uptake by target cells (particularly when they involve the reticuloendothelial system), thereby sparing sensitive but non-target organs such as the kidneys.

Our results clearly show the overall reduced toxicity of CsA after it is incorporated into liposomes (Figs. 1 and 2). Also improved are the functional (Fig. 3) and morphologic (Fig. 5) outcomes of CsA nephrotoxicity. Cyclosporine plasma levels do not appear to be affected by incorporation into liposomes and are thus not associated with the reduced toxicity although any relationship between these two factors remains unclear. Since cremophore by itself does not increase serum creatinine levels, the reduction of CsA nephrotoxicity after encapsulation of the drug into liposomes should be attributable to those carriers, which presumably modify CsA tissue distribution, keeping it away from the kidney.

Reduced renal toxicity of CsA-liposomes in a rat model has also been demonstrated by Hsieh and associates,[14] using the glomerular filtration rate by inulin clearance as an index of nephrotoxicity, but morphologic studies were not performed.

This beneficial effect of a CsA-liposome preparation warrants further attention, particularly if immunosuppression is not affected, as shown by Aziz and colleagues[15] and Hsieh's group.[14] Preliminary experiments done in our laboratory, using a CsA-liposome preparation in renal allografts, did not show any deleterious effect on the immunosuppressive activity obtained with CsA-cremophore, at the dose of 2 mg/kg for 14 days. Further investigation needs to be done to determine the optimal liposome preparation, since the tissue distribution and pharmacokinetics of drugs can be modified by altering their lipid composition, size and charge.

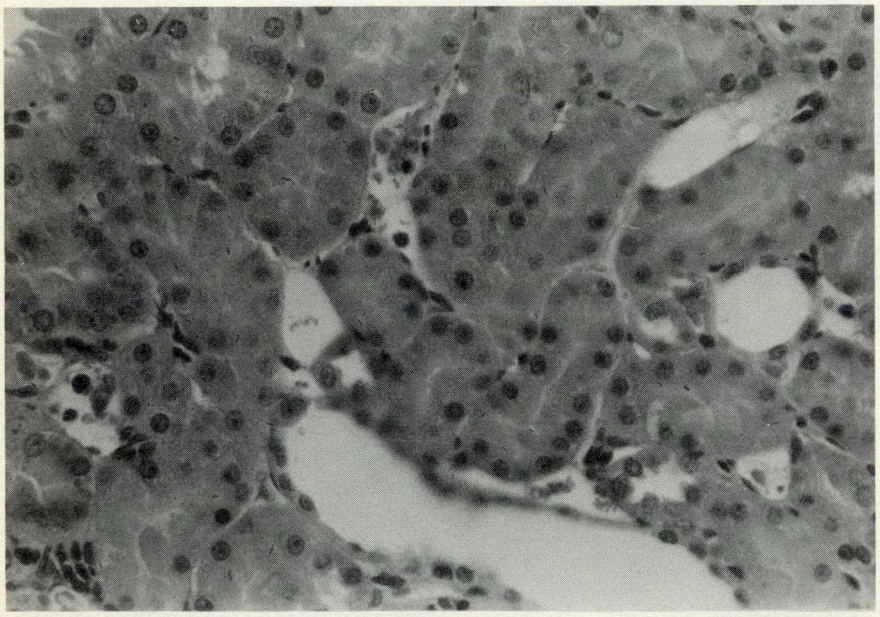

FIG. 5—After treatment with CsA-liposomes, epithelial cells of proximal tubules appear normal, without evidence of vacuolization (hematoxylin-phloxine-saffron stain, original magnification × 400).

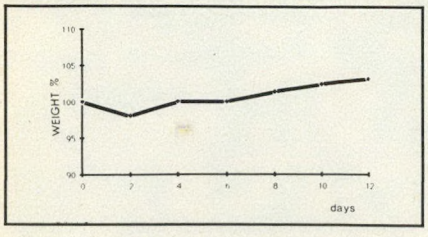

FIG. 6—Weight of rats after intravenous administration of cremophore solution.

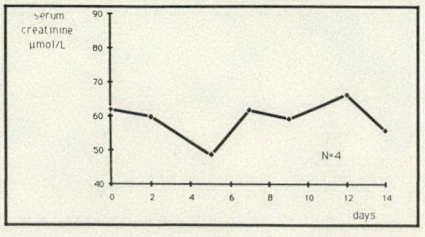

FIG. 7—Serum creatinine concentrations in rats after intravenous administration of cremophore solution.

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MILTON LAUTATZIS, MD, FRCPC;* J. PATRICK SHOENUT, B SC;†
JOHN SCURRAH, MD, FRCSC;‡ A.B. MICFLIKIER, MD, FRCPC§

Pseudocalculus of the Common Bile Duct

Common-bile-duct growths are rarely identified unless they cause chronic biliary obstruction. This case report describes a 71-year-old woman who had jaundice and epigastric pain. A cholecysto–colonic fistula was demonstrated by endoscopic retrograde cholangiopancreatography. The patient also had multiple filling defects in the common bile duct. The fistula was closed and stones were removed. A postoperative cholangiogram showed two calculi. One was removed with a basket through the T-tube tract, but the second, which did not appear completely free of the common-duct wall, could not be removed by the basket method. Subsequently at laparotomy this was found to be a benign pedunculated polyp, composed of collagenous and vascular tissue and with no surface epithelium. Surgeons should bear in mind the possibility of a common-bile-duct growth in cases of extrahepatic biliary obstruction.

Les tumeurs du cholédoque sont rarement identifiées à moins qu'elles causent une obstruction biliaire chronique. On décrit le cas d'une femme de 71 ans souffrant d'ictère et de douleur épigastrique. Une fistule cholécystocolique fut mise en évidence par cholangiopancréatographie endoscopique rétrograde. La patiente présentait de multiples lacunes radiologiques dans le cholédoque. La fistule fut fermée et des calculs retirés. Un cholangiogramme pratiqué en postopératoire révéla deux calculs. Un calcul put être enlevé par un panier passé dans un tube en T; l'autre qui ne paraissait pas complètement détaché de la paroi du cholédoque, ne put être retiré par la méthode du panier. Subséquemment, à la laparotomie on identifia un polype pédiculé bénin, composé de tissus collagène et vasculaire, sans surface épithéliale. Le chirurgien devrait garder à l'esprit la possibilité d'une tumeur du cholédoque dans les cas d'obstruction biliaire extrahépatique.

Benign epithelial tumours of the extrahepatic biliary system are rare. A review by Chu[1] in 1950 demonstrated that only 30 of 55 presented cases withstood vigorous application of clinical and histologic criteria. In no case was a correct preoperative diagnosis made. By 1970, 76 cases had been demonstrated.[2] The etiology of these lesions has not become any clearer since Chu's retrospective study; however, the importance of identifying these tumours and distinguishing benign from malignant lesions has become increasingly clear.

This report illustrates the difficulty in obtaining a correct preoperative diagnosis when a pedunculated polyp mimicked a retained common-duct calculus at T-tube cholangiography and endoscopic retrograde cholangiopancreatography (ERCP).

Case Report

A 71-year-old woman with a 5-year history of biliary colic was admitted to St. Boniface General Hospital, Winnipeg, with jaundice and epigastric pain. Endoscopic retrograde cholangiopancreatography revealed a cholecysto–colonic fistula and choledocholithiasis (Fig. 1). Severe heart disease, requiring placement of a pacemaker, and the patient's refusal precluded surgery. She was readmitted 13 months later with a clinical diagnosis of cholangitis; she was jaundiced, had epigastric pain and was febrile. Endoscopic retrograde cholangiopancreatography demonstrated multiple common-bile-duct calculi and the persistent cholecysto–colonic fistula. The patient now consented to surgery, and cholecystectomy, choledocholithotomy, closure of the cholecysto–colonic fistula and choledochoscopy were carried out. The patient's common bile duct and hepatic ducts were found to be patulous. Choledochoscopy revealed debris throughout the extrahepatic biliary system, but no other calculi were evident. A no. 6 Baker's dilator passed with ease into the duodenum. A no. 18 French T tube was placed in the common bile duct for drainage.

On postoperative day 10, a T-tube cholangiogram demonstrated two filling defects in the distal common bile duct, diagnosed as calculi (Fig. 2). The patient was referred to the Department of Radiology for stone extraction through the T-tube tract. One stone was easily removed with the Medi-Tech biliary stone basket (Medi-Tech Ltd., Watertown, Mass.), but removal of the second was unsuccessful. One week later a second attempt at removal was unsuccessful, so a drainage tube was placed in the tract. The second attempt induced a gram-negative (*Escherichia coli*) bacteremia that was treated successfully with antibiotics. When the patient returned to the hospital 4 weeks later for stone

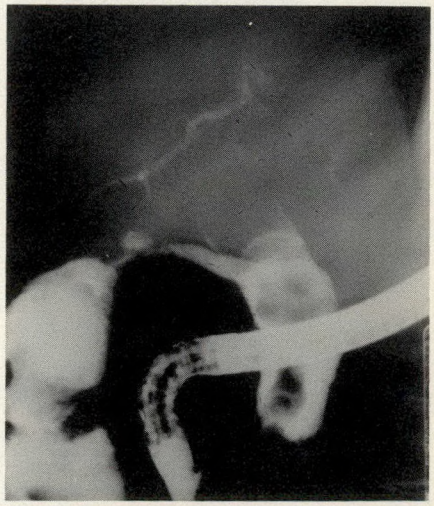

FIG. 1—Cholecysto–colonic fistula and multiple calculi in common bile duct.

From the Department of Radiology, Department of Medicine and Department of Surgery, University of Manitoba, Winnipeg, Man. and St. Boniface General Hospital and Victoria General Hospital, Winnipeg

**Associate professor and head, Department of Radiology, St. Boniface General Hospital, Winnipeg*

†Research associate, Department of Radiology, University of Manitoba

‡Lecturer, Department of Surgery, University of Manitoba

§Assistant professor of medicine, University of Manitoba

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Reprint requests to: Dr. Milton Lautatzis, Department of Radiology, St. Boniface General Hospital, 409 Taché Ave., Winnipeg, Man. R2H 2A6

extraction, the drainage tube had pulled out and the tract could not be dilated.

At a repeat laparotomy 3 months later, choledochotomy revealed a common-duct lesion, which was excised. A postoperative cholangiogram was clear and the T tube was removed 6 weeks after surgery. The patient's recovery was uncomplicated.

The excised lesion was a polypoid structure composed of a reparative pattern of collagenous and vascular tissue elements totally devoid of surface epithelium (Fig. 3). This polyp arose from an area of the common-duct mucosa where mucosal distortion was observed. There was no evidence of malignant disease in the margins of mucosal epithelium. The polypoid growth did not show the more active growth pattern of an invasive fibromatosis that can occasionally be seen in this area. Thirty-one months after surgery, the patient remains asymptomatic.

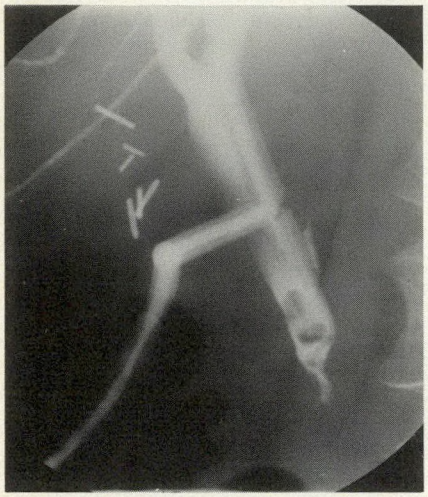

FIG. 2—Two filling defects in common bile duct. More proximal defect was benign pedunculated polyp.

Discussion

The most frequently reported benign tumours of the extrahepatic bile ducts are adenomas and papillomas, and the most frequently reported associated symptoms are jaundice and pain.[2,3] The common bile duct was the site of 90% of benign extrahepatic biliary tumours[1] but was the site of only 35% of extrahepatic carcinomas.[3]

Our patient had a long history of cholelithiasis and choledocholithiasis. The presumed cause of the cholecysto–colonic fistula was a calculus. It is tempting to relate the lesion found in the common bile duct to the patient's long-standing choledocholithiasis. Others have attempted to link choledocholithiasis and common-duct growths.[4,5] In this case, the pathology report supported the idea that prolonged irritation of the mucosal surface resulted in a collagenous tissue growth. In retrospect, the possibility that the second filling defect in the common bile duct was a polyp should perhaps have occurred to us during the first attempt at basket removal. The polyp continually popped out of the basket as it was being closed, quite unlike routine stone removal. An additional possibility for distinguishing calculi from polyps is suggested in Fig. 2. The most distal defect is seen to float free surrounded by contrast medium. A cholesterol calculus was removed during the first basket extraction. The remaining defect, although quite mobile during extraction attempts, is not seen to be completely free of the common-duct wall and was in fact attached by a pedicle.

The clinical importance of benign common-duct growths relates to their potential for causing recurrent cholangitis and intermittent obstruction. They may also act as a nidus for recurrent calculus formation in the biliary system.

An alternative method for managing an elderly patient such as ours might include endoscopic retrograde sphincterotomy with the placement of a biliary endoprosthesis. This mode of treatment, however, would leave the nature of the lesion unknown. In 1957, Duncan and Wilson,[6] in a report of benign tumours of the common bile duct, suggested that newer radiopaque imaging techniques would make diagnosis of duct lesions much easier. The case presented here shows, however, that despite these newer techniques, we must consider the possibility of unusual pathologic findings in cases of extrahepatic biliary obstruction.

We gratefully acknowledge the assistance of Drs. G.P. Sharma, M. Hamonic and A. Molgat in preparing this report.

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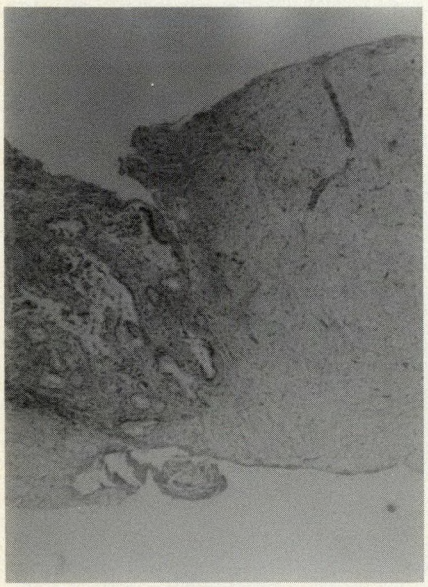

Fig. 3a

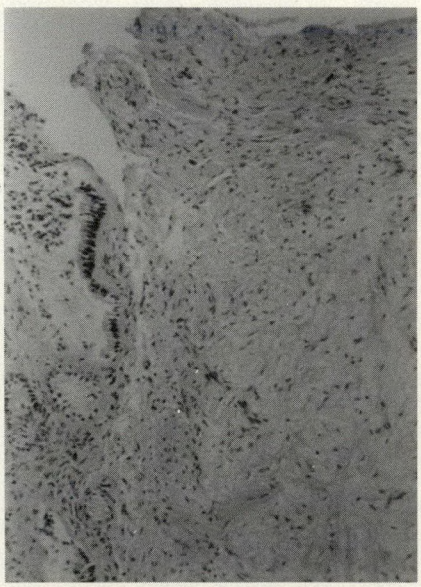

Fig. 3b

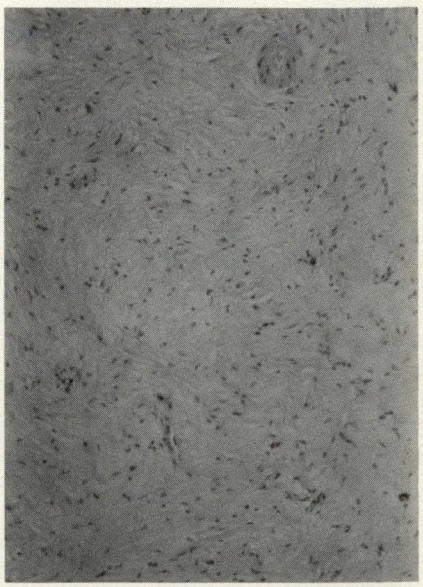

Fig. 3c

FIG. 3—(a) Lesion removed from common duct was polypoid reparative growth of collagenous tissue protruding from common-duct mucosa (hematoxylin and eosin, original magnification × 50). (b) Junction between common-duct mucosa and reparative growth of collagen. Polypoid lesion is denuded of surface epithelium (hematoxylin and eosin, original magnification × 150). (c) Stroma of lesion is composed entirely of collagenous and vascular component devoid of any malignant features and inflammatory elements (hematoxylin and eosin, original magnification × 150).

J.H. ROTH, MD, FRCSC;* A. MINIACI, MD†

Healing of Extra-articular Angulated Apex Volar Fractures of the Distal Radius

Healed extra-articular angulated apex volar fractures of the distal radius are a relatively common orthopedic finding. The functional end-results of treatment of this injury are controversial.

Twenty-nine patients with 34 fractures were reviewed by subjective and objective assessment, as well as radiologic examination. Some had unsatisfactory results. These poor results were associated with older age, poor anatomical reduction and, in some, the presence of a midcarpal instability pattern.

Les fractures extra-articulaires consolidées de la partie distale du radius qui présentent une angulation sont observées relativement fréquemment en orthopédie. Les résultats fonctionnels du traitement de cette blessure sont discutables.

Vingt-neuf patients présentant 34 fractures ont fait l'objet d'évaluations subjectives et objectives, ainsi que d'examens radiologiques. Certains montraient des résultats insatisfaisants. Les mauvais résultats étaient reliés au grand âge, à une mauvaise réduction anatomique et, dans certains cas, à la présence d'un terrain mésocarpien instable.

Although a common orthopedic injury, the fractured distal radius continues to generate controversy with regard to treatment and its functional end-results. Since 1814, when Abraham Colles[1] first described the fracture named after him, numerous studies have attempted to analyse the functional end results of fracture management. Colles' initial paper[1] assured that whatever the form of treatment "...one consolation only remains, that the limb at some remote period will again enjoy perfect freedom in all its motions, and be completely exempt from pain". Despite this assurance, a number of authors have taken issue with Colles' original statement. Gartland and Werley[2] reported unsatisfactory results that correlated with the loss of the normal volar tilt of the distal radius. Bacorn and Kurtzke[3] reviewed over 2000 patients with distal radial fractures and identified a subset of patients who did poorly. They reported that the degree of dysfunction in patients with poor results was directly related to the amount of residual deformity. Scheck[4] agreed, noting that a poor anatomical result led to greater disability. Others have disputed these findings. Smaill[5] reported satisfactory results with less-than-adequate anatomical reduction. As recently as 1983, Rubinovich and Rennie[6] took the position that Colles was correct in his original assessment that at some time functional end-results of treatment would be satisfactory despite less-than-adequate reduction. Therefore, the controversy continues. Is anatomical reduction important in determining the end-result of treatment of distal radial fractures? In an attempt to resolve this controversy, an analysis of the results of healed extra-articular angulated apex volar fractures of the distal radius was undertaken.

The purpose of this paper is to find out if there exists a group of patients with poor end-results after a healed extra-articular apex volar fracture of the distal radius. If so, we intended to identify the etiologic factors involved and draw up guidelines that could serve as prognostic indicators for the final result of treatment.

Patients and Methods

One-hundred patients were treated at Victoria Hospital, London, Ont. between 1977 and 1982 for healed extra-articular angulated apex volar fractures of the distal radius. Twenty-nine (10 men, 19 women) agreed to return for a clinical and radiologic follow-up examination. Patients who had been treated in any fashion other than casting, with or without reduction, were excluded.

Clinical examination, performed on all patients by one of the authors (A.M.), consisted of both subjective assessment and objective testing. Subjective assessment included a questionnaire that made special reference to the presence of pain, feelings of weakness and functional limitation.

Based on the subjective questionnaire, the 29 patients (34 wrists) were assigned to one of four groups. Group 1 consisted of the contralateral, normal wrists of 24 of our patients and served as a control group. These 24 wrists were asymptomatic and had not sustained any previous injury. Group 2 included seven wrists with healed extra-articular angulated apex volar fractures of the distal radius. These wrists were asymptomatic and had no functional limitation. Group 3 comprised 11 wrists associated with mild to moderate symptoms including an occasional ache or pain but still allowing the patient to perform normal daily activities. Finally, in group 4 were 16 wrists that produced symptoms at rest. The patient had to modify work activities because of functional limitation, pain or weakness in the affected extremity.

Objective testing consisted of grip strength measurements with a Jamar dynomometer (Asimow Engineering Co., Los Angeles, Calif.) at all five levels and pinch strength assessed with a Bunnell pinch meter to assess key and tip pinch strength in both hands on each patient. Range of motion was recorded in both wrists in palmar and dorsiflexion and radial and ulnar deviation was recorded with a standard goniometer.

Radiologic examination of both wrists in all patients consisted of standard anteroposterior and lateral films, as well as stress films in radial and ulnar devia-

From the Victoria Hospital, The University of Western Ontario, London, Ont.

**Clinical associate professor, Division of Orthopedics, The University of Western Ontario, London*

†Resident, Division of Orthopedics, The University of Western Ontario

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Reprint requests to: Dr. J.H. Roth, 345 Westminster Ave., London, Ont. N6C 4V3

tion and in palmar and dorsiflexion. A clenched-fist posteroanterior view was also obtained.

Findings

The 29 patients ranged in age from 19 to 84 years at the time of follow-up (mean 59.2 years). The mean ages of patients in groups 2 and 3 were 47 and 57 years respectively. Patients in group 4 had the highest mean age (65.6 years) (Fig. 1). Fourteen wrists were dominant. Follow-up averaged 30.7 months (range from 17 to 134 months).

The mean range of motion decreased from group 2 to group 4 (Fig. 2). Grip and pinch strength were reduced in all fractured wrists when compared to the contralateral normal wrists (Figs. 3 and 4). Patients in group 4 had the greatest reduction in grip and pinch strength.

Three radiologic parameters were associated with the poor end-results: ulnar variance, radial angle and volar tilt. The greatest aberrations from normal occurred in group 4 wrists. No difference was noted in the scapholunate angle and there was no evidence of scapholunate dissociation in any of the patients.

Mean ulnar length, as seen on the posteroanterior view, was −0.6 mm. In the group 4 patients the mean side-to-side difference in ulnar length was +3.05 mm

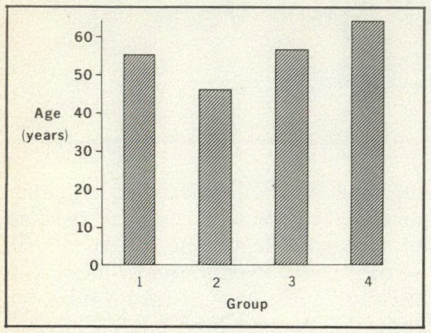

FIG. 1—Mean age greatest in those with poorest subjective results.

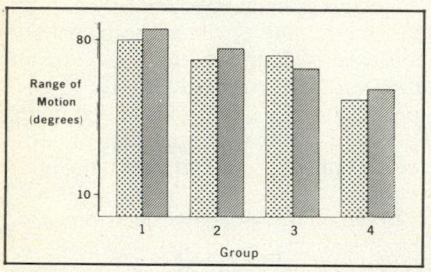

FIG. 2—Mean range of motion was less and side-to-side difference greater in more symptomatic patients. Dotted bars = palmar flexion, hatched bars = dorsiflexion

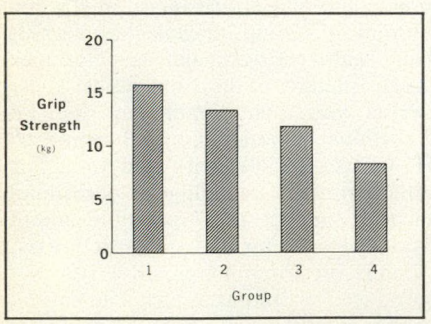

FIG. 3—Mean grip strength, as measured at level 2 on Jamar dynomometer.

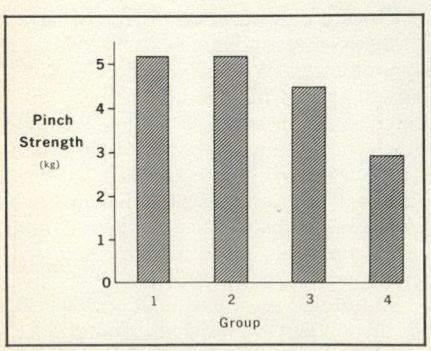

FIG. 4—Mean key pinch strength is diminished in more symptomatic patients.

Table I—Ulnar Length

Group	Mean side-to-side difference, mm
1	Normal
2	+0.50
3	+0.64
4	+3.05

Table II—Radial Angle

Group	Mean reduction from normal, °
1	Normal
2	1.5
3	4.7
4	7.5

Table III—Volar Tilt

Group	Mean loss of volar tilt, °
1	Normal
2	8.50
3	12.90
4	18.30

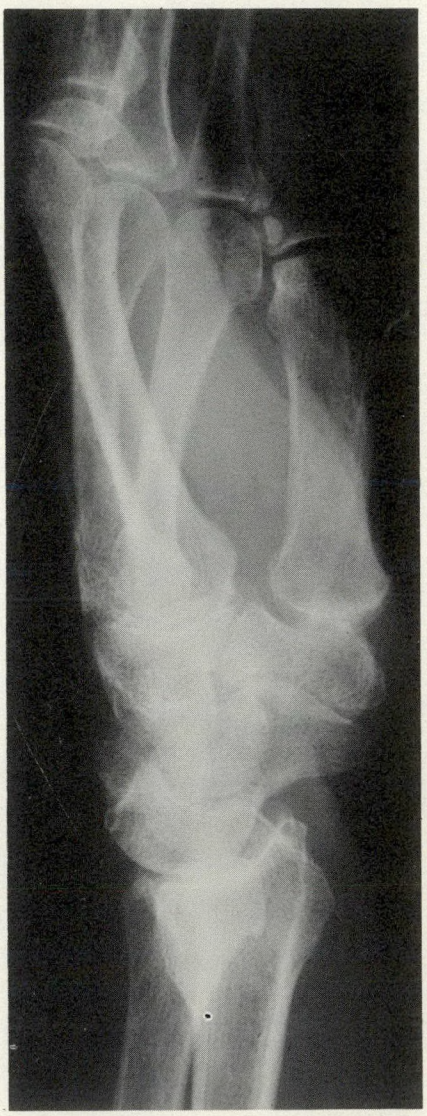

FIG. 5—Radial fracture. Note angulation apex volar at lunocapitate articulation. Lunate is volar-flexed with respect to radius.

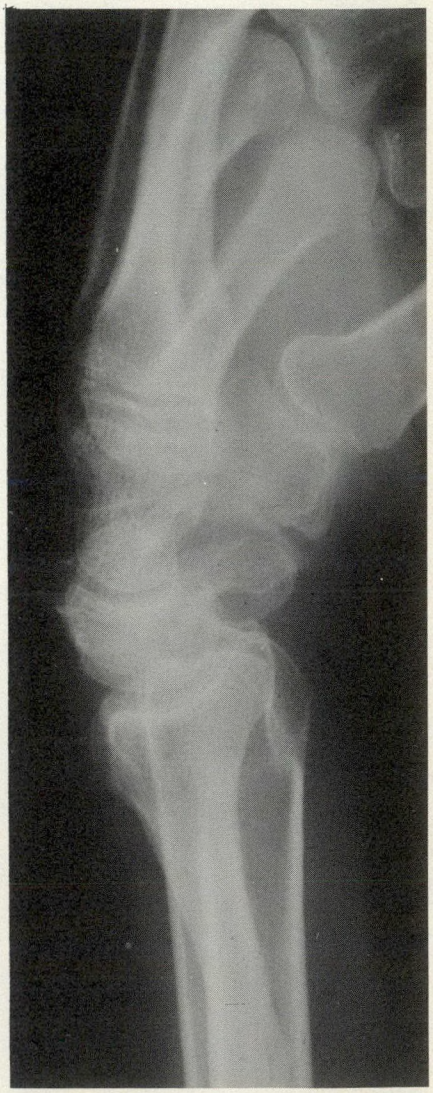

FIG. 6—Healed radial fracture. Lunate is volar-flexed with respect to distal radius. Note angulation apex dorsal at lunocapitate articulation.

(Table I). Shortening and radial deviation results in a diminished radial angle. The largest mean reduction in the radial angle of 7.5° occurred again in group 4 wrists (Table II).

The normal attitude of the distal radius, as seen on the lateral view, is approximately 10° of volar angulation.[7] The group 4 patients exhibited the largest mean loss of volar tilt of 18° when compared with the normal wrists (Table III).

Interestingly, 9 of 16 patients in group 4 demonstrated increased angulation at the midcarpal articulation (Figs. 4 and 5).

Discussion

The fact that the majority of patients sustaining distal radial fractures have good results is not disputed. However, this review demonstrated that a group of patients with poor subjective and objective results does exist.

As in previous studies,[2-4] anatomical reduction seems to be the key factor in determining the final result. Ulnar variance, radial angle and loss of volar tilt are all a good measure of the adequacy of reduction. Taleisnik and Watson[8] reported 13 cases of malunited fractures of the distal radius with associated midcarpal instability and suggested that this resulted from the loss of normal palmar tilt of the distal radius that disrupts normal radiocarpal mechanics. Whether this instability is a result of compensatory realignment or of ligamentous disruption is unknown but requires further study because midcarpal instability may be a factor in patients with poor end-results.

Conclusions

A group of patients exists in which poor subjective and functional results occur after treatment of extra-articular apex volar fractures of the distal radius. The adequacy of reduction seems to be the most important factor in assuring good results.

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This list is an acknowledgement of books received. It does not preclude review at a later date.

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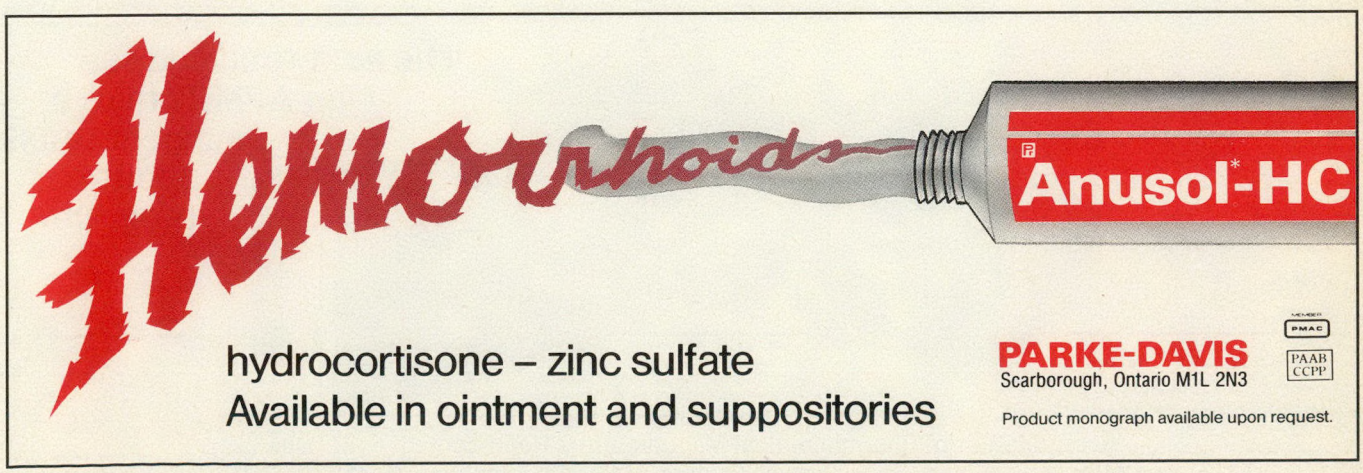

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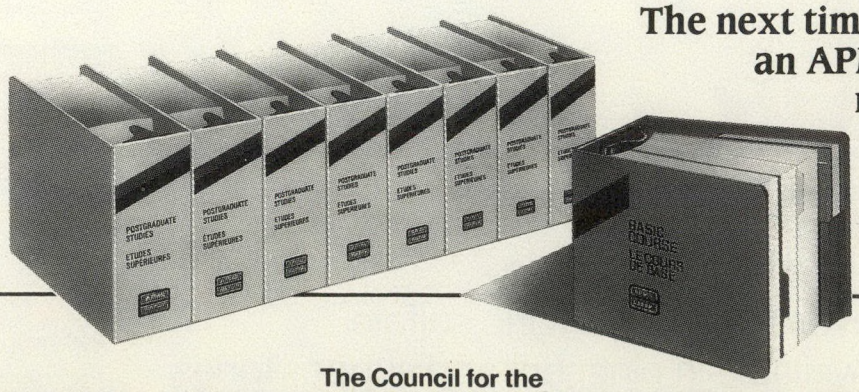

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In-Vivo Comparison of Four Absorbable Sutures: Vicryl, Dexon Plus, Maxon and PDS

Absorbable sutures are initially equal or superior to nonabsorbable sutures in terms of tensile strength but are absorbed at variable rates by the action of hydrolysis. This study demonstrated that the in-vivo half-life tensile strength of the braided absorbable sutures polyglycolic acid (Dexon Plus) and polyglactin 910 (Vicryl) is 2 weeks, whereas those of the monofilament absorbable sutures polyglyconate (Maxon) and polydioxanone (PDS) are 3 and 6 weeks respectively. The addition of a single hitch or six knots reduced the in-vitro tensile strength by 30% to 35%. Polyglyconate (Maxon) suture demonstrated the best in-vitro knot security.

Au début, les sutures résorbables sont égales ou supérieures aux sutures non résorbables en matière de force de tension, mais elles sont absorbées par voie d'hydrolyse à des vitesses qui varient. Cette étude démontre que la demi-vie in vivo de la force de tension des sutures résorbables tressées faites d'acide polyglycolique (Dexon Plus) et de polyglactin 910 (Vicryl) est de 2 semaines, alors que celles des sutures résorbables faites de monofilament de polyglyconate (Maxon) et de polydioxanone (PDS) sont respectivement de 3 et 6 semaines. L'addition d'un seul ou de six noeuds réduit la force de tension in vitro de 30% à 35%. Les sutures de polyglyconate (Maxon) montrent in vitro la sécurité la plus grande sur le plan des noeuds.

The strength of a healing wound is important to the practising surgeon, as it may mean the difference between the success or failure of a given procedure. The rate of healing is related not only to the structure involved but also to local and general factors.[1] In a clean incised wound, the fundamental purpose of suture placement is to oppose the wound edges until healing has progressed sufficiently that normal tensile forces can be withstood. Relatively vascular tissues such as skin, subcutaneous tissue and muscle heal relatively quickly compared with ligaments and tendons. The use of inappropriate suture material might lead to dehiscence of an abdominal incision, wound breakdown of a repaired rotator cuff tear or patellar subluxation following a total knee replacement.

Historically, nonabsorbable sutures have played an important role in the development of surgical procedures. Local reaction to many of these sutures prompted the development of absorbable sutures,[2–8] which disintegrate at variable rates by the action of hydrolysis. Braided, absorbable sutures such as polyglycolic acid (Dexon Plus; Davis & Geck, Willowdale, Ont.) and polyglactin 910 (Vicryl; Ethicon Ltd., Peterborough, Ont.) have become the standard.[2,4,9–12] Their rapid hydrolysis has led to the development of monofilament absorbable sutures such as polyglyconate (Maxon; Davis & Geck) and polydioxanone (PDS; Ethicon),[13,14] which provide a smaller surface area for hydrolysis and hence retain their tensile strength longer.

Our objectives were to compare the in-vitro and in-vivo tensile strengths of four of the most commonly used absorbable sutures (Vicryl, Dexon Plus, Maxon and PDS). Although tensile strength is an important determinant in the success or failure of a given suture, it was recognized that stress raisers (i.e., hitches) and knot security were other important factors.[15] We, therefore, decided to study these factors as well.

Materials and Methods

In-Vitro Tensile Strength

Dry, unused sutures.—Tensile testing was performed on four 0-gauge nonabsorbable sutures (polypropylene [Prolene; Ethicon], silk and two polyesters [Ethibond; Ethicon, and Ti-Cron; Davis & Geck]) and the four 0-gauge absorbable sutures chosen, by looping the sutures around capstans and applying tension with an MTS no. 858 Bionix test system (MTS, Minneapolis, Minn.) (Fig. 1). A crosshead speed of 1 mm/s to the point of suture breakage was used. Each test suture was 20 cm long, but the actual length between the capstans around which the sutures were wrapped twice was 5 cm. Ten sutures were tested in each subgroup to obtain a standard deviation for each suture's tensile strength. Tensile strength was recorded in newtons.

Absorbable sutures in normal saline for 24 hours.—The four absorbable sutures were immersed in a normal saline solution for 24 hours at room temperature. They were then subjected to the same tensile strength testing as demonstrated in Fig. 1.

Absorbable sutures with knots.—The

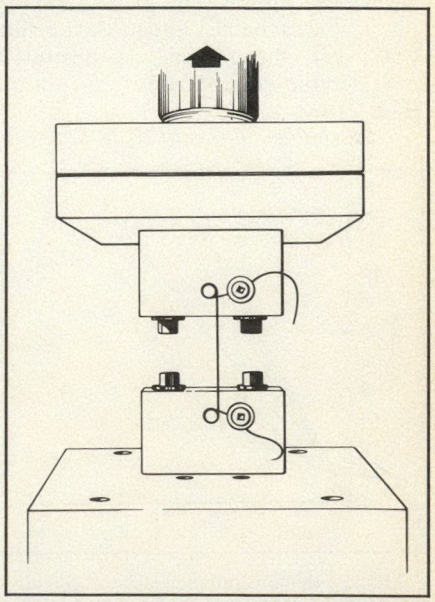

FIG. 1—Capstan method of tensile testing on MTS no. 858 Bionix testing machine. Each 20-cm suture had 5-cm test length between two capstans.

From the Division of Orthopedic Surgery, University Hospital, The University of Western Ontario, London, Ont.

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Reprint requests to: Dr. R.B. Bourne, University Hospital, PO Box 5339, Station A, London, Ont. N6A 5A5

four absorbable sutures were divided into four subgroups of 10 sutures. A single hitch was placed at the midpoint of each suture and the tensile testing repeated. This process was repeated both for dry and wet sutures.

To assess knot security, the absorbable sutures were transected then joined with four, five and six square knots. Each group consisted of 10 sutures. The tests were performed with the sutures both dry and wet. Tensile testing was performed as before with the knot at the midpoint between the capstans.

In-Vivo Tensile Strength

We used five female, adult, New Zealand, white rabbits weighing a mean of 2 kg each. Four suture bundles, each containing 10, 20-cm lengths of one of the four suture types, were placed in the dorsal subcutaneous space of each rabbit. At weeks 1, 2, 3, 4 and 6, the dorsal incisions were reopened and the suture bundles removed. The sutures were placed in normal saline while in transit from the animal operating room to the orthopedic research laboratory. Tensile testing as demonstrated in Fig. 1 was performed on the sutures within 2 hours of harvesting.

Results

In-Vitro Tensile Strength

Dry, unused sutures.—Tensile testing of dry, unused sutures revealed that the strongest was Maxon (106 N) followed by Vicryl, Dexon Plus and PDS. Nonabsorbable sutures were not superior to absorbable sutures. Silk and Prolene had only about 50% of the tensile strength of absorbable sutures (Fig. 2). The monofilament absorbable sutures (Maxon and PDS) and the Prolene demonstrated considerable elongation before rupture (Fig. 3).

Absorbable sutures after 24 hours in saline.—Soaking in normal saline for 24 hours reduced the tensile strength of each absorbable suture by 4% to 13% (Fig. 4).

Absorbable sutures with knots.—The placement of a single hitch at the midpoint of an absorbable suture reduced the tensile strength of each suture, whether dry or wet, by 30% to 35%. Interestingly, this reduction in tensile strength was similar to that of the various sutures with six knots (Fig. 5).

Polyglactin 910 (Vicryl) and polyglycolic acid (Dexon) demonstrated poor knot security when tested dry. Knot holding power was enhanced when they were wet (Fig. 5). Polyglyconate (Maxon) sutures demonstrated superiority over the other sutures tested in terms of knot security. Testing sutures with four or five knots was associated with a large standard deviation owing to occasional knot insecurity. The use of six knots gave the most consistent results.

In-Vivo Testing

Figure 6 demonstrates the tensile strength of the four absorbable sutures studied in vivo from weeks 1 to 6. The braided absorbable sutures, Dexon Plus and Vicryl, had lost approximately one-half of their tensile strength by 2 weeks and had virtually no tensile strength by 4 weeks.

The monofilament absorbable sutures Maxon and PDS demonstrated longer half-lives in terms of tensile strength. Whereas Maxon started out with greater tensile strength, by 3 weeks it was much inferior to PDS. This trend continued. By

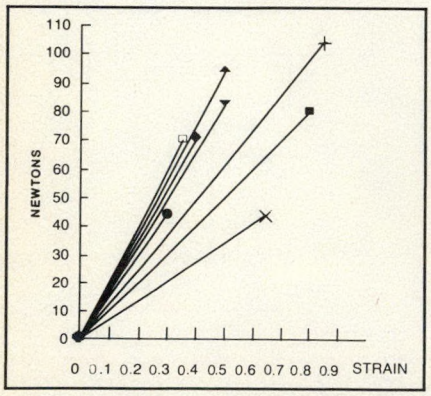

FIG. 3—Demonstration of stiffness and ultimate tensile strength of sutures tested (crosshead speed 1 mm/s). Absorbable sutures: ▲ = Vicryl, ▼ = Dexon Plus, + = Maxon, ■ = PDS. Nonabsorbable sutures: □ = Ethibond, ◆ = Ti-Cron, • = silk, × = Prolene.

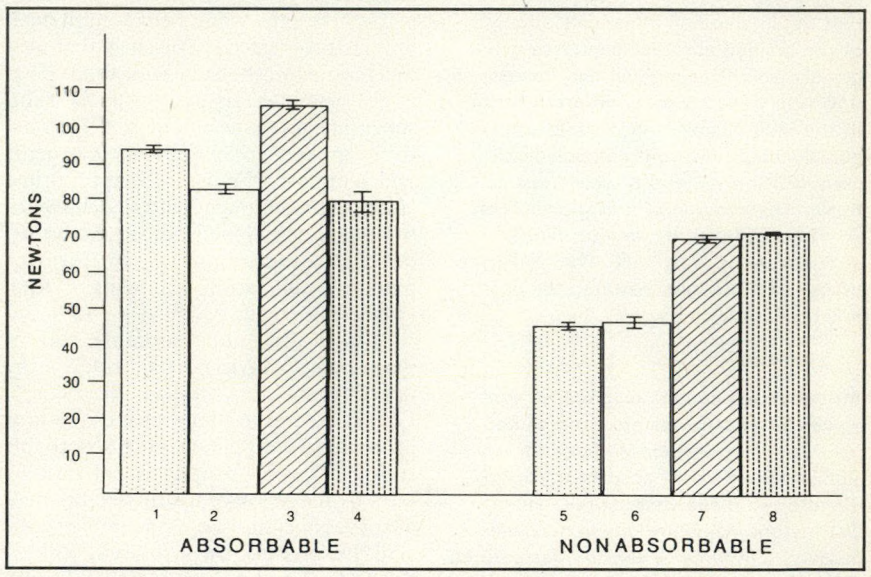

FIG. 2—Tensile strength of dry unused absorbable and nonabsorbable sutures (crosshead speed 1 mm/s). 1 = Vicryl, 2 = Dexon Plus, 3 = Maxon, 4 = PDS, 5 = Prolene, 6 = silk, 7 = Ethibond, 8 = Ti-Cron.

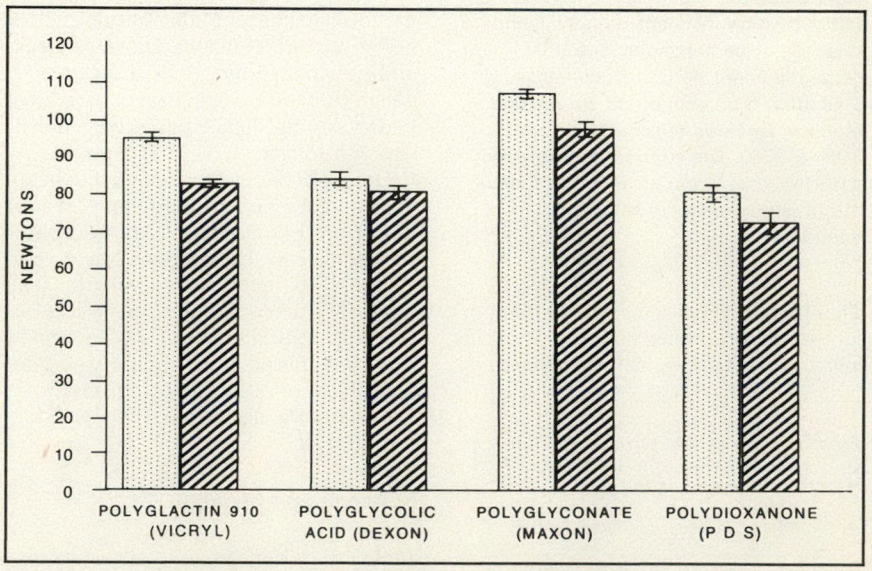

FIG. 4—Tensile strength of absorbable sutures before (dotted bars) and after (hatched bars) soaking in normal saline for 24 hours (crosshead speed 1 mm/s).

6 weeks, Maxon had virtually no tensile strength whereas PDS retained about 50% of its tensile strength (Fig. 6).

Discussion

The purpose of any suture material is to oppose wound edges until the wound is strong enough to withstand the tensile forces to which that structure is normally subjected. It is well known that various tissues heal at different rates, depending upon such factors as local blood supply and the structure involved. Braided, nonabsorbable sutures such as polyglactin 910 (Vicryl) and polyglycolic acid (Dexon Plus) should be used only when sufficient healing can be expected within 2 weeks (i.e., for subcutaneous tissue and subcuticular skin closure). When wound healing will likely take more than 2 weeks, a nonabsorbable suture or one of the monofilament absorbable sutures (Maxon or PDS) should be chosen. Maxon is appropriate when approximately 3 weeks' healing is required, whereas PDS seems more appropriate for cases requiring up to 6 weeks for wound healing (e.g., rotator cuff repairs).

In the in-vivo tests, we measured only the tensile strength of intact absorbable sutures. We did not test the knot characteristics of these sutures. Hitches and knots have a marked effect on the tensile strength of sutures and the in-vivo influence on these would be of interest. In-vitro, polyglyconate (Maxon) seemed to have enhanced knot characteristics.

From the findings of this study, we believe that a number of statements can be made.

- Unused, absorbable sutures are equal or superior to nonabsorbable sutures in terms of tensile strength.
- Tensile strength of absorbable sutures will be reduced by 4% to 13% with 24 hours of soaking in normal saline.
- The addition of one hitch or six knots will reduce the tensile strength of absorbable sutures by 30% to 35%.
- The most consistent knot security was achieved when six square knots were used to tie the braided or monofilament absorbable sutures.
- Polyglyconate (Maxon) sutures demonstrated the best in-vitro knot security.
- The half-life, in terms of tensile strength, of the absorbable sutures studied was 2 weeks with polyglycolic acid (Dexon Plus) and polyglactin 910 (Vicryl), 3 weeks with polyglyconate (Maxon) and 6 weeks with polydioxanone (PDS).

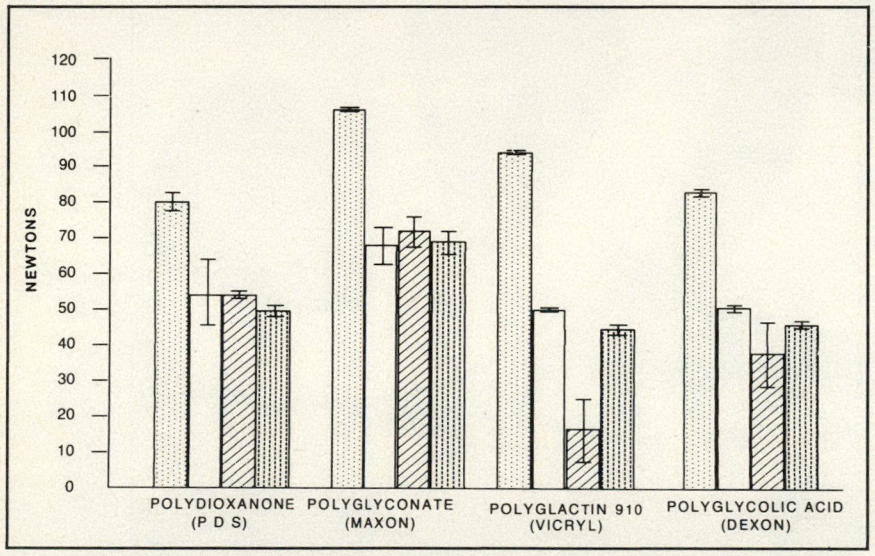

FIG. 5—Effect of single hitch and six knots on suture tensile strength in vitro (crosshead speed 1 mm/s).

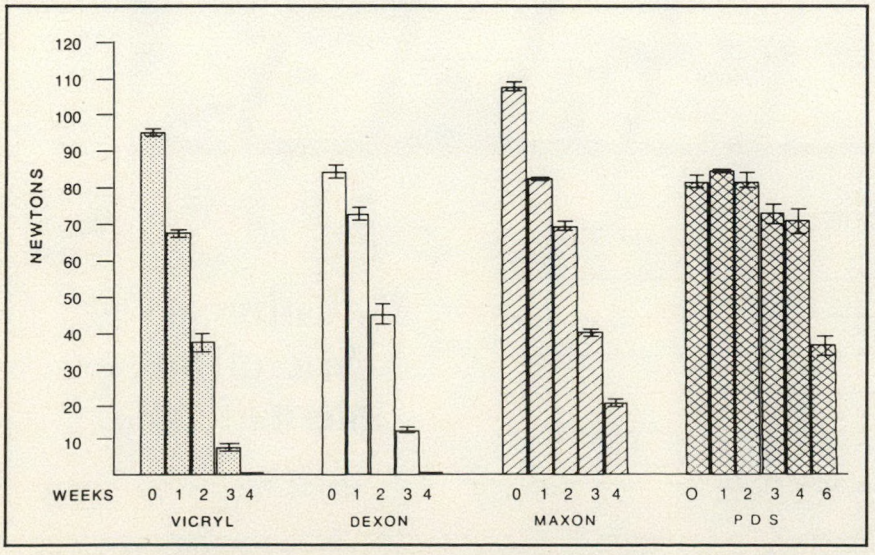

FIG. 6—Tensile strength of Vicryl, Dexon Plus, Maxon and PDS sutures in vivo after 1 to 6 weeks' implantation.

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DOUGLAS R. WALKER, MD, FRCPC;* RICHARD N. RANKIN, MB, CH B, FRCR, FRCPC;*
COLIN ANDERSON, MD, FRC PATH, FRCPC;† MICHAEL G. ROCK, MD, FRCSC‡

Giant-Cell Tumour of the Sacrum in a Child

Giant-cell tumours rarely are seen in children before epiphyseal fusion occurs and such tumours in the spine are uncommon. The authors report the case of a giant-cell tumour of the sacrum that developed in a 12-year-old girl before epiphyseal fusion. Embolization with activated microfibrillar collagen relieved her symptoms and was carried out twice before progression of the tumour necessitated radiotherapy. Giant-cell tumours of the spine are particularly difficult to manage since the accepted treatment for such tumours at other sites is wide resection, excisional curettage or surgical curettage with chemical cautery. However, embolization alone or combined with other methods of treatment is valuable, particularly in non-resectable giant-cell tumours of the spine.

Il est rare qu'on observe une tumeur à cellules géantes chez l'enfant avant que ne survienne la fusion des épiphyses et il est également rare qu'une telle tumeur soit localisée au niveau de la colonne vertébrale. Les auteurs décrivent une tumeur à cellules géantes qui est apparue au niveau du sacrum chez une fillette de 12 ans, avant la fusion des épiphyses. L'embolisation à l'aide de collagène microfibrillaire activé a permis, à deux reprises, de soulager les symptômes avant que la tumeur ne progresse au point de nécessiter de la radiothérapie. Les tumeurs à cellules géantes de la colonne sont particulièrement difficiles à traiter puisque les tumeurs de ce type exigent habituellement une résection large, un curetage excisionnel ou un curetage chirurgical avec cautérisation chimique. Néanmoins, l'embolisation seule ou associée à d'autres méthodes de traitement est utile, particulièrement dans le cas de tumeurs à cellules géantes de la colonne, non résécables.

Giant-cell tumours occurring before epiphyseal fusion takes place are rare. They occur uncommonly in the spine and in this site are difficult to treat. We report a case of a child who had a giant-cell tumour in the sacrum prior to epiphyseal fusion.

Case Report

A 12-year-old girl had a 9-month history of bilateral lower extremity and lower back pain originally treated as sciatica with analgesics. X-ray films at the time of admission to another hospital showed extensive destruction of the sacrum by an expansile lesion (Fig. 1). Retrospective analysis of films obtained 4 months earlier showed loss of the anterior spinal line. A computed tomogram at the time of admission showed a large sacral and pelvic mass with cortical expansion and destruction. In the belief that this was an intrapelvic tumour, a laparotomy was performed. Biopsies taken from the large cystic mass were not diagnostic. The patient was transferred to our hospital in July 1986, at which time she had a 4-week history of urinary incontinence and decreased sensation in the plantar aspect of the right foot. She had lost 5.5 kg and had secondary amenorrhea. Objectively there was mild weakness of quadriceps and hamstring muscles bilaterally with absence of right ankle and knee reflexes. Urinary tract infection was present, the urinary bladder was grossly distended and hypotonic with a large residual volume.

Biopsy through a posterior approach was again not diagnostic. On Aug. 4, 1986 a third operative biopsy was obtained under general anesthesia. The material was decalcified, embedded in paraffin and processed for routine histologic examination. The features of this lesion were typically those described by Mirra and colleagues[1] and correspond to those considered by Jaffe[2] as a low-grade lesion. Other tumours of bone and soft tissues that could have been confused with the present one histologically were considered in the differential diagnosis but were easily ruled out, and giant-cell tumour of bone was confirmed (Fig. 2). Biochemical and hematologic test results indicated no abnormalities with the exception of normochromic normocytic anemia. Bone scanning did not reveal any other lesions.

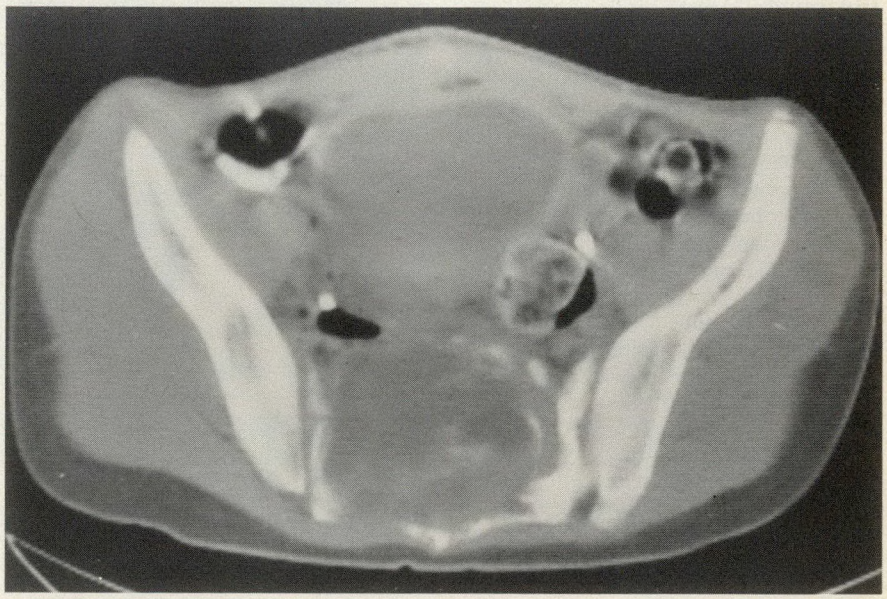

FIG. 1—Computed tomogram of pelvis through sacroiliac joints at time of initial presentation shows large sacral tumour causing cortical expansion and destruction. There is inhomogeneity of soft-tissue component, likely due to tumour necrosis and cyst change.

*From the *Department of Diagnostic Radiology, †Department of Pathology and ‡Division of Orthopedic Surgery, University Hospital, The University of Western Ontario, London, Ont.*

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Reprint requests to: Dr. Richard N. Rankin, Radiology Department, University Hospital, PO Box 5339, Station A, London, Ont. N6A 5A5

On Aug. 11, 1986, abdominal aortography and selective internal iliac angiography were performed under general anesthesia. Embolization of branches of both the internal iliac arteries and the median sacral artery was performed using activated microfibrillar collagen (Avitene; Alcon Canada Inc., Mississauga, Ont.). A small amount of tumour blush remained after the procedure. The patient did not complain of pain or fever after embolization. Subjectively there was improvement in the lower extremity weakness and better bladder control with decreased residual volumes.

The girl did well until October 1986 when she experienced increased discomfort in her left leg after a fall. Palpation of the sacrum elicited pain. Computed tomography showed a slight increase in the size of the mass and some peripheral calcification, particularly anteriorly. Angiography showed a return of some of the tumour vascularity, and embolization using Avitene was repeated into selected internal iliac and median sacral branches.

Repeat computed tomography 2 months later showed no increase in the intrapelvic portion of the tumour, but there was an increase in size posteriorly with further loss of bone. On Dec. 29, 1986, before the girl received radiotherapy, bilateral oophoropexy was carried out to preserve ovarian function. With a cobalt unit, three-field radiation was applied to cover the sacrum from L5 to the tip of the coccyx and to include both sacroiliac joints. A total dose of 4000 rad (40 Gy) was given between Jan. 5, 1987 and Feb. 10, 1987. After this, the bulging mass over the sacrum decreased in size and urinary incontinence improved.

At follow-up in April 1987 the patient was active, pain free and continent of urine. However, straight-leg raising was limited to 35° and there was bilateral wasting of leg muscles. Computed tomography showed regression of the posterior bulge with increased calcification within the remaining tumour mass (Fig. 3).

In July 1987, 1 year after initial treatment, further calcification was seen in the tumour, and the only remaining neurologic deficit was mild residual urinary incontinence.

Discussion

Giant-cell tumour in children before epiphyseal fusion is uncommon. Picci and associates[3] reviewed the literature and found a rate of 1.7% (20 lesions in 1162 cases). They added six new cases from their experience of 326 tumours. Eftekhari and colleagues[4] reported two further cases of giant-cell tumour in children, making the reported number 28. Giant-cell tumour is uncommon in the spine, being seen in only 3.2% of giant-cell tumours.[5] Recently Dahlin[6] reported 33 cases in the sacrum from his experience of 407 cases. Smith and colleagues[7] reported 13 giant-cell tumours of the sacrum in 200 cases, and they stated that this is the most common location after the long bones. They also found it to be the most common benign tumour of the sacrum in their series.

Tumours of the sacrum are difficult to manage. The accepted treatment for giant-cell tumour is surgical curettage with chemical cautery, or excisional curettage or wide resection. Lower recurrence rates are found in those who have undergone a wide resection.[8] Surgical therapy can be carried out in the vertebrae, and Sung and associates[9] reported total excision of the sacrum with placement of a large homograft in one patient. This patient also received radiotherapy and had residual sphincter disturbance, gait abnormality and amenhorrea after the procedure. Smith's group[7] used radiotherapy or partial excision with radiotherapy in their patients with nonresectable tumours of the sacrum. They reported a recurrence in 7 of their 13 patients with five deaths due to the disease or complication of the treatment.

Chuang and associates[10] reported the use of intra-arterial embolization with Gelfoam and spring coils in eight patients with giant-cell tumour and two with combined giant-cell tumour and aneurysmal bone cyst of the pelvis, both of which were unresectable. These had been assessed as nonresponding tumours at least 6 weeks after radiotherapy or chemotherapy. Pain was relieved in seven patients and calcification increased, sig-

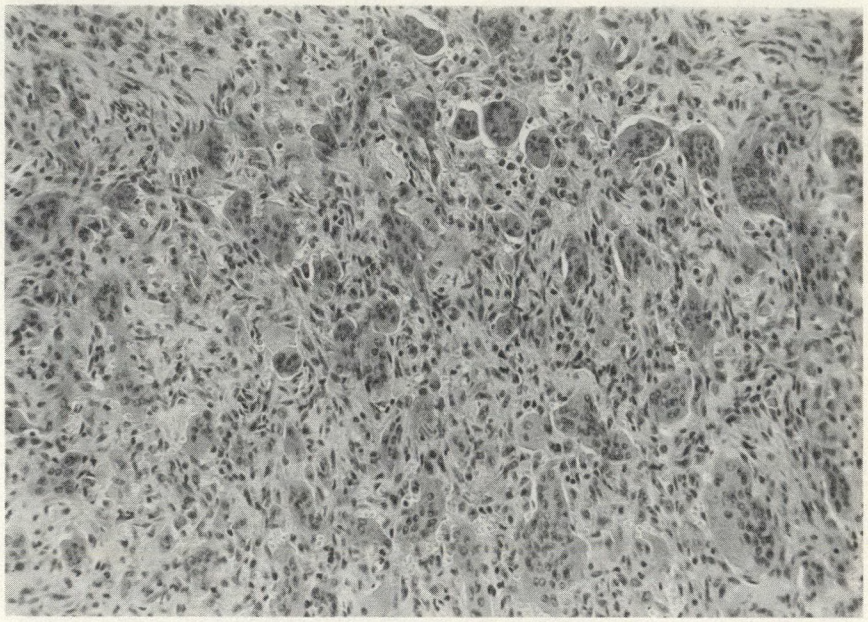

FIG. 2—Histologic features of biopsy specimen obtained on Aug. 4, 1986 (hematoxylin and eosin, original magnification × 250). Low-grade neoplastic giant-cell tumour. Figure shows mononuclear stromal cells with diffuse and homogeneous sprinkling of giant cells. There is no histologic or cytologic feature indicative of aggressive growth.

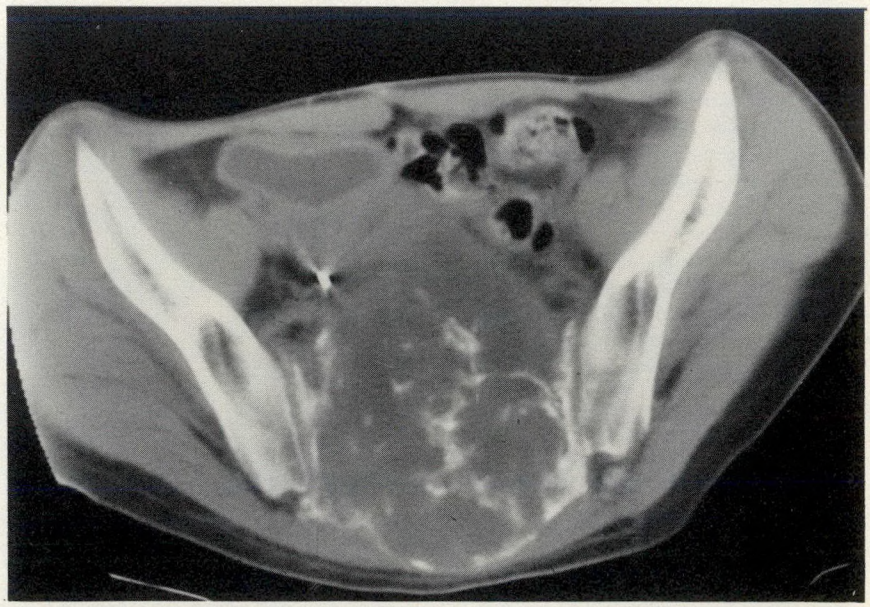

FIG. 3—Computed tomogram through pelvis at level of sacroiliac joints 8 months after presentation shows increase in size of sacral mass anteriorly that had been noted in December 1986. However, there has been regression of posterior extension of tumour. There is also increase in calcification within tumour.

nifying healing, in five patients. Four of these five patients had giant-cell tumours without aneurysmal bone cyst. Eftekhari and colleagues[4] reported on two girls aged 12 and 15 years. The 12-year-old girl had a giant-cell tumour of the L4 vertebral body, previously reported by Chuang and colleagues.[10] She underwent decompressive laminectomy as well as chemotherapy with methotrexate and Adriamycin, followed by 5000 rad (50 Gy) of radiotherapy. Failure to control the tumour prompted arterial embolization of the lumbar arteries at L4 and L5 with Gelfoam and spring coils, with lessening of the pain, regression of the mass and rim calcification. Embolization of the right superior gluteal artery was repeated 2 years later with Ivalon when the mass appeared to be slightly larger. Six months after this she had full range of activity with no pain and no neurologic deficit. The second patient had an aneurysmal bone cyst with giant-cell components in the sacrum that recurred after resection. Over 9 months she received cisplatinum therapy intra-arterially then embolization with Ivalon, Gelfoam and spring coils in three sessions to occlude the branches of the internal iliac and middle sacral arteries as well as the fourth lumbar arteries. Additional cisplatinum was given intra-arterially on four occasions. Follow-up at 9 months after the first cisplatinum infusion showed increased calcification of the mass and apart from minimally decreased strength of the right hamstrings, no neurologic deficit was present. Feldman and associates[11] reported the use of intra-arterial embolization preoperatively to control hemorrhage in a patient with multiple giant-cell tumours.

Radiotherapy for giant-cell tumours has been related to increased malignant transformation. Giant-cell tumours are also relatively radioresistant.[10] Sarcoma can complicate these tumours in approximately 10% of cases. A recurrence rate of approximately 50% follows irradiation.[10]

We used activated microfibrillar collagen as the embolization material in our patient. It is a nonpermanent occlusion material, being resorbed after approximately 1 month. We thought that with complete occlusion radiologically, tumour necrosis would take place, but because of the absorbable nature of the material, repeat embolization would be possible if necessary. There was initial relief of symptoms and some increased calcification within the tumour mass after embolization. Unfortunately the tumour progressed posteriorly and it was decided to offer radiotherapy to control this symptomatic extension. There appears to have been further healing following the radiotherapy and the patient was doing well 8 months after the first embolization.

Symptoms from giant-cell tumour growth may be relieved by embolization, which can be combined with other methods of therapy. This may be important in the treatment of nonresectable giant-cell tumours of the spine.

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S. TADROS, MD, FRCSC;* J.M. WATTERS, MD, FRCSC

Retroperitoneal Perforation of the Rectum During Barium Enema Examination

Colorectal perforation during barium enema examination is rare. The authors report the case of an 84-year-old woman in whom retroperitoneal perforation of the rectum occurred during barium enema examination. Potential mechanisms of injury include trauma, overinflation of the balloon, recent instrumentation and associated disease of the rectal mucosa. When the colon has been well prepared before examination, and air alone, not barium, has been insufflated into the retroperitoneum, then such injuries may be managed successfully without operation, as in this case.

Il est rare qu'on assiste à une perforation du côlon ou du rectum au cours d'un lavement baryté. C'est ce que décrivent les auteurs, cas survenu chez une femme de 84 ans qui subit une perforation rétropéritonéale pendant cet examen. Divers mécanismes peuvent être impliqués dont un traumatisme, un gonflement exagéré du ballonnet, un examen récent à l'aide d'instruments ou une maladie sous-jacente de la muqueuse rectale. Quand le côlon a été bien préparé pour l'examen et que de l'air seulement (nom du baryum) a été insufflé dans l'espace rétropéritonéal, comme ce fut le cas ici, de tels lésions peuvent alors être traités avec succès sans intervention chirurgicale.

The occurrence of perforation of the colon or rectum complicating barium enema examination is extremely low.[1,2] Perforation of the rectum may be free into the abdominal cavity or retroperitoneum. We describe the case of an elderly woman who suffered retroperitoneal perforation of the rectum during barium enema examination. The patient was successfully managed without operation.

Case Report

An 84-year-old woman with moderately severe ischemic and valvular heart disease underwent air-contrast barium enema for vague complaints of abdominal pain. After evacuation of the barium column and during

From the Department of Surgery, Faculty of Health Sciences, University of Ottawa, Ottawa Civic Hospital, Ottawa, Ont.

**Present address: Maelor General Hospital, Wrexham, Clwyd, Wales LL13 7TD, UK*

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Reprint requests to: Dr. J.M. Watters, Department of Surgery, Ottawa Civic Hospital, 1053 Carling Ave., Ottawa, Ont. K1Y 4E9

the insufflation of air, the patient experienced angina, which was relieved by sublingual administration of nitroglycerin. The radiologist noted the presence of air retroperitoneally on fluoroscopy so the examination was terminated. No other abnormality was noted.

When we assessed her condition approximately 6 hours later in the emergency department she had few symptoms. She had minor retrosternal discomfort and noted that her voice was higher pitched than normal. There was widespread subcutaneous emphysema, involving her entire trunk, neck and head. There was emphysema of her eyelids and initially she could not open her eyes fully. The patient was afebrile and not tachycardic. Her abdomen was soft and not tender. Bowel sounds were normal. No blood was noted on rectal examination. Other findings on physical examination were normal. Her leukocyte count was 11.4×10^9/L.

Rigid sigmoidoscopy with minimal insufflation of air showed a small (less than 1 cm) anterior laceration or puncture of the rectum at about 6 cm from the anal verge. The colon was empty of stool and there was little barium. The mucosa was normal. Diffuse retroperitoneal air, pneumomediastinum and subcutaneous emphysema were evident on plain abdominal and chest x-ray films (Fig. 1); no free intraperitoneal air could be identified. No other abnormality was noted on the barium enema films.

We decided to manage the patient nonoperatively for several reasons: there were no clinical signs of peritonitis several hours after the injury, nor were there radiologic indications of air or barium within the abdominal cavity; the colon had been well cleansed of stool before radiologic examination and it appeared that air only, and not barium, had been insufflated into the retroperitoneum; the operative risk related to the patient's cardiac disease was considered greater than the risk of infection when the patient's condition was closely monitored. The patient was admitted to hospital and assessed frequently by clinical examination. She was given nothing by mouth initially and received cefoxitin intravenously for 1 week. The subcutaneous emphysema resolved completely over 2 to 3 days and the patient was well at follow-up 1 month later.

Discussion

Most perforations related to barium enema examination occur in the rectum above the peritoneal reflection. Four mechanisms of injury have been suggested: (a) trauma from the enema tip; (b) overinflation of the balloon; (c) recent colonic instrumentation, especially associated with biopsy; (d) the presence of rectal mucosal disease such as cancer, diverticulosis or inflammatory bowel disease. The cause of the perforation in our patient is not certain, but traumatic insertion of the enema tip and inadvertent overinflation with air are the most likely causes.

Approaches to the management of rectal trauma in general have been influenced by wartime experience.[3] The treatment of high-velocity injuries includes laparotomy with closure of the perforation, complete diversion of the fecal stream by colostomy, distal rectal washout, presacral drainage and the use of broad-spectrum antibiotics. In general, similar principles apply to civilian injuries.[4,5]

Colorectal perforation during barium enema differs in several ways from other such trauma. Perforation may occur retroperitoneally, intraperitoneally and even into the portal circulation.[1] Injury to rectal mucosa only and the introduction of barium into the rectal wall may result in the formation of an intramural barium granuloma.[1,2] Barium within the abdominal cavity undergoes progressive aggregation, partial or complete phagocytosis and fibroblastic encapsulation with extensive adhesion formation.[6] In addition, barium acts as an adjuvant; that is, in combination with bacteria it accelerates the inflammatory response and the septic course of peritonitis.[7] Feces, bile and blood behave in a similar fashion. However, unlike these substances, barium rapidly disperses and forms tenacious adhesions to peritoneal and retroperitoneal surfaces. In view of these properties an aggressive operative approach to intraperitoneal perforation with barium spillage has been advocated, including copious saline irrigations and complete débridement of all the barium, with presacral drainage and a diverting colostomy.[8,9] Retroperitoneal barium instillation requires similar aggressive débridement.[10]

Retroperitoneal emphysema in the absence of a barium leak may follow a more benign course and may not require surgical intervention.[2,10,11] In contrast to unprepared bowel, prior mechanical cleansing of the colon and rectum usually greatly diminishes the bacterial inoculum. The majority of perforations related to barium enema are believed to be small, and the leakage of air probably stops spontaneously upon relief of the increased intraluminal pressure.[10] In the absence of symptoms the retroperitoneal air generally disperses within 2 weeks.[10]

The use of air-contrast examinations of the colon in place of single-contrast barium studies may result in colorectal perforations with air insufflation alone. As exemplified by our patient, nonoperative management of such injuries may be appropriate. Frequent clinical assessment must be made and surgical intervention carried out in the event of any deterioration in the patient's condition.

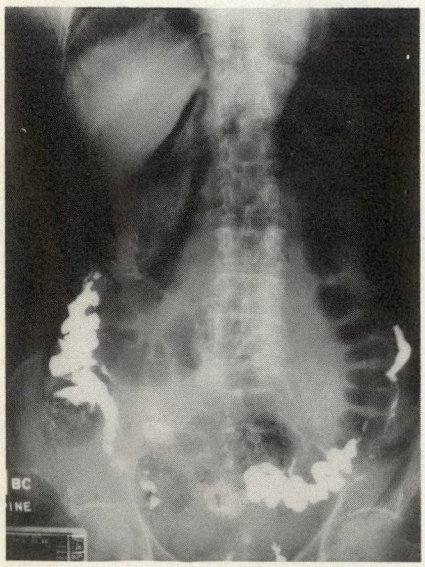

Fig. 1a

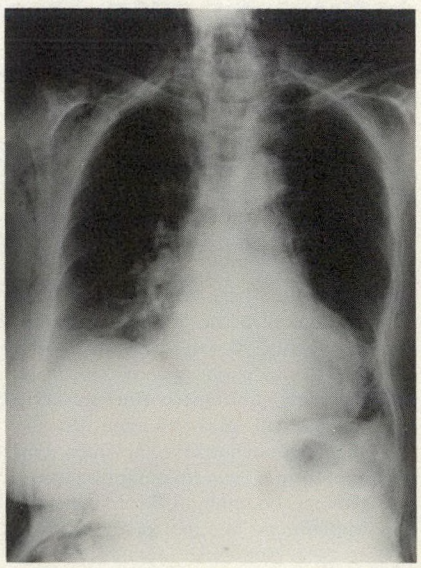

Fig. 1b

FIG. 1—Plain abdominal (a) and chest (b) x-ray films, taken several hours after perforation, demonstrate extensive subcutaneous emphysema and air in soft tissues. Right kidney is clearly outlined with air, and pleura is dissected off right hemidiaphragm.

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A.A. GIACHINO, MD, FRCSC; A.W. PROFITT, MD, FRCSC; W. TAINE, MD

Expected Contamination of the Orthopedic Surgeon's Conjunctiva

Likely contamination of a surgeon's conjunctiva by patients' body fluids is surprisingly frequent. Blood and fat are the most common agents but cellular implantation may occur. Possible contamination was documented in 37 of 60 orthopedic procedures. Power tools, hammering and the use of rongeurs are the main culprits in producing a forced spray most likely to cause contamination. Reduction of the hip at the time of replacement arthroplasty is often associated with propulsion of blood. Not a single case of possible contamination resulted from the pumping action of a severed vessel. Since orthopedic surgeons work in a high-risk environment, safety glasses are recommended to prevent contraction of viral diseases such as hepatitis B and acquired immune deficiency syndrome by way of the conjunctiva. The glasses will also protect the surgeon from bacterial and cellular conjunctival contamination, in addition to preventing physical damage secondary to propelled bone and cement.

La contamination probable de la conjonctive d'un chirurgien par les liquides organiques de ses patients est étonnamment fréquente. Le sang et les tissus adipeux sont les plus souvent impliqués mais des implantations cellulaires peuvent survenir. Sur 60 interventions orthopédiques, une contamination possible a été vérifiée dans 37 cas. L'utilisation d'outils électriques, de marteaux et de rugines, tous capables de provoquer des éclaboussures de tissus, est la principale cause de contamination. Lors d'une arthroplastie de la hanche, la réduction chirurgicale est souvent accompagnée d'un jet de sang. Aucun cas de contamination possible n'a été relié au sectionnement d'un vaisseau. Puisque le chirurgien orthopédique travaille dans un environnement à risque, le port de verres de sécurité est recommandé afin de prévenir l'acquisition via la conjonctive d'une maladie virale telle que l'hépatite B ou le syndrome d'immunodéficience acquise. Les verres servent aussi de barrière contre les contaminations conjonctivales bactériennes et cellulaires en plus de prévenir les lésions physiques consécutives à la projection d'os ou de ciment.

From the Department of Surgery, University of Ottawa, Ottawa General Hospital, Ottawa, Ont.

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Reprint requests to: Dr. A.A. Giachino, Ottawa General Hospital, 501 Smyth Rd., Ottawa, Ont. K1H 8L6

It is well recognized that hepatitis may be contracted by minute amounts of contaminated blood entering the body through a break in the skin, needle prick or through mucosal surfaces including the conjunctiva.[1–4] Multiple other infections occurring after conjunctival contamination have been documented,[5–7] including a fatal case of rabies contracted by a veterinary surgeon from blood splashed into his eyes while performing an autopsy.[8]

This study was undertaken to define the rate of likely macroscopic contamination of the conjunctiva by orthopedic surgeons during their work.

Method

In a prospective study of 60 cases, high-impact polycarbonate glasses (as used by squash players) were worn by all members of the surgical team for every orthopedic procedure, excluding arthroscopy. Contamination was recorded as present or absent by observing macroscopic blood or fat droplets on the lenses at the conclusion of each procedure. Initially, the quantity of contamination was assessed by estimating the size and number of spots, but this proved impractical and was abandoned. The perceived cause of the spray was recorded as was the composition of the contaminant.

Results

Thirty-seven of 60 consecutive cases were associated with contamination of the protective glasses. With two or more surgeons frequently present, there were 125 exposures in 60 procedures. In the 37 cases both surgeon and assistant were contaminated during the same procedure for a total of 59 contaminations. Power tools, hammers and rongeurs were the cause of forced spray in 35 cases; they were not used in the other 2. No power tool, hammer or rongeur was used in 16 of 23 "clean" cases. In one case of chondroma contamination, tissue was propelled from a curette. Fat droplets often appeared on the lenses in total knee replacement and bunion excisions, related to the use of an oscillating saw; blood droplets were most often associated with the use of a hammer or rongeur. Particulate matter was identified on glasses after the use of a rotary burr.

All total joint procedures were associated with lens contamination.

In 29 operations a tourniquet was used; 14 were associated with contamination, 15 were not.

Discussion

Conjunctival contamination is related to orthopedic instruments that spray body fluids at high speed. No case was recorded secondary to the relatively slow single spurt from a severed blood vessel.

After conjunctival contamination, the droplet or cell would be washed away by tears and carried down the nasolacrimal ducts to areas in the upper nasal passages where microorganisms might establish an infection.[8] The amount of contamination may be exceedingly minute; 1.0 ml of plasma from a person infected with hepatitis B proved infectious at a 10^{-7} dilution in a chimpanzee.[9] The surgeon should be aware that hepatitis B virus retains its infectivity even when the droplet has dried and after a prolonged period on a suitable environmental surface.[9] Rabies,[3] Newcastle disease,[6] Coxsackie B viral infection,[5] and hepatitis B[1–4] are a few examples of diseases acquired via the conjunctiva. No case of acquired immune deficiency syndrome contracted in this manner has yet been reported.

Orthopedic surgeons work in a high-risk environment and must protect themselves against conjunctival contamination

and the subsequent possibility of hepatitis B infection or AIDS.

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ALAIN VERDANT, MD, FRCSC;* ARTHUR PAGÉ, MD, FRCSC;* RICHARD BAILLOT, MD, FRCSC;* CLAIRE LAVOIE, MD, FRCPC†

Total Replacement of the Transverse Aortic Arch With the Gott Aneurysm Shunt

A new method of temporary external shunting for total replacement of the aortic arch is described. Its greatest advantage is that systemic heparinization is not required. In a 46-year-old man total body perfusion was achieved with two 9-mm Gott aneurysm shunts inserted between the ascending aorta and both femoral arteries. Blood supply to the brain was maintained with the cut halves of a 7-mm Gott shunt connected as side branches to one of the 9-mm shunts, allowing cannulation of both carotid arteries. The total cardiac output, measured at 4.7 L/min by the thermodilution technique through a Swan–Ganz catheter, was propelled through these preheparinized multibranch shunts. A flowmeter adapted on one of the 9-mm Gott shunts demonstrated a shunt flow of 2000 ml/min and it was deduced that the other 2700 ml of the total cardiac output was delivered by the other shunt. During the 29 minutes of cross-clamping, there was no change in the filling pressure of either the right heart (central venous pressure 5 cm H_2O) or the left heart (pulmonary wedge pressure 8 mm Hg). Aortic continuity was re-established with the interposition of a 34-mm tubular woven Dacron prosthesis, on which two 10-mm woven Dacron side branches were anastomosed to the innominate and left common carotid arteries. The patient had no neurologic deficit and had normal physiologic function of all other organs.

Les auteurs décrivent une nouvelle méthode de dérivation temporaire externe destinée au remplacement total de la crosse aortique. Son avantage majeur est l'exclusion complète de toute héparinisation systémique. Toute la perfusion du corps humain est assurée à coeur battant par l'intermédiaire de deux shunts de Gott no 9 introduits proximalement au niveau de l'aorte ascendante et distalement dans chacune des deux artères fémorales. Pour préserver l'irrigation du cerveau, les deux moitiés d'un shunt de Gott no 7 étaient jointes latéralement sur un des shunts de Gott no 9 et canulées distalement dans chacune des deux artères carotides primitives. La totalité du débit cardiaque, mesuré à 4.7 L/min par la méthode de thermodilution avec un cathéter de Swan–Ganz, fut ainsi dérivée à travers ce système de tubes pré-héparinisés. Un débit-mètre électromagnétique disposé sur l'un des shunts de Gott no 9, enregistra un débit de shunt de 2000 ml/min, permettant de déduire que le reste du débit cardiaque, soit 2700 ml/min était absorbé par le deuxième shunt de Gott no. 9. Durant les 29 minutes qu'a duré le clampage aortique, la pression veineuse centrale est restée à 5 cm de H_2O et la pression pulmonaire bloquée est demeurée à 8 mm Hg, démontrant toute absence de surcharge cardiaque droite et gauche. La reconstruction de la crosse aortique a été réalisée à l'aide d'une prothèse de Dacron tubulaire tissée de 34 mm interposée, sur laquelle avaient été préalablement anastomosées deux branches latérales de Dacron tissé de 10 mm, destinées respectivement au tronc innominé et à la carotide primitive gauche. Le patient se réveilla dès la fin de l'intervention chirurgicale sans aucune séquelle neurologique et l'analyse de certains paramètres vitaux permet la conclusion que la physiologie normale de tous les autres organes a aussi été préservée.

Extracorporeal circulation combined with hypothermic total circulatory arrest[1–3] has been widely adopted over the past 10 years as a method of physiologic support during resection of aneurysms of the transverse aortic arch. However, because

*From the *Department of Cardiovascular and Thoracic Surgery and the †Department of Anesthesiology, Hôpital du Sacré-Coeur, Université de Montréal, Montreal, PQ*

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Reprint requests to: Dr. Alain Verdant, Ste. 303, 12245, rue Grenet, Montréal, PQ H4J 2J6

hypothermia and systemic heparinization are needed, coagulopathy and hemorrhagic complications are still frequent.[4] Moreover, it remains to be demonstrated that this method assures optimal long-term protection of the brain without any further deterioration of the nerve cells.

In order to reproduce as closely as possible the physiologic conditions, we have perfected a new method of organ preservation. Perfusion of the body is assured by propelling the total blood volume through a sutureless temporary external bypass by a normally perfused beating heart under normothermic conditions. Systemic heparinization is not used. This sophisticated shunting device was constructed from the 9-mm Gott aneurysm shunt (Sherwood Medical Industries, St. Louis, Mo.) that we have already used in the resection of 175 descending thoracic aortic aneurysms and confirmed as a safe shunting procedure.[5]

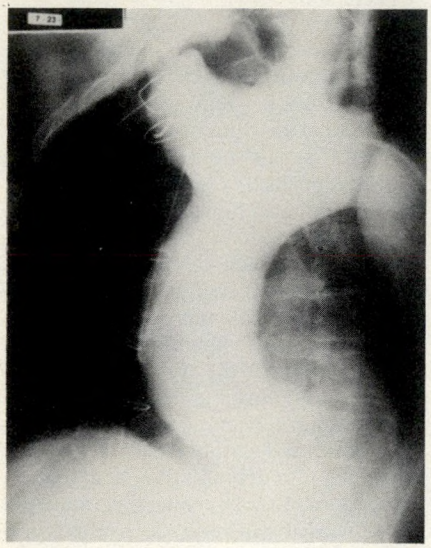

FIG. 1—Preoperative aortogram shows aneurysm of transverse aortic arch, involving origin of innominate and left common carotid arteries. Left vertebral artery originates separately from aortic arch and, like left subclavian artery, is not involved in aneurysm.

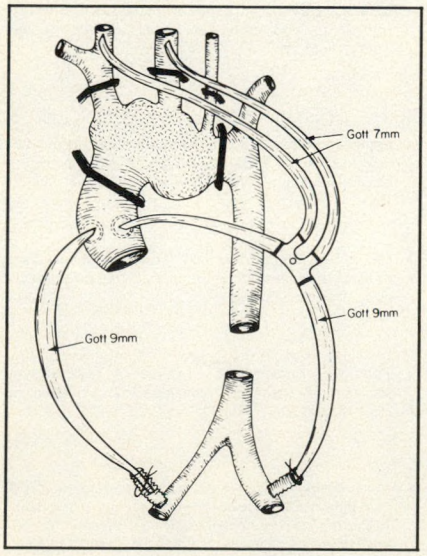

FIG. 2—Diagram of new temporary external shunting procedure proposed for total replacement of aortic arch. Two 9-mm Gott aneurysm shunts are inserted from ascending aorta to both femoral arteries through 10-mm woven Dacron prostheses previously anastomosed as side branch to each femoral artery. Circulation to brain is maintained with two halves of 7-mm Gott aneurysm shunt connected proximally to one of two 9-mm Gott aneurysm shunts and inserted distally into innominate and left common carotid arteries.

Case Report

A 46-year-old man was seen at another hospital for progressive dyspnea of 6 months' duration that had become severe. A chest x-ray film disclosed an anterior mediastinal mass believed to be a tumour. At exploration through a median sternotomy a thoracic aneurysm was found and the patient was referred to our institution for surgical treatment.

There was no history of trauma. A serologic test for syphilis gave positive results. Aortography (Fig. 1) revealed an irregular thoracic aneurysm 8 cm in dimension limited to the transverse aortic arch and involving the origin of both innominate and left carotid arteries. The ascending aorta was slightly enlarged but not aneurysmal. The left vertebral artery coming directly off the aortic arch and the left subclavian artery were not included in the aneurysm. A thoracic scanogram obtained with perfusion excluded any dissecting process and confirmed left tracheobronchial compression by the aneurysm.

Technique of External Shunting

The lesion was approached through a median sternotomy, and the incision was extended along the right sternocleidomastoid muscle border. The innominate vein was under excessive tension and had to be ligated for better exposure. The external shunt was constructed with two 9-mm Gott shunts and the two halves of a 7-mm Gott shunt (Fig. 2). Each groin was exposed and a 10-mm woven Dacron graft was anastomosed as a side branch on each femoral artery. This allowed retrograde perfusion of the upper body and also conserved distal perfusion of both lower limbs.

The right anterolateral side of the ascending aorta was cannulated with one of the 9-mm Gott shunts, through a double pursestring suture. The distal tip of the shunt was introduced into the 10-mm Dacron graft previously anastomosed to the right femoral artery. An electromagnetic flowmeter was adapted on the shunt as previously described.[6] The other 9-mm Gott shunt was inserted in the same manner from the left anterolateral side of the ascending aorta to the 10-mm woven Dacron graft previously anastomosed to the left femoral artery. A stainless-steel connector with two side branches was interposed between the two cut halves of this 9-mm shunt.

As described before,[7] the two side branches of the connector allowed branching of the two cut halves of a 7-mm Gott aneurysm shunt and the cannulation of each distal tapered end of this shunt into the right and the left carotid arteries in that order. Then the origin of the right subclavian artery, the right carotid artery and the left carotid artery were occluded with clamps and all the circulation to the brain was supplied by the two halves of the 7-mm Gott shunt connected to the 9-mm Gott shunt previously introduced into the ascending aorta. The patient's head had been covered previously with ice-bags and no electroencephalography was used.

Surgical Technique

First the ascending aorta was cross-clamped 4 cm below the aortic arch aneurysm, then the distal aorta was occluded proximal to the left subclavian artery. A clamp was also applied separately on the left vertebral artery. The aneurysm was opened longitudinally and found to be full of old clots and fibrin. The aorta was transected at both anastomotic ends to make sure that the posterior aortic adventitia was included in the suture line.

A 34-mm woven Dacron graft, on which two separate 10-mm woven side branches had previously been anastomosed, was used to reestablish aortic continuity. The distal anastomosis was performed first, preserving the takeoff of the left vertebral artery. The proximal anastomosis was then completed and air bubbles evacuated thoroughly through the 10-mm side branches by first releasing the clamp on the distal aorta. The ascending aortic clamp was then removed and the two 9-mm Gott shunts were occluded with clamps in order to preserve a selective perfusion of the brain through the two 7-mm Gott shunts. The innominate and left common carotid arteries were reimplanted on the newly constructed aortic arch with an end-to-end anastomosis on each 10-mm Dacron side branch. Cannulas were removed from both vessels, assuring normal cerebral perfusion with a pulsatile flow. The proximal tip of each 9-mm Gott shunt was removed from the ascending aorta and hemostasis was secured by tying down the two pursestring sutures. Cannulas were removed from both femoral arteries which were closed by leaving a piece of the Dacron branches so that an angioplasty could be done.

Adjunct to the surgical technique.—As for every surgical procedure involving the thoracic aorta[6] we have used autotransfusion for two major reasons.

- If any signs of left-heart overload appear, selective conservation of the blood in the autotransfusion reservoir will decrease the preload and help to control the proximal hypertension immediately. This blood can then be given back to the patient before removing the aortic clamps in order to readjust the blood volume.
- If blood loss is extensive, the blood pressure can be stabilized by rapid reinfusion.

Hemodynamic Data (Table I)

The cardiac output was measured preoperatively at 4.7 L/min by the thermodilution technique through a Swan–Ganz catheter. The period of cross-clamping lasted 29 minutes. During this time the heart had to propel its total output throughout this multibranch tubing. The right carotid artery was perfused through the shunt for 44 minutes and the left carotid artery for 64 minutes.

The cardiac output (4.7 L/min), the cardiac index (2.3 $L/min \cdot m^{-2}$), the central venous

pressure (5 cm H_2O) and the pulmonary wedge pressure (7 mm Hg) did not vary during aortic cross-clamping and the proximal aortic pressure did not increase to more than 140 mm Hg and averaged 120 mm Hg, while a drip of both nitroglycerin and nitroprusside were infused at a rate of 25 microdrip/min. Continuous electrocardiographic monitoring disclosed a normal sinus rhythm throughout the aortic reconstruction. The patient's urine output during the 29 minutes of aortic occlusion was 80 ml. The total perioperative blood losses were 2000 ml of which 1000 ml were saved by autotransfusion and the other 1000 ml were replaced with banked blood.

Postoperative Course

On arrival in the intensive-care unit, the patient was awake and had normal neurologic function of both upper and lower limbs. No vasoactive drugs were required. Hemodynamic measurements showed a cardiac output of 7.3 L/min, a cardiac index at 3.6 $L/min \cdot m^{-2}$, a central venous pressure at 5 cm H_2O and a pulmonary wedge pressure of 8 mm Hg. Normal heart and pulmonary function allowed extubation of the patient on the morning after operation. Total chest-tube drainage was 150 ml, and the drains were removed 24 hours after the operation. Blood urea nitrogen and serum creatinine levels did not vary from normal preoperative levels, indicating no renal dysfunction. An aortogram obtained on postoperative day 7 (Fig. 3) disclosed a normal aortic arch and patent side branches going to the innominate and left carotid arteries. It showed also that the left vertebral artery was preserved. The patient went home on postoperative day 10. He resumed work 3 months after the operation. When seen at the outpatient clinic 9 months after the surgical repair, he was asymptomatic and enjoying a normal life.

Comments

To our knowledge, this is the first report of this technique of external shunting with two Gott aneurysm shunts for replacement of an aortic arch aneurysm. It represents a tremendous physiologic improvement of a similar technique that we described in 1979.[7] Our experience with the Gott aneurysm shunt is quite extensive and conclusive: 175 descending thoracic aortic aneurysms were resected without causing paraplegia. This encouraged us to apply the same principle of shunting to more complex procedures.

We found by measuring hemodynamic data[6] that as much as 4000 ml/min of blood can be delivered through a 9-mm Gott shunt. By using two such shunts we were convinced that the total cardiac output could be absorbed through the tubing without any fear of heart overload and acute left ventricular distension. An electromagnetic flowmeter adapted on one of the 9-mm Gott shunts recorded a flow of 2000 ml/min. As the total cardiac output was measured at 4.7 L/min, the other 9-mm shunt likely delivered the extra 2700 ml/min ejected by the heart. This is probably close to the reality, considering that neither the central venous pressure nor the pulmonary wedge pressure changed during the period of aortic cross-clamping. From hemodynamic data detailed in Table I, it is also obvious that optimal left heart decompression was achieved. A hemodynamic tracking profile determined with both the left ventricular stroke-work index and the pulmonary capillary wedge pressure shows that normal ventricular function was preserved throughout the aortic cross-clamping. The absence of neurologic deficit and the preservation of the normal renal function are also obvious signs of optimal organ protection. The absence of metabolic acidosis during aortic cross-clamping is also evidence of optimal tissue perfusion.

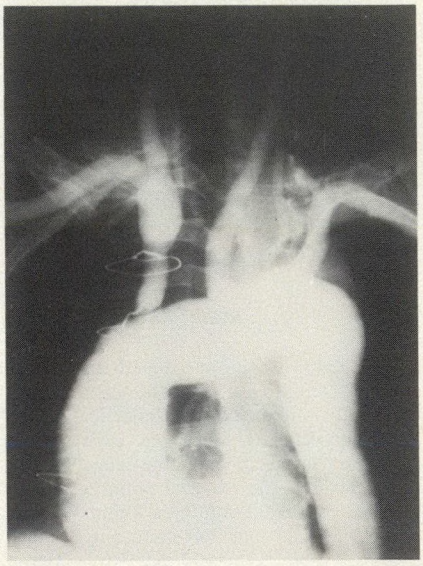

FIG. 3—Postoperative aortogram showing surgical correction of aortic arch aneurysm with 34-mm woven Dacron prosthesis on which two side branches (10-mm woven Dacron prosthesis) have been anastomosed to re-establish continuity of innominate artery and left common carotid artery.

Table I—Mean Cardiac Hemodynamic Data

Measurement	Aortic cross-clamping		
	Before	During	After
Arterial pressure, mm Hg	120	140	120
Heart rate, beats/min	62	62	62
Cardiac output, L/min	5.1	4.7	4.6
Cardiac index, $L/min \cdot m^{-2}$	2.5	2.3	2.2
Stroke volume, ml	83	75	73
Left ventricular stroke-work index, $g \cdot m/m^2 \cdot beat^{-1}$	34	31	30
Systemic vascular resistance, $dynes/s \cdot cm^{-5}$	979	1080	1106
Pulmonary vascular resistance, $dynes/s \cdot cm^{-5}$	124	137	140
Pulmonary capillary wedge pressure, mm Hg	7	7	7
Central venous pressure, cm H_2O	5	5	5

Conclusions

The experience of only one case of a new technique should be interpreted with much caution. However, the hemodynamic data obtained in our patient proved that this shunting procedure was safe and perfectly tolerated by the heart, which continued to work with normal filling pressures during aortic cross-clamping. In such cases, when there is enough length of healthy ascending aorta to allow safe proximal cannulation, this method of aortic shunting is an important adjunct for the surgeon faced with repairing an aortic arch aneurysm. One of the main advantages is the preservation of normal cardiovascular physiology without disturbing the coagulation process because systemic heparinization is not needed. However, use of this procedure demands that the surgeon be familiar with the techniques of aortic cannulation.

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ALPER AKINOĞLU, MD; ILTER BILGIN, MD

Tuberculous Enteritis and Peritonitis

In Turkey, diseases associated with *Mycobacterium tuberculosis* are common. Intestinal tuberculosis has generally been a complication of pulmonary tuberculosis, but recently there has been an increase in the frequency of intestinal tuberculosis without the pulmonary form.

The authors present their experience over 8 years in 41 patients (aged 15 to 56 years) who underwent surgery for tuberculous enteritis (14), peritonitis (13), a combination of the two (5), genital tuberculosis and peritonitis (5) and tuberculous mesenteric lymphadenitis (4). Of these, 29 had no associated pulmonary tuberculosis. Eighteen of the 41 patients had complications of their disease — bowel obstruction in 13, intestinal perforation in 2, intestinal bleeding in 2 and enterocutaneous fistula in 1. The diagnosis was established at operation and by the appearance of caseating granuloma on histologic examination and isolation of the causative organism.

Twenty-four patients required emergency surgery; 2 who had bowel perforation died. Operative procedures included laparotomy with biopsy (17), resection of intestine (10), division of adhesions (7), evacuation of mesenteric abscesses (4) and bypass (3). There were seven (17%) operative deaths.

The authors recommend that noninvasive procedures be used for the diagnosis of intestinal tuberculosis, but if these fail, surgery is indicated.

En Turquie, les maladies causées par *Mycobactérium tuberculosis* sont fréquentes. La tuberculose intestinale est généralement une complication de la tuberculose pulmonaire mais, récemment, on a assisté à une augmentation de la fréquence de la tuberculose intestinale en l'absence de forme pulmonaire.

Les auteurs décrivent 8 années d'expériences au cours desquelles 41 patients (âgés de 15 à 56 ans) ont été opérés pour entérite (14) ou péritonite (13) tuberculeuse, ou l'association des deux (5), une tuberculose génitale avec péritonite (5) ou une lymphadénite mésentérique tuberculeuse (4). De ce nombre, 29 n'avaient pas de tuberculose pulmonaire. Dix-huit des 41 patients ont présenté des complications de leur maladie: obstruction intestinale (13), perforation intestinale (2), hémorragie intestinale (2) et fistule entérocutanée (1). Le diagnostic a été établi à l'opération, à l'observation d'un granulome caséeux à l'examen histologique et à l'isolation de l'organisme causal.

Vingt-quatre patients ont dû subir une intervention d'urgence; 2 malades victimes d'une perforation intestinale sont décédés. Parmi les interventions pratiquées, on compte, des laparotomies avec biopsies (17), la résection intestinale (10), la division de l'adhésion (7), l'évacuation d'abcès mésentériques (4) et des dérivations (3). Il y eut 7 décès peropératoires (17%).

Dans les cas de tuberculose intestinale, les auteurs recommandent une intervention diagnostique non sanglante; en cas d'échec, la chirurgie est indiquée.

Diseases due to *Mycobacterium* sp are common in Turkey. New cases are usually seen in patients living under poor conditions. In the past, abdominal tuberculosis caused by ingestion of milk contaminated by *Mycobacterium bovis* frequently complicated extensive pulmonary tuberculosis. But recently the rate of primary intestinal tuberculosis, in the absence of recognizable pulmonary disease, has increased.

Mycobacterium tuberculosis and *M. bovis* are not the only mycobacteria associated with abdominal tuberculosis. Because of a declining rate of tuberculosis and greater awareness and recognition of mycobacteriosis, atypical varieties are now more frequently seen. In contrast to tuberculosis, the other mycobacteria are not transmitted from person to person but infection is acquired from the environment by mechanisms that are not yet understood.[1]

In some patients, an imprecise preoperative diagnosis can result in tuberculosis being an unexpected finding at surgery. In this retrospective study we relate our experience with the clinical and surgical features of abdominal tuberculosis.

Patients and Methods

We reviewed the charts of 41 consecutive patients who underwent laparotomy for tuberculous enteritis and peritonitis at Çukurova University Hospital in Adana, Turkey, between 1979 and 1986. Their ages ranged from 15 to 56 years, with 27 patients being between 20 and 35 years old. As in most reported series, women were affected more often than men — 1.7 to 1 in our series.

The diagnosis of tuberculosis was accepted with one or all of the following: demonstration of acid-fast bacilli, either by stain of the biopsy or ascitic fluid; determination of *Mycobacterium* sp in culture and differentiation tests; confirmation of caseating granuloma on biopsy.

Findings

Of the 41 patients, 14 had tuberculous peritonitis, 13 intestinal tuberculosis, 5 tuberculous enteritis and peritonitis, 5 genital tuberculosis and peritonitis and 4 had only tuberculous mesenteric lymphadenitis. In the last group, one patient had been operated on for small-bowel volvulus due to mesenteric lymphadenitis, and at laparotomy for abdominal trauma in the other three mesenteric lymphadenitis was an incidental finding.

In 24 of the 41 cases the organisms were demonstrated by culture and differentiation tests. *Mycobacterium tuberculosis* was isolated from 11 patients, *M. bovis* from 5 and atypical mycobacteria from 8.

Active pulmonary tuberculosis was seen in five patients, six had a history of the disease and one had cervical lym-

From the Department of Surgery, Çukurova University, Adana, Turkey

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Reprint requests to: Dr. A. Akinoğlu, Department of Surgery, Çukurova University Medical School, Genel Cerrahi Klinigi, Adana, Turkey

phadenitis. The other 29 patients had no associated pulmonary tuberculosis. The tuberculin skin test (PPD) was positive in only 22 of the 41 patients.

The early symptoms were generally nonspecific, consisting of abdominal pain, nausea, vomiting and periods of alternating diarrhea and constipation. Two of the five patients who had genital tuberculosis with peritonitis had been infertile for 3 and 7 years respectively, amenorrhea being the clinical symptom in one. Mediterranean lymphoma was the likely preoperative diagnosis in the two patients with malabsorption syndrome and weight loss. Low-grade fever, palpable abdominal mass and abdominal distension were the most common findings in patients with chronic symptoms. Of the 24 with tuberculous peritonitis, 10 patients manifested peritoneal irritability and 7 had clinically determined painless ascites.

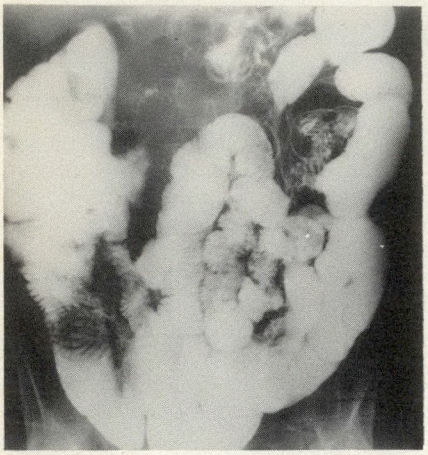

FIG. 1—Irregular distribution of barium and destruction of mucosal pattern in some areas in patient with intestinal tuberculosis.

FIG. 2—Patchy mucosal changes and small aphthoid ulcers in transverse colon of patient with intestinal tuberculosis.

In 13 patients who had intestinal obstruction, x-ray films of the abdomen revealed gas-fluid levels. Pneumoperitoneum was detected in one patient who had a perforated cecum. A barium study of the small intestine showed mucosal defects and irregular distribution of barium (Fig. 1). These signs suggested intestinal tuberculosis in five cases. Barium enema study showed filling defects in the cecum, colonic strictures and small aphthoid ulcers of the transverse colon (Fig. 2). Ultrasonography revealed enlarged mesenteric lymph nodes, thickening of the bowel wall, intensely echogenic areas in mesentery and ascites in 14 cases. Computed tomography in seven patients indicated high-density ascites, irregular masses in the omentum, low-density masses and lymph nodes in various areas, but a definitive diagnosis of abdominal tuberculosis could not be made on these findings alone.

Results of routine laboratory investigations were usually within the normal range. In 7 of the 24 patients with tuberculous peritonitis, the protein content of ascitic fluid ranged from 2.8 to 6.1 g/L. The moderate number of lymphocytes in the fluid was suggestive of tuberculosis, but the fluid was positive for acid-fast bacilli by stained smear in only two patients. The normal values for ADA of peritoneal and pleural fluids in our hospital were accepted as 15 IU/L to 25 IU/L. In all our cases the ADA levels in ascitic fluid were greater than 58 IU/L (mean 102 IU/L).

Table I—Preoperative Diagnosis or Indication for Laparotomy

Diagnosis/indication	No. of patients
Intestinal obstruction	13
Abdominal mass	8
Acute abdomen	7
Incidental finding at operation	4
Bowel perforation	2
Gastrointestinal bleeding	2
Carcinoma of the colon	2
Mediterranean lymphoma	2
Spontaneous enterocutaneous fistula	1

The problem most frequently requiring surgery was intestinal obstruction (13 patients); 9 of these were found to have tuberculous peritonitis and 4 intestinal tuberculosis (Table I). Intestinal tuberculosis was located in the ileocecal region in nine patients, small intestine in five, transverse colon in one and sigmoid colon in one. Two patients had diffuse colonic and ileal involvement.

The surgical procedures are set forth in Table II.

The most consistent histopathologic changes were the presence of granulomatous inflammation including Langhans' giant cells, epithelioid cells and lymphocyte infiltration with central caseation. The tubercle formation was not prominent in some patients, although diffuse lymphocyte infiltrations were frequent (Fig. 3).

There were seven operative deaths (17.0%) in our series, two of which occurred after emergency surgery for bowel perforation. Four deaths were due to advanced abdominal tuberculosis with intestinal obstruction and one resulted from tuberculous peritonitis with hepatic involvement.

All patients received antituberculous chemotherapy as follows: isoniazid (300 mg/d) for 12 months, rifampicin (600 mg/kg) for 9 months, morphazinamide (30 mg/kg daily) for 2 months and streptomycin (1 g intramuscularly) to a total dose of 45 g. Prednisone was administered to patients with the adhesive form of tuberculous peritonitis.

Table II—Types of Operation

Operative procedure	No. of patients	Peritonitis (n = 19)	Enteritis (n = 13)	Enteritis + peritonitis (n = 5)	Mesenteric lymphadenitis (n = 4)	Operative deaths (n = 7)
Biopsy only	17	11	2	1	3	2
Lysis of adhesions	7	7	–	–	–	–
Evacuation of mesenteric abscesses	4	1	–	2	1	1
Intestinal resection						
Right hemicolectomy	4	–	4	–	–	1
Right hemicolectomy + terminal ileum resection	1	–	1	–	–	–
Subtotal colectomy	3	–	2	1	–	1
Small intestinal resection	2	–	2	–	–	1
Bypass						
Ileotransverse colostomy	2	–	1	1	–	–
Gastrojejunostomy	1	–	1	–	–	1

Discussion

Although intestinal tuberculosis was sometimes secondary to pulmonary disease, enteritis was frequently the primary focus of the disease in most reported cases.[2-4] Tuberculous peritonitis may result from rupture of the mesenteric lymph nodes, secondary to disease in fallopian tubes and intestine. Among our 24 patients with tuberculous peritonitis we located the primary focus as mesenteric lymph nodes in 7, enteritis in 5 and genital tuberculosis in 5. In the other seven patients primary focus was not clinically evident.

The mycobacteria were all identified from culture and biochemical tests as described by Runyon.[5] Despite the absence of atypical mycobacteria in some reported series,[3,6] we isolated them in eight patients. Changing patterns of extrapulmonary tuberculosis are evident, including an insidious clinical presentation, negative findings of tuberculin skin tests, the absence of pulmonary tuberculosis and a rarity of caseation granulomas.[7] These changes we believe are due to the increasing proportion of atypical mycobacteria in this disorder.

In many reported series, the association between alcoholism and tuberculosis is as high as 60%.[8] We did not find this in any of our patients, possibly because in Turkey tuberculosis is endemic and poor hygiene is a more important causative factor than alcoholism. The symptoms we observed and noted in other reports[2,9] were insidious in the group of chronic cases.

In tuberculous peritonitis, the entire peritoneal surface is usually covered with tubercles, varying in size from 1 to 2 mm. We observed also a spider's web appearance with pseudomembranes on the peritoneum. In patients with ascites, the soapy, slippery impression of the fluid was probably due to the high concentration of protein and lymphocytes.

Tuberculous peritonitis may present as a protein and lymphocyte-rich ascites or as severe fibrotic adhesions.[10] In our experience extensive dissection may be hazardous and should be avoided when there are fibrotic adhesions. It should be noted that the primary treatment is antituberculous chemotherapy and that recurrent ileus subsides spontaneously.

In some patients, histologic findings of intestinal tuberculosis were similar to those of Crohn's disease. The identification of *Mycobacterium* sp is the most accurate method of diagnosing tuberculosis.[4,6] Crohn's disease appears to occur much less frequently in Turkey than in Western countries. In the same period there were only three surgically verified cases of Crohn's disease compared with 18 of intestinal tuberculosis. Colonic tuberculosis may manifest features of other inflammatory bowel disease and has been misdiagnosed as ulcerative colitis.[11,12] Amebic colitis, another endemic disease in our country, was the disease most commonly considered in the differential diagnosis of tuberculosis.

Radiologic investigations are of limited value in diagnosing abdominal tuberculosis and the ability of a gastrointestinal series to detect the disease has been reported elsewhere.[13-15] The colonic aphthoid small ulcers commonly seen in Crohn's disease have been demonstrated radiologically by Carr-Locke and Finlay[13] in a patient with colonic tuberculosis. In our two cases of diffuse colonic tuberculosis, there were aphthoid ulcers in the transverse colon which led us to conclude that these ulcers are also frequently seen in this disease.

The complications of abdominal tuberculosis that we encountered were bowel obstruction (31.7%), intestinal perforation (4.9%), intestinal bleeding (4.9%), enterocutaneous fistula (2.4%) and small-bowel volvulus due to mesenteric lymphadenitis (2.4%). Ulcer perforation occurred in 7% to 15% of all patients who had intestinal tuberculosis.[2] Gilinsky and colleagues[16] recently reported their experience with eight cases of perforated tuberculous bowel. They advocated simple closure of the perforation rather than resection or bypass. We recommend that noninvasive procedures be used in the initial investigation of suspected cases but surgical intervention may

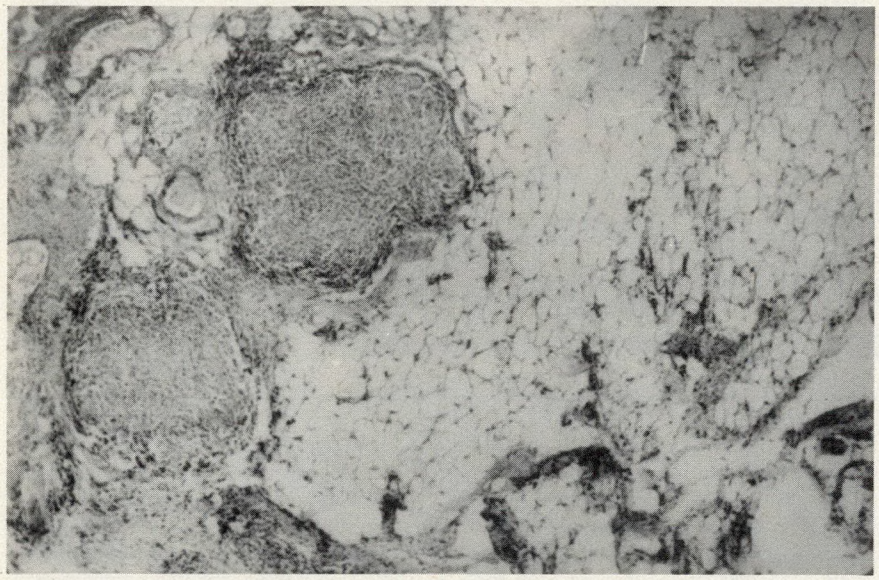

Fig. 3a

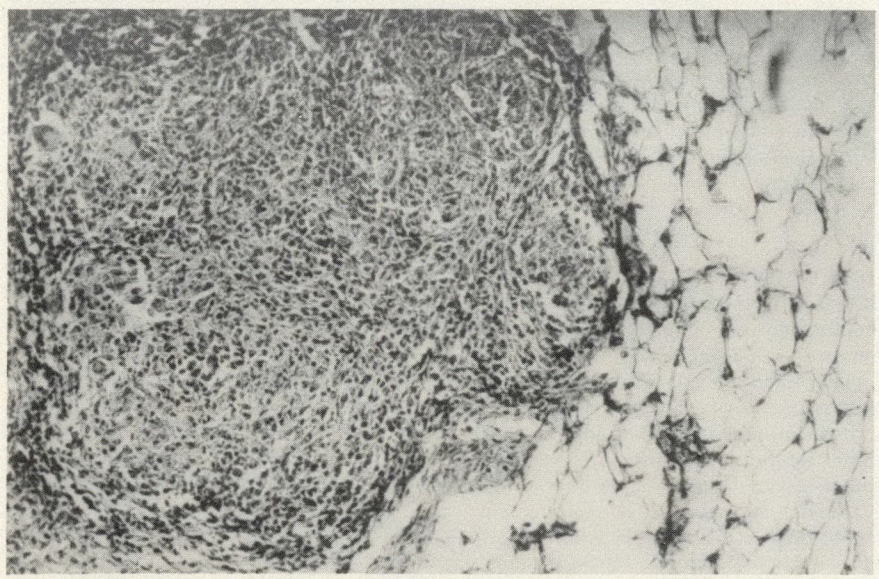

Fig. 3b

FIG. 3—(a) Omentum shows mass of tuberculous granulomas (hematoxylin and eosin, original magnification × 25). (b) Areas of tubercles surrounded by lymphocytes and Langhans' giant cells. Caseation was not feature (hematoxylin and eosin, original magnification × 40).

be necessary when the diagnosis is in doubt.

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R.W. LANDYMORE, MD, FRCSC;* A.E. MARBLE, PH D(ENG);* M. MACAULAY, MD, FRCPC;† B. SHERIDAN, MD, FRCPC;† C. CAMERON, BN*

Effect of Various Low-Dose Concentrations of Verapamil Cardioplegia on Small-Amplitude Electrical Activity During Cardioplegic Arrest

The effect of verapamil cardioplegia on atrioventricular conduction was examined in 19 dogs. During 90 minutes of ischemic arrest, five dogs received multidose potassium cardioplegia, containing 1.2 mg/L of verapamil (group 1), five received potassium cardioplegia containing 600 μg/L of verapamil (group 2) and nine animals received cardioplegia containing 300 μg/L of verapamil (group 3). Atrioventricular conduction was measured in all groups before bypass, after 90 minutes of ischemia and after 45 minutes of reperfusion. Specially designed plunge electrodes were used to monitor the electrical status of the heart during arrest in group 3 and, in addition, left ventricular function and concentration of high-energy phosphates were determined before and after ischemic arrest. Conduction was prolonged in four group 1 dogs and in two group 2. Atrioventricular conduction was measured in six group 3 dogs; five had prolonged conduction and one experienced second-degree heart block. Small-amplitude electrical potentials were recorded from the myocardium in two of nine dogs in group 3. Persistent electrical activity was associated with continued use of high-energy phosphates and resulted in decreased left ventricular function after 90 minutes of ischemic arrest. Our data indicate that small doses of verapamil will delay atrioventricular conduction and will not prevent small-amplitude electrical activity.

On a étudié chez 19 chiens les effets d'une cardioplégie au vérapamil sur la conduction auriculo-ventriculaire. Durant un arrêt ischémique de 90 minutes, cinq chiens furent soumis à une cardioplégie provoquée par de multiples doses de potassium renfermant 1,2 mg/L de vérapamil (le groupe 1) cinq autres reçurent du potassium additionné de 600 μg/L de vérapamil (le groupe 2) et neuf animaux furent mis en cardioplégie avec 300 μg/L de vérapamil (le groupe 3). Dans tous les groupes, la conduction auriculo-ventriculaire fut mesurée avant dérivation, après 90 minutes d'ischémie et après 45 minutes de reperfusion. Des électrodes implantées, spécialement conçues pour ces mesures, furent utilisées pour monitorer la conductivité électrique du coeur durant l'arrêt chez le groupe 3; de plus, la fonction ventriculaire gauche et la concentration des phosphates à haut niveau énergétique ont été déterminée avant et après l'arrêt ischémique. La conduction a été prolongée chez 4 chiens du groupe 1 et deux du groupe 2. La conduction auriculo-ventriculaire du groupe 3 a été mesurée chez six chiens; cinq montraient une prolongation de la conduction et un a subi un bloc auriculo-ventriculaire au second degré. Des potentiels électriques de faible amplitude furent enregistrés du myocarde de deux des neuf chiens du groupe 3. Une activité électrique persistante était associée à l'utilisation continue des phosphates à haut niveau énergétique et causait une baisse de la fonction ventriculaire gauche après 90 minutes d'arrêt ischémique. Ces résultats indiquent que de petites doses de vérapamil retardent la conduction auriculo-ventriculaire et ne protègent pas contre une activité électrique de faible amplitude.

*From the *Department of Surgery and †Department of Pathology, Dalhousie University, Halifax, NS*

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Reprint requests to: Dr. R.W. Landymore, Rm. 3065, R.C. Dickson Centre, Victoria General Hospital, Halifax, NS B3H 2Y9

Ischemic injury frequently occurs after prolonged aortic occlusion despite strict adherence to current methods of myocardial preservation. The mechanism

of this injury is still unclear, although recent investigations in our laboratory indicate that potassium cardioplegia may not maintain complete electrical arrest and persistent small-amplitude electrical potentials may be recorded from the myocardium at 10°C.[1] These observations prompted us to investigate the effects of verapamil cardioplegia on myocardial preservation. Standeven and colleagues[2] suggested that verapamil cardioplegia may augment the myocardial protection afforded by potassium cardioplegia by providing more complete electrical arrest. In a previous study,[3] we found that high-dose verapamil cardioplegia abolished electrical activity from the myocardium and provided excellent myocardial protection during prolonged aortic occlusion but resulted in a 25% incidence of complete heart block. We, therefore, designed the present study to determine whether low doses of verapamil could augment the myocardial protection afforded by potassium cardioplegia and maintain complete electrical arrest without an unacceptable rate of atrioventricular dissociation.

Material and Methods

We studied 19 adult mongrel dogs, weighing between 22 and 26 kg. Atrioventricular conduction was measured in five animals that received 10 ml/kg body weight of potassium crystalloid cardioplegia (Table I) containing 1.2 mg/L of verapamil (group 1). This concentration of verapamil was half the dose that had been used in earlier experiments[3] and had resulted in a 25% incidence of complete heart block. The cardioplegia was infused into the ascending aorta after application of the aortic cross-clamp, with subsequent infusions at 30-minute intervals during the 90-minute period of arrest. Similar conduction measurements were made in five animals receiving potassium crystalloid cardioplegia containing 600 μg/L of verapamil (group 2) and nine animals receiving potassium crystalloid cardioplegia containing 300 μg/L of verapamil (group 3). Because of the substantial reduction in verapamil concentration in group 3 dogs, we decided not only to measure atrioventricular conduction but to determine the effects of this concentration of verapamil on myocardial preservation and the presence of persistent electrical activity in the myocardium.

Table I—Composition of Potassium Crystalloid Cardioplegia

Ringer's lactate, ml	800
Dextran 40 in 10°C dextrose, ml	180
Potassium, mmol/L	20
Heparin, U/L	2000
Toronto insulin, U/L	4
Solu-Cortef, mg/L	40
Sodium bicarbonate, mmol/L	25
pH	7.7

Transmural myocardial temperature and electrical activity were continuously monitored with specially designed plunge electrodes over the left anterior descending coronary distribution during arrest. The technical aspects related to the measurement of transmural temperature and small-amplitude electrical potentials from the myocardium during cardioplegic arrest have been described in detail previously.[1]

Left ventricular function was also assessed before bypass, after 90 minutes of ischemia and after 45 minutes of reperfusion, and transmural biopsies were obtained for analysis of high-energy phosphates before bypass and at 15 and 45 minutes after ischemic arrest.

Surgical Preparation

The dogs were sedated with 1 ml of Innovar and anesthesia was induced and maintained with sodium pentobarbital (5 mg/kg). Pancuronium bromide (0.1 mg/kg) was administered intravenously after intubation, and ventilation was provided with a pressure-regulated ventilator.

The chest was opened through a median sternotomy and the heart suspended in a pericardial cradle. The left femoral artery was cannulated with a no. 14 French USCI arterial cannula (C.R. Bard Inc., Billerica, Mass.) while both cavae were cannulated with no. 34 French USCI cannulas. A no. 8 French USCI catheter was positioned in the right femoral artery for continuous monitoring of blood pressure and a no. 7 French Swan–Ganz thermodilution catheter was positioned in the pulmonary artery to determine cardiac output. A no. 5 French transducer catheter (frequency response 0 to 24 kHz) was introduced through the apex of the left ventricle to measure left ventricular end-diastolic pressure and the rate of rise of left ventricular pressure (dP/dt). Cardiopulmonary bypass was established with a Medtronic impellar pump (model 1835-00U; Medtronic Inc., Circulatory Systems Division, Roseville, Miss.) driven by a Medtronic circulatory assist console (model 1810) that would deliver nonpulsatile flow at a rate of 2.5 L/min • m^{-2}. The azygous vein and both cavae were snared and the ventricles were vented during arrest.

At a rectal temperature of 26°C, the aorta was cross-clamped and 10 ml/kg of crystalloid potassium cardioplegia, containing varying concentrations of verapamil, was administered to induce the arrest and at 30-minute intervals during the 90 minutes of ischemia. Topical iced saline was placed in the pericardial well and over the anterior surface of the heart to maintain myocardial temperature within the range of 8° to 10°C.

Measurement of Atrioventricular Conduction

Atrioventricular conduction was measured after sternotomy, after 90 minutes of ischemic arrest and after 45 minutes of reperfusion. By manipulation during reperfusion, the rectal temperature 45 minutes after ischemic arrest was brought to an identical reading with that measured initially. The atrium was paced with a Cordis Chronocor model 156B pacemaker (Cordis Corp., Miami, Fla.) at a rate of 150 beats/min and the electrocardiogram was recorded on a Gould-Brush 260 amplifier (Gould Inc., Oxnard, Calif.) and recorder. Measurements of atrioventricular conduction were determined from strip-chart recordings that displayed the atrial pacemaker potential and the R-wave of the electrocardiogram.

Determination of Left Ventricular Function

Cardiac index, left ventricular stroke-work index and the rate of rise of left ventricular pressure (dP/dt) were measured after sternotomy, after 90 minutes of ischemia and after 45 minutes reperfusion in group 3. Measurements were determined at a heart rate of 150 beats/min and at a left ventricular end-diastolic pressure of 10 mm Hg. Heart rate was increased to 150 beats/min in dogs with lower heart rates by temporary atrial pacing. The left ventricular end-diastolic pressure was manipulated to 10 mm Hg by withdrawing or infusing volume from the oxygenator. Left ventricular function was calculated from standard formulas described previously.[4]

High-Energy Phosphate Levels

Full-thickness transmural left ventricular biopsies were obtained from group 3 dogs for determination of high-energy phosphate levels. The specimens were removed from the left ventricle overlying the left anterior descending coronary distribution after sternotomy and at 15 and 45 minutes of reperfusion. The techniques for obtaining, preserving and analysing these specimens have been outlined previously[5].

Statistical Analysis

Results have been reported as the arithmetic mean with standard error and the unpaired Student's *t*-test was used for statistical comparisons.

Results

Group 1

Group 1 dogs received 876 ± 27 μg of verapamil during cardiac arrest (4.9 ± 0.2

μg/g of heart muscle). Atrioventricular conduction was prolonged in four of the five animals, but there was no incidence of complete heart block. The small number of animals in this initial group precluded statistical analysis, but the results suggested that this concentration of verapamil prolonged conduction.

Group 2

In the five dogs in group 2 that received potassium crystalloid cardioplegia, containing verapamil 600 μg/L, a total of 410 ± 7 μg of verapamil was administered during the period of arrest (2.9 ± 0.6 μg/g of heart muscle). Atrioventricular conduction was prolonged in two dogs.

Group 3

The nine group 3 animals received 209 ± 3.4 μg of verapamil (1.4 ± 0.01 μg/g of heart muscle) during the arrest. Atrioventricular conduction was measured in six of the nine animals; it was delayed in five. The increase in atrioventricular conduction ranged from 8 to 64 ms (mean 28 ms, $p < 0.04$). One animal in this group had prolonged 2:1 heart block.

Small-amplitude electrical potentials from the myocardium.—The administration of verapamil-potassium cardioplegia induced complete electrical arrest in all dogs, but two had small-amplitude electrical activity within 10 to 15 minutes after the initial infusion of cardioplegia. Electrical activity was abolished by reinfusion of cardioplegia at 30 minutes, but again became apparent before reinfusion at 60 minutes. Plunge-electrode activity was present when there was no visual mechanical activity and when the electrocardiogram was isoelectric. The remaining seven animals in this group maintained complete electrical arrest throughout the entire period of ischemia.

Left ventricular function.—The dogs were subdivided into two groups based on the presence of small-amplitude electrical activity. The hemodynamic data for these groups are summarized in Table II and expressed as a mean increase or decrease in each measurement after 90 minutes of ischemia and 45 minutes of reperfusion. Cardiac index increased by 1.3 ± 7 $ml/min \cdot kg^{-1}$ in those animals without electrical activity and by 23 ± 14 $ml/min \cdot kg^{-1}$ in those with electrical activity ($p < 0.05$). Left ventricular stroke-work index was reduced by 0.07 ± 0.06 $g\text{-}m/beat \cdot kg^{-1}$ in the nonfibrillators and by 0.15 ± 0.2 $g\text{-}m/beat \cdot kg^{-1}$ in the fibrillators ($p < 0.5$). The rate of rise of left ventricular pressure (dP/dt_{max}) was reduced by 39 ± 64 mm Hg/s in the animals without electrical activity and by 60 ± 34 mm Hg/s in those with electrical activity ($p < 0.4$). Peripheral vascular resistance decreased by 400 $dynes/s \cdot cm^{-5}$ in the nonfibrillators and by 2002 $dynes/s \cdot cm^{-5}$ in those with electrical activity ($p < 0.06$).

High-energy phosphates.—There was no significant change in the concentration of adenosine triphosphate (μmol/g dry weight of cardiac muscle) in any of the animals after 15 minutes of reperfusion. However, ATP decreased by 0.05 ± 0.6 μm/g in the nonfibrillators and by 4.5 ± 0.5 μm/g in those animals with electrical activity after 45 minutes of reperfusion ($p < 0.09$).

Discussion

Calcium channel blockers have been used clinically to augment the myocardial protection provided by potassium cardioplegia.[6,7] This group of drugs is thought to reduce the cellular influx of calcium during ischemic arrest and to prevent post-ischemic calcium-ion influx, thereby reducing reperfusion injury.[8,9] Standeven and colleagues[2] demonstrated that adding a calcium channel blocker to potassium cardioplegia improved myocardial preservation; they suggested that calcium-channel-blocker cardioplegia may protect the myocardium by providing more-complete electrical arrest. This concept has been supported by recent investigations in our laboratory,[3] showing that the addition of high-dose verapamil to potassium crystalloid cardioplegia prevents small-amplitude electrical activity during extended periods of aortic occlusion. Unfortunately, we found that the increased protection afforded the high-dose verapamil was associated with a 25% rate of complete heart block, which persisted for 1 to 2 hours after the arrest. The clinical use of calcium-channel-blocker cardioplegia has also been associated with a high frequency of atrioventricular conduction abnormalities. When Guffin and associates[10] added verapamil to potassium crystalloid cardioplegia they found that 78% of patients experienced varying degrees of heart block; 33% of their patients required atrioventricular sequential pacing. A similar experience was reported by Hicks and colleagues[6] after the use of verapamil cardioplegia; 70% of their patients experienced conduction abnormalities and 6% required pacing in the intensive-care unit. Clark and associates[7] employed nifedipine cardioplegia and noted that the heart frequently failed to beat spontaneously after release of the aortic cross-clamp and that much longer periods of reperfusion were necessary before atrioventricular conduction returned to normal. Thus, both experimental and clinical studies indicate that conduction abnormalities are a common complication of calcium-channel-blocker cardioplegia.

Conduction abnormalities associated with the use of calcium channel antagonists appear to be related not only to the concentration of the drug used in cardioplegia but also to the total dose administered during the period of cardiac arrest. Keefe and Kates[11] and Hulthén and colleagues[12] investigated the effects of verapamil on cardiac membranes. They demonstrated that verapamil has a high affinity for binding sites in cardiac membranes that results in the gradual accumulation of the drug within muscle cells; this explains why conduction abnormalities may persist long after infusion of calcium-channel-blocker cardioplegia. The concentration of verapamil in the cardioplegic solution is also a factor although there appears to be considerable individual variability. Although Yamamoto and colleagues[13] suggest that the optimum concentration of verapamil in cardioplegia is approximately 500 μg/L and that higher doses frequently cause varying degrees of heart block, Guffin and colleagues[10] have shown that much smaller doses (375 μg/L) are also associated with a high rate of complete heart block. These observations indicate that multidose verapamil cardioplegia may result in the gradual accumulation and binding of the drug with cellular membranes, resulting in the prolongation of atrioventricular conduction or heart block following cardioplegic arrest.

In an earlier study,[3] we demonstrated that potassium cardioplegia containing 5 mg/L verapamil provided excellent myocardial preservation and prevented small-amplitude electrical activity during ischemic arrest but resulted in a 25% incidence of persistent atrioventricular dissociation. The concentration of verapamil

Table II—Mean Change in Ventricular Function After 90 Minutes of Ischemia and 45 Minutes of Reperfusion

Measurement	Nonfibrillators	Fibrillators	p value*
Cardiac index, $ml/min \cdot kg^{-1}$	+1.3 ± 7†	+23 ± 14	<0.05
Left ventricular stroke-work index, $g\text{-}m/beat \cdot kg^{-1}$	−0.07 ± 0.06	−0.15 ± 0.2	<0.5
dP/dtmax, mm Hg/s	−39 ± 64	−60 ± 34	< 0.4
Peripheral vascular resistance, $dynes/s \cdot cm^{-5}$	−400 ± 362	−2002 ± 779	< 0.06

*Unpaired Student's *t*-test.
†SEM = standard error of mean.

used in these experiments[3] was extrapolated from previous canine experimental investigations[14,15] that had demonstrated no conduction abnormalities with the intravenous infusion of similar concentrations of verapamil. The disparity between our observations and these experimental results[14,15] is presumably related to the fact that we infused verapamil directly into the coronary circulation, which may have resulted in excessively high concentrations of the drug in the myocardium. We, therefore, designed the present study to determine an optimum dose of verapamil that would prevent small-amplitude electrical activity during ischemic arrest without provoking untoward effects on atrioventricular conduction. The concentration of verapamil used in our earliest experiments[3] was reduced by 50% in group 1. These five dogs received a total dose of verapamil that ranged from 780 to 984 μg. Atrioventricular conduction was generally prolonged but there was no instance of complete heart block. In group 2, the dogs received a lower total dose of verapamil ranging from 390 to 450 μg. Atrioventricular conduction was prolonged but in only two of the five animals. In group 3 nine dogs received a total dose of verapamil ranging from only 192 to 219 μg. Atrioventricular conduction was measured in six of the nine animals and despite the marked decrease in the concentration of verapamil, conduction was prolonged in five dogs and one experienced prolonged second-degree heart block. The effect of verapamil cardioplegia on atrioventricular conduction was, therefore, not always predictable.

We decided to monitor the electrical status of the heart during cardioplegic arrest in group 3 animals and to assess the effects of this very small concentration of verapamil on myocardial preservation, because we felt that any further reduction in the concentration of verapamil would be unlikely to prevent small-amplitude electrical activity. Persistent electrical potentials were recorded from the myocardium at 10°C in two of nine animals in group 3, indicating that low-dose verapamil indeed will not prevent small-amplitude electrical activity. In contrast, high-dose verapamil (5 mg/L of crystalloid cardioplegia) studied in our earlier experiments,[3] using an identical surgical preparation, completely abolished small-amplitude potentials from the myocardium. The data reported in this study complement those of a previous report by Ferguson and colleagues[16] who used nifedipine cardioplegia during 40 minutes of ischemic arrest. They added 200 μg of nifedipine to each litre of potassium crystalloid cardioplegia and monitored electrical activity from the myocardium with specially designed plunge electrodes. Nifedipine reduced but did not abolish the incidence of small-amplitude electrical activity; small-amplitude electrical potentials were frequently recorded from the myocardium before the reinfusion of cardioplegia at regular intervals during the period of cardiac arrest.

Assessment of myocardial preservation after 90 minutes of ischemia and 45 minutes of reperfusion in group 3 indicated that preservation was only optimal when the heart was completely electrically arrested. Persistent electrical activity was associated with substantially greater reduction of ATP after 45 minutes of reperfusion. The rate of rise of left ventricular pressure (dP/dt_{max}) was lower after ischemic arrest in animals with electrical activity, although the results were not statistically significant. Cardiac index and left ventricular stroke-work index rose in both the fibrillators and nonfibrillators, the increase in both these indices being greater in the fibrillators. These observations might be explained by the fact that peripheral vascular resistance was much lower in the nonfibrillators. The difference in peripheral vascular resistance, however, between these two groups is not readily apparent and was not related to the total dose of verapamil administered during the arrest or the core temperature during the measurements.

Our data indicate that low-dose verapamil cardioplegia will not prevent small-amplitude electrical activity and that even very small concentrations of verapamil are frequently associated with conduction abnormalities. Furthermore, the effects of verapamil on atrioventricular conduction are not directly related to the concentration of the drug, because the delay in conduction in group 3 dogs receiving a very small dose of verapamil was similar to that in the first two groups of animals receiving higher concentrations.

Our data suggest that clinical application of calcium-channel-blocker cardioplegia may be limited since cardioplegia must be safe and nontoxic to the myocardium and the total volume of cardioplegia administered during the elective arrest should not be a critical factor. The clinical use of cardioplegia frequently results in the administration of large volumes of cardioplegic solution to ensure optimum myocardial cooling, particularly in patients with critical coronary artery stenosis and in those patients with myocardial hypertrophy. These data and previous observations in our laboratory[3] indicate that excellent myocardial preservation may be provided with crystalloid solutions as long as a complete electrical arrest is maintained during the period of anoxia. Our observations suggest that attention should be focused on the development of techniques to monitor the electrical status of the heart during cardioplegic arrest rather than continuing to modify contemporary cardioplegic solutions. Continuous monitoring of the electrical status of the heart would provide the surgeon with a method of gauging the volume and frequency of cardioplegic administration necessary to provide a complete electrical arrest and to ensure optimal myocardial preservation during prolonged aortic occlusion.

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KENNETH ROCKWOOD, MD; PETER ROCKWOOD, MD; W.H. EATON, MD

Elderly Long-Stay Surgical Patients

This paper examines long hospital stays (more than 30 days) among 196 surgical patients over 65 years of age in two acute-care hospitals. Patients in the long-stay group — 54 (28%) of the 196 — were not demographically different from the others but showed a significantly ($p < 0.05$) higher rate of cognitive impairment, dependence before admission and admission through the emergency department. Although these patients more often required catheterization and were nursed in bed or in "gerichairs", many were suitable for discharge to the community if appropriate accommodation could have been found.

Cet article se penche sur les séjours hospitaliers prolongés (de plus de 30 jours) parmi 196 patients chirurgicaux de plus de 65 ans qui ont été admis dans deux centres hospitaliers pour soins de courte durée. Les patients dont l'hospitalisation fut prolongée, 54 (28%) des 196, ne présentaient pas de caractéristiques différentes des autres, mais ils montraient un taux significativement plus élevé ($p < 0.05$) de déficit cognitif, d'état de dépendance avant leur hospitalisation et d'admission par le service d'urgence. Bien que ces malades eurent plus souvent besoin d'un cathéter et furent traités au lit ou dans une chaise pour vieillard, plusieurs auraient pu réintégré la communauté si des services appropriés avaient pu y être trouvés.

From the Faculty of Medicine, Memorial University of Newfoundland, St. John's, Nfld.

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Reprint requests to: Dr. K. Rockwood, Room 2G2.08, Department of Medicine, University of Alberta Hospital, Edmonton, Alta. T6G 2R7

Elderly patients (those over 65 years of age) who must be hospitalized for longer than 30 days pose a particular problem to the health-care system in terms of both appropriate treatment and hospital costs. Yet long hospital stay as a measure of the outcome of surgery in the elderly has received comparatively little attention. Most reports deal mainly with death rate;[1] where length of stay is mentioned, long hospital stay as an outcome is generally not reported.[2]

This paper examines long hospital stays among elderly surgical patients and focuses on the risks associated with prolonged hospitalization and the type of care that such patients require.

Methods

In this paper, surgical patients were defined as those admitted or transferred to a surgical unit. Long-stay patients were those hospitalized for 30 days or more on the day of the interview.

The study was conducted as two cross-sectional surveys, in April 1983 and April 1984 respectively, in St. John's, Nfld. The two hospitals studied serve as tertiary care centres for 590 000 persons. In 1981, approximately 8.5% of the population was aged 65 years or older.[3]

The data collection protocol included a standardized review of the health-care record. Data on demographic variables, residence at admission and discharge, type of admission, diagnosis, type of procedure, complications and in-hospital transfers were recorded. Next, a structured interview with the patient was carried out. Information comprised observer assessment, test data and self-reported information. The interview gave information on health attitudes and beliefs, on functional capacity in the activities of daily living (e.g., eating, bathing, meal preparation),[4,5] on cognitive impairment[6] and on the presence of urinary catheters, use of restraints, tube-feeding and "gerichairs" and other variables related to patient care. In addition, the patient's primary nurse was interviewed, at which time a standardized nursing assessment was completed and corroboration of the patient's history sought. The protocol was pretested on 10 patients.

The significance of differences in means was assessed using the two-tailed t-test. The χ^2 test was used in the analysis of proportions.

Results

Data collection forms were completed on 196 elderly surgical patients. Of these, 67% came to hospital from their own homes, 20% from a relative's home and the remaining 13% from a nursing home. The age distribution was similar to that of the Newfoundland population, with 61% being between 65 and 74 years, 28% between 75 and 84 years and 11% 85 years or older.[4]

Of those living in the community, 38% were dependent in at least one essential activity of daily living. Almost 40% of this group were living with a spouse, 33% with a child and the remainder with another relative or friend.

Over 67% of the patients were either on general surgery or orthopedic services, the remainder being divided between neurosurgery, urology, ophthalmology and otolaryngology. In 60% a serious preoperative medical risk was identified; a further 15% suffered from dementia. Only 25% of patients had no identifiable risk factor.

Of the 196 patients, 54 (28%) had hospital stays longer than 30 days (range from 31 to 365 days). Two-thirds of them had stays in excess of 60 days.

There were few demographic differences between the long-stay and short-stay patients (Table I). Both groups showed a small preponderance of women. Long-stay patients were less likely to be married than short-stay patients. The majority of both groups came from their own homes. Although the average ages did not differ substantially, it is interesting that the long-stay group had proportionately twice as many very elderly (85 years or more) patients as the short-stay group.

Long-stay patients were significantly ($p < 0.05$) more often dependent in some

essential activity of daily living[4] than short-stay patients (62% versus 26% respectively).

The length of stay was associated with the type of procedure performed (Fig. 1). In particular, those who underwent orthopedic procedures were more likely to experience long stays, as was the case in 43% of elderly orthopedic patients.

The presence of cognitive impairment also posed a significant risk of long hospital stay (Table II). Moderate to severe cognitive impairment was present in 59% of long-stay patients compared with only 25% (14 of 57) of short-stay patients.

The mode of admission to hospital also shows significant differences between the two groups (Fig. 2), emergency admission being associated with prolonged hospitalization.

Excluding dementia, preoperative medical risks did not favour either of the two groups. In spite of factors that included a history of myocardial infarction, peripheral vascular disease, untreated hypertension, congestive heart failure, anemia, chronic obstructive lung disease, diabetes mellitus, stroke, pneumonia and urinary tract infection, there were fewer preoperative medical risks in the long-stay group. Although there was no difference in the rate of major postoperative complications (two patients), long-stay patients did have a higher frequency of minor complications, particularly anemia and uncontrolled diabetes mellitus. Such complications occurred in 46% of long-stay patients, compared with 30% of short-stay patients. In both groups, the most common complication was a transient postoperative anemia. Decubitus ulcers were present in 5% of long-stay patients.

Table III compares selected characteristics of the care received by both patient groups. When interviewed, most long-stay patients were in bed with the rails up and 30% (compared with 11% of the short-stay patients) were either in "gerichairs" or had them at the bedside. Although a higher rate of urinary catheterization might be expected in those most recently operated on, only 11% of short-stay patients compared with 39% of the long-stay group had urinary catheters in place. Slightly more long-stay patients were restrained or were being tube fed, but the differences were not significant. The proportion of long-stay patients who were in bed or were catheterized suggests a higher level of dependence in this group, but it is interesting to note that, by nursing assessment, 37% of these were considered ready to be discharged with little or no assistance from the community, if there was a place for them to go.

Discussion

Several studies on the outcome of hospital admissions of the elderly have included surgical patients, but prolonged hospitalization as an outcome has not been examined,[7-10] although Lamont and colleagues[10] did report that 11.5% of surgical patients and 40% of orthopedic patients were discharged to nursing homes, an outcome associated with prolonged hospitalization in the elderly.[11-15]

Murphy[13] found that 16% of 325 surgical and orthopedic beds were "blocked" by long-stay patients. This estimate is similar to the 14.2% noted in a Toronto study[16] of medical and surgical beds, but is somewhat higher than estimates of 4.8% in another British study[12] and 10% in a New York report cited by Glass and associates.[17] The proportion of bed-days affected is, of course, higher; McArdle and colleagues[11] reported that 33% of bed-days in an acute medical service were occupied by patients not needing acute care. Similarly, Robbins and Donaldson[15] found that 28% of bed-days used by elderly patients with hip fractures were spent awaiting discharge.

The definition of "long stay" is controversial. Although some prospective studies have not used a pre-set limit, arguing that "social stay" can occur at any time,[15,17] most set a criterion, ranging from 28 days[12] to 6 months,[18] depending on the particular administrative setting. While these definitions are necessarily arbitrary, our clinical experience accords with the impressions of McAlpine[19] and Rubin and Davies[12] in selecting the 30-day cutoff. Of note, in the prospective series of Robbins and Donaldson,[15] is that most patients had completed active treatment by 30 days.

The estimate of the proportion of beds occupied by long-stay patients is higher

Table I—Demographic Characteristics of 196 Long-Stay and Short-Stay Patients

	Long stay, no. (%)	Short stay, no. (%)
Sex		
Male	24 (44)	67 (47)
Female	30 (56)	75 (53)
Residence*		
Own home	33 (61)	96 (70)
With relative	15 (28)	23 (17)
Nursing home	6 (11)	19 (14)
Marital status†		
Single	5 (9)	14 (10)
Married	25 (47)	72 (51)
Widowed/divorced	23 (43)	56 (39)
Age, yr		
65 – 74	29 (54)	91 (64)
75 – 84	17 (31)	38 (27)
≥ 85	8 (15)	13 (9)
Average age (± SD), yr	75 ± 7.4	73 ± 6.5

*Data not available for 4 short-stay patients.
†Data not available for 1 long-stay patient.

Table II—Cognitive Impairment in Long-Stay and Short-Stay Elderly Patients*

	Cognitive impairment, no. (%)		
Length of stay	Severe	Moderate	None
Long	19 (41.3)	8 (17.4)	19 (41.3)
Short	5 (8.8)	9 (15.8)	43 (75.4)

*103 patients. Only in the second year were short-stay patients interviewed. Data are missing on 10 patients (8 long-stay, 2 short-stay) with whom an interview could not be completed. $p < 0.05$.

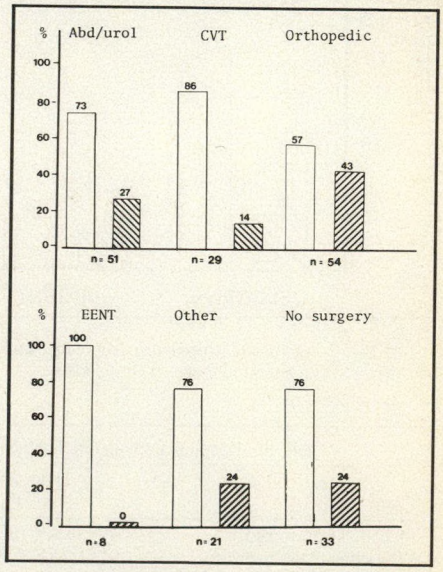

FIG. 1—Proportion of long-stay patients by type of surgical procedure. Abd/urol = abdominal/urologic, CVT = cardiovascular/thoracic, EENT = opthalmologic/ears, nose, throat. White bars = short stay, hatched bars = long stay.

than has been reported previously in studies using a 30-day criterion. The result seems a reliable estimate for the population, as it did not vary much in the 2 years studied. In both years, the proportion of patients with stay in excess of 60 and 90 days did not vary. These findings may reflect local practices and be attributable to the lack of an established geriatric service at the time of the study or to the relatively undeveloped system of home-care services in the community.

Many factors contribute to long hospital stays,[16] but some groups are reported to be consistently at risk — those with cognitive impairment,[11,16–18,20,21] unreliable community support,[11–13,17,18] problem behaviour,[14,18] those who are more than 75 years old[12,13,17] and women.[12,13,18]

In contrast to these reports we found that the long-stay patients were not more often female, widowed or very elderly. None the less, the twofold higher frequency of dependence in the community before admission suggests that the long-stay patients in this study share essential features with others described previously.[12,13,18] The finding of a higher proportion with cognitive impairment also supports this view.[11,16–18,20,21]

Other risks, such as emergency admission, are controversial.[12,13,18,22] In this study we found that 72% of long-stay patients were admitted through the emergency department. It is interesting that while limited mobility before admission is a risk factor for long stay,[12,13,18] Murphy[13] found that only 3 of 43 (7%) long-stay patients required nursing in bed. Moreover, although most agree that the long-stay patients do not require acute care,[11–15] the types of care needed are not often reported. In our study, most (85%) of the long-stay patients were in bed when interviewed and compared with short-stay patients more were restrained, had urinary catheters and were fed by nasogastric tube.

Many of the elderly long-stay patients nursed in bed or in "gerichairs" were considered capable of relatively independent living. Notwithstanding Asher's 40-year-old warning about the dangers of bedrest,[23] its prevalence in the hospitalized elderly is still quite high.[17,24] As with urethral catheterization, this often reflects practices undertaken for easier patient care.[17,24]

In summary, the typical elderly long-stay patient on the surgical service is one who is dependent, cognitively impaired and required emergency surgery. Thus, little can be done to prevent admission. It is, therefore, imperative that practical strategies of management be developed for these patients[25] so that the quality of care can be improved and further dependency avoided.

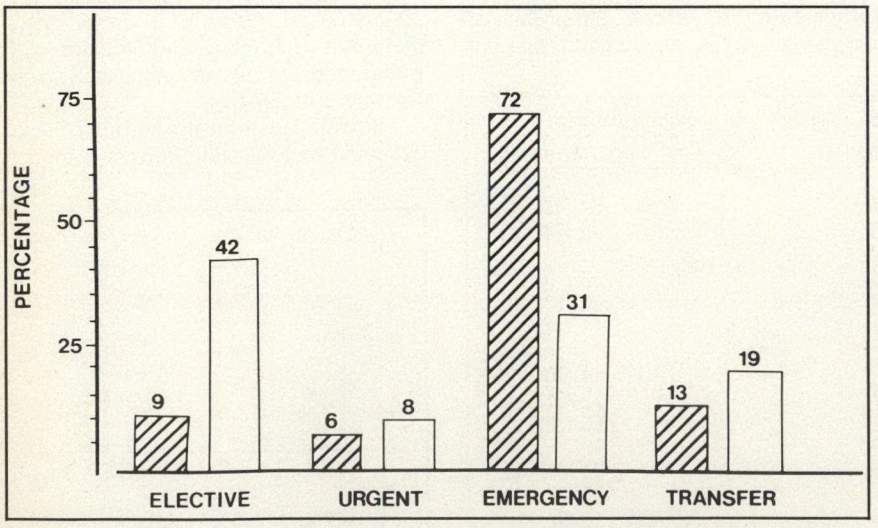

FIG. 2—Type of admission for long- and short-stay elderly surgical patients. White bars = short stay, hatched bars = long stay.

Table III—Hospital Care in 54 Long-Stay and 56 Short-Stay Elderly Patients*

Care	Long stay, no. (%)	Short stay, no. (%)	p value
In bed, sides raised	46 (85)	29 (52)	< 0.05
"Gerichairs" at bedside	16 (30)	6 (11)	< 0.05
Restrained	5 (9)	3 (5)	> 0.05
Urinary catheter in place	21 (39)	6 (11)	< 0.05
Nasogastric tube feeding	3 (6)	1 (2)	> 0.05

*110 patients. Only in second year were short-stay patients interviewed. Data are missing on 3 short-stay patients.

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L. NORMANDIN, MD; C. GODIN, MD, FRCSC; J. FOWLES, MB, FRCSC

Le syndrome des loges de la jambe et le scorbut

Il importe aux professionnels de la santé de se souvenir des maladies d'autrefois et de savoir reconnaître la population à risque dans notre société. Les auteurs décrivent le cas d'une mère immigrante âgée de 42 ans, vivant sous le seuil de la pauvreté, qui a subi une fasciotomie à l'hôpital Hôtel-Dieu de Montréal pour un syndrome des loges postérieures de la jambe. Elle présentait des ecchymoses de la peau de la jambe et un hématome intermusculaire du mollet. Trois semaines plus tard, la malade est revenue avec une récidive de la douleur et une enflure de la jambe, une gingivite hypertrophique, une folliculite hémorragique, des pétéchies et une hémorragie digestive. La réponse clinique à la vitamine C fut remarquable et a confirmé le diagnostic de scorbut.

Old people living alone and in poverty are most at risk for developing scurvy, but the diagnosis may be missed unless the physician is aware of it. A 42-year-old immigrant living in poverty was treated surgically at the Hôtel-Dieu Hospital in Montreal for a compartment syndrome of the leg. She had ecchymoses on the skin of the leg and an interstitial hematoma in both posterior compartments. Three weeks later, she was readmitted with more swelling in the leg, gingivitis, hemorrhagic folliculitis, petechiae and gastrointestinal hemorrhage. Her response to vitamin C was remarkable and confirmed the diagnosis of scurvy.

Le scorbut est une maladie qui se rencontre rarement dans notre société. Aussi peut-elle se manifester avec des signes cliniques capables de nous la faire confondre avec d'autres pathologies plus courantes comme une vasculite, une diathèse hémorragique ou une thrombophlébite profonde.[1]

De Section d'orthopédie, hôpital Hôtel-Dieu de Montréal, Montréal, PQ

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Les demandes de tirés à part doivent être adressées au: Dr J.V. Fowles, 3875, rue St-Urbain, Ste 209, Montréal, PQ H2W 1V1

Le diagnostic précoce ne peut être fait que si le médecin traitant considère cette possibilité dans l'éventail des diagnostics différentiels. Pour illustrer cette affirmation, nous présentons l'histoire d'une patiente qui fut traitée pour un syndrome non traumatique des loges de la jambe sans que l'on puisse reconnaître l'étiologie exacte de ce syndrome.

Histoire de cas

Il s'agit d'une patiente de 42 ans d'origine Portugaise, mère de huit enfants, issue d'un milieu social défavorisé, qui se présente au service d'urgence en mai 1985 pour des douleurs persistantes à la jambe gauche. L'examen physique est considéré comme normal et elle reçoit des analgésiques mineurs.

Cette patiente se présente de nouveau en juin 1985 pour persistance des douleurs à la jambe avec, comme éléments nouveaux, un gonflement important et une ecchymose au niveau du mollet gauche. Le diagnostic soupçonné est alors une thrombophlébite ou une rupture du plantaire grêle. On procède à une radiographie simple, une échographie du mollet et une phlébographie qui s'avèrent normales. L'hémoglobine sanguine est mesurée à 117 g/L et l'hématocrite à 35.3.

Quelques jours plus tard, le gonflement du mollet progresse à un point tel qu'on pose un diagnostic de syndrome de la loge postérieure de la jambe gauche et la malade est vue en orthopédie.

La prise des pressions dans la loge postérieure superficielle (38 mm Hg) et profonde (60 mm Hg) confirme le diagnostic et on procède sous anesthésie générale à une fasciotomie des deux loges postérieures. Les muscles superficiels et profonds sont normaux sauf pour la découverte d'un hématome inter- et intramusculaire disséquant les plans des différents fascias.

La plaie chirurgicale cicatrise apparemment normalement par la suite.

Vingt jours plus tard, la patiente se présente de nouveau à l'urgence avec atteinte de l'état général: asthénie marquée, gingivite hypertrophique, folliculite hémorragique, pétéchies et hémorragie digestive avec hématémèse. Il y a aussi une récidive de la douleur et du gonflement au mollet gauche, et une déhiscence de plaie. L'hémoglobine est alors à 63 g/L avec une leucopénie associée.

Un bilan nutritionnel confirme que la patiente ne consomme aucun fruit ou légume. L'apport quotidien de vitamine C est établi à 0.5 mg/d tandis que le taux normal est de 60 mg/d. Le taux plasmatique était à 17 μmol/L, à la limite inférieure de la normale (normale: 11.4 à 113.6 μmol/L).

La patiente est traitée par des doses quotidiennes de vitamine C (500 mg/d) par voie orale. La réponse clinique est remarquable.

Discussion

Le syndrome des loges secondaire à une coagulopathie, comme l'hémophilie est bien connu,[2] mais le scorbut ne fut jamais rapporté comme pouvant être à l'origine de ce syndrome.

Le scorbut était autrefois une maladie endémique parmi les marins et les immigrants car ceux-ci manquaient de légumes et de fruits frais pendant des semaines ou des mois d'affilés lorsqu'ils étaient en mer. Actuellement le scorbut ne se rencontre qu'exceptionnellement dans les milieux soci-économiques défavorisés.[3]

Jacques Cartier[4] fut l'un des premiers européens à connaître le traitement du scorbut. En 1535, alors qu'il passait l'hiver au bord de la rivière St-Charles où se trouve aujourd'hui la ville de Québec, plusieurs de ses marins souffrirent de scorbut et 26 d'entre eux moururent.

Un indien leur a alors enseigné comment guérir cette maladie avec des extraits de feuilles de conifères. Ce mystérieux remède s'appelait "Anneda". Après quelques jours les symptômes ont commencé à régresser et la maladie disparut.

Par la suite, les européens ont oublié ce remède pendant près de deux siècles, et ce n'est qu'en 1753 que le docteur James Lind[5] étudia cette maladie chez des groupes sélectionnés de marins et constata une incidence diminuée de scorbut au sein d'un groupe de marins ayant consommé des agrumes. Le capitaine James Cook appliqua les études de Lind et réussit à se protéger du fléau du scorbut lors des périples en mer. Le privilège d'identifier l'agent anti-scorbutique revint à Harden et Zilva[6] en 1918 qui nommèrent cet agent la vitamine C.

On sait aujourd'hui que la vitamine C agit comme agent réducteur permettant une hydroxylation de la proline et lysine et favorisant par-delà la biosynthèse du collagène. La plupart des manifestations cliniques, d'ailleurs, s'expliquent par l'instabilité des fibrilles de tropocollagène, dont les liaisons transversales sont affai-

blies, et qui produisent en conséquence la dégradation du tissu conjonctif vasculaire et des espaces périvasculaires.[1,7] Les manifestations cliniques apparaissent habituellement lorsque la réserve corporelle totale de vitamine C approche 300 mg (la normale est de 1500 mg). Un apport quotidien de 10 mg peut maintenir la réserve corporelle totale à 350 mg. La dose minimale recommandée pour prévenir cette maladie est de 60 mg/d. Pour corriger une déficience déjà existante, de 300 à 500 mg/d sont nécessaires.

Le scorbut est généralement causé par une carence nutritionelle en fruits et légumes frais, et peut prendre de 4 à 6 mois avant de se manifester. Les signes cliniques sont une diathèse hémorragique par fragilité capillaire pouvant se manifester par des gingivites et folliculites hémorragiques, ecchymoses, pétéchies et hémorragies gastro-intestinales. Chez l'enfant on peut rencontrer une hémorragie sous-periostée avec glissement épiphysaire aux membres inférieurs et déformation du thorax en baïonnette. Le niveau urinaire et plasmatique d'acide ascorbique se situe alors sous la limite inférieure, quoique dans le cas présenté le niveau plasmatique de vitamine C était juste à la limite inférieure de la normale. Finalement, la réponse clinique et biochimique s'avère dans l'ensemble favorable à l'apport soutenu de vitamine C.

En conclusion, il importe aux professionnels de la santé de se souvenir des maladies d'autrefois et de savoir reconnaître la population à risque élevé dans notre société: personne âgée, isolée, vivant sous le seuil de pauvreté avec une alimentation déficiente.[1,8]

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DAVID ROUSELLE, MD, FRCSC;* JOHN JARRELL, MD, FRCSC;* LARRY BELBECK, DVM, PH D;† ESTEBAN ANDRYJOWICZ, MD, FRCSC;* PAUL HIBBERT, MD, FRCSC;* A. MCMAHON*

Thrombin as an Adjuvant to Reanastomosis of the Fallopian Tubes Reduces Implantations in the Rabbit

To study the efficacy of topically administered thrombin as an adjuvant in tubal microsurgery, 24 rabbits underwent a 1-cm resection and microsurgical anastomosis of both fallopian tubes and were randomized to either thrombin or cautery for hemostasis. Ovarian wedge biopsies were done on the left ovary. The animals were mated 4 to 5 weeks postoperatively with a buck of proven fertility. They were killed at 2 to 3 weeks' gestation to note the number of fetuses per patent tube and presence or absence of pelvic adhesions. There was no effect of topical thrombin on the crude pregnancy rate but it was associated with a marked reduction in the number of fetuses per patent tube, despite similar rates of pelvic adhesions between groups. Topically administered thrombin appeared to reduce fertility in this experimental model by an undefined mechanism.

Dans une étude portant sur l'administration de thrombine par voie topique comme traitement d'appoint en microchirurgie tubaire, 24 lapines ont subi une résection d'un segment de 1 cm, puis une anastomose microchirurgicale des deux trompes utérines. Pour réaliser l'hémostase, les animaux ont ensuite, après attribution au hasard, été soit cautérisés, ou ils ont reçu de la thrombine topique. Une biopsie cunéiforme de l'ovaire gauche fut pratiqué. Les lapines furent accouplés de 4 à 5 semaines après l'opération avec un mâle de fertilité certaine. Elles furent sacrifiées à la 2e ou 3e semaine de gestation pour permettre l'observation du nombre de foetus par trompe perméable et la présence ou l'absence d'adhésions pelviennes. On n'a constaté aucun effet de la thrombine topique sur le taux brut de grossesse mais le traitement fut relié à une diminution marquée du nombre de foetus par trompe perméable, malgré des taux similaires d'adhésions pelviennes chez les deux groupes. Dans ce modèle expérimental, la thrombine administrée par voie topique semble diminuer la fertilité par un mécanisme qui demeure inexpliqué.

*From the *Department of Obstetrics and Gynecology and †Department of Pathology, McMaster University, Hamilton, Ont.*

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Reprint requests to: Dr. J. Jarrell, Department of Obstetrics and Gynecology, McMaster University, 1200 Main St. W, Hamilton, Ont. L8N 3Z5

The prevention of postoperative pelvic adhesions remains a fundamental goal in microsurgical repair of the fallopian tube.[1,2] There is increasing evidence that the cause of peritoneal adhesions is trauma and ischemia of the tissues being dissected.[3,4] Inadequate hemostasis has similarly been associated with pelvic adhesions, particularly when ischemic tissue is present.[3,4] While such adhesions do not necessarily produce sterility in women, they are frequently associated with failure to conceive postoperatively.[5]

For many years a large number of adjuvant treatments have been used to prevent adhesions.[6,7] It is of interest that although many have been used extensively, very few studies have evaluated the ability of these agents to preserve fecundity rather than simply inhibit adhesions. Topically administered thrombin has been suggested as an adjuvant to microsurgery to prevent adhesions by reducing capillary oozing and maintaining hemostasis.[8,9]

The purpose of this study was to investigate the effects of topical thrombin on the reproductive capacity of New Zealand white rabbits that had undergone resection and repair of the fallopian tubes.

Material and Method

Twenty-four female New Zealand white rabbits, maintained on food and water *ad libitum*, were randomly allocated to receive either topical thrombin or bipolar cautery for hemostasis after surgery.

On the day of operation, the rabbits were anesthetized intramuscularly with 200 mg ketamine and 25 mg promethazine, then intubated and ventilated with enflurane. Under general anesthesia, the

abdomen was opened through a midline incision, the uterine horns were identified and a 1-cm segment of each fallopian tube was resected 1 to 2 cm distal to the tubal–uterine junction, after methylene blue injection of the tubes. Standard microsurgical reanastomosis of the tube ends was performed using 8-0 Vicryl interrupted sutures in a one-layer closure. Wedge biopsy of the left ovary was also done in all rabbits. During the procedure, hemostasis was maintained with either bipolar microcautery or topical administration of thrombin in saline (1000 units/ml). The abdomen was closed with interrupted polyglycolic acid sutures and the rabbits underwent a period of recovery. They were mated 4 to 5 weeks postoperatively with a single buck of proven fertility.

The rabbits were killed 2 to 3 weeks after mating. At autopsy, the presence or absence of pregnancy, the number of implantations per tube, the patency of the tubes (determined by methylene blue injection), the presence or absence of ovarian or nonovarian adhesions were all noted by an observer blinded to the grouping of the rabbits.

A 1-cm segment of the tube in the region of the anastomosis was removed, placed longitudinally in paraffin and sectioned at 10 μm through its entire length. Sections were prepared by alcohol dehydration and hematoxylin and eosin staining. One blinded observer evaluated each tube to identify the anastomotic site. Luminal (L), submucosal (S) and muscularis (M) areas were measured on a Bioquant Digitizing System (R. and M. Biometrics Inc., Nashville, Tenn.). To determine the proportion of tube that was submucosal tissue, the following equation was used:

$$\% \text{ submucosal area} = \frac{(S - L) \times 100\ \mu m^2}{M}.$$

The coefficient of intra-observer variation in measurement was 2.2%.

Results

Seven rabbits died during the procedure, five in the cautery group and two in the topical thrombin group. The deaths were thought due to anesthetic complications in all but one rabbit which died of enflurane hepatotoxicity.

No differences were noted between groups with respect to animal weight, specific operator experience, the time taken for the procedure or the number of sutures used (Table I) ($p > 0.05$).

There was no difference in the overall pregnancy rate: six of eight rabbits in the cautery group became pregnant as did five of nine in the topical thrombin group ($p > 0.05$) (Table II). There was no difference in tubal patency rates between the groups.

Topical administration of thrombin produced a significantly ($p < 0.05$) lower number of implantations per patent tube on the horn contralateral to the ovarian biopsy when compared with the number in rabbits treated with bipolar cautery (Fig. 1). A similar trend was noted on the ipsilateral side but the difference was not significant. Ovarian biopsy markedly lowered the total number of implantations per patent tube in animals receiving bipolar cautery ($p < 0.5$) but had no effect on animals treated topically with thrombin.

Table I—Comparison of Animals and Surgical Procedures (Means ± Standard Error of Mean)

	Cautery	Topical thrombin
Weight, kg	3.97 ± 0.24	4.11 ± 0.30
Operator experience*	18.3	16
Time for procedure, min		
Right	26.3 ± 14.5	33.0 ± 15
Left	28.1 ± 15.4	25.9 ± 12.9
Number of sutures		
Right	4.5 ± 1.8	4.2 ± 0.4
Left	3.8 ± 0.3	4.1 ± 0.7

*The numbers refer to the graded total number of procedures done by all operators.

Table II—Comparison of Bipolar Cautery and Topical Thrombin on Pregnancy Rate

	Bipolar cautery	Topical thrombin
No. randomized	13	11
No. deaths due to anesthetic	5	2
Pregnant rabbits	6	5
Nonpregnant rabbits	2	4

Table III—Incidence of Nonovarian Adhesions in Rabbits With Patent Right Tube

	Cautery		Thrombin	
	Left	Right	Left	Right
Ovarian adhesions	6	1	7	1
Nonovarian adhesions	3		8	
Both ovarian and nonovarian adhesions	2		5	
Patent tubes	8	5	6	9
Implant/patent tube	16/8	27/5	6/6	24/9
Patent tube				
No adhesions*	1	4	1	1
Adhesions	7	1	5	8
Implant/patent tube				
No adhesions†	6	22	2	4
Adhesions	10	5	4	20

*Neither ovarian (that side) nor nonovarian.
†No. of implants in rabbits with patent tubes and neither ovarian nor nonovarian adhesions.

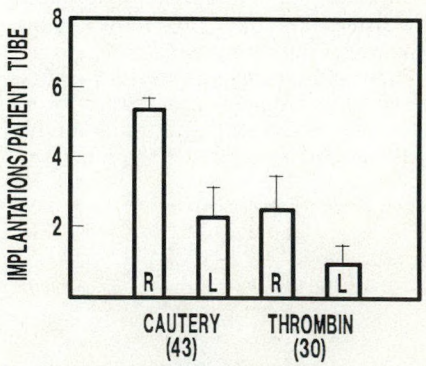

FIG. 1—Comparison of bipolar cautery and topical thrombin implantation rates per patent tube. Topical thrombin reduces number of implantations per patent tube on side contralateral to ovarian biopsy (i.e., right side). Ovarian biopsy was associated with reduction in implantations per patent ipsilateral tube. This reached significance only in cautery treated group. Numbers in brackets refer to total number of implantations per group.

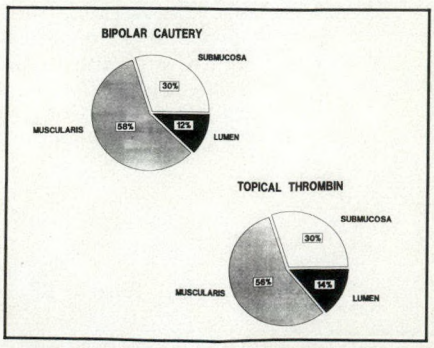

FIG. 2—Comparison of bipolar cautery and topical thrombin with respect to percentage submucosal area at anastomosis. No differences were noted.

There was no difference in the overall incidence of ovarian or nonovarian adhesions between the cautery and thrombin groups. However, in rabbits with patent tubes, there was a significant ($p < 0.05$) increase of nonovarian adhesions in those that received thrombin (Table III).

The percentage of cross-sectional area taken up in submucosal tissues is shown in Fig. 2. At autopsy in 17 rabbits, the anastomosis could be identified in 14. All other sections appeared to be completely healthy and were not measured. There was no difference between the groups.

Discussion

The purpose of this experiment was to compare the use of topical thrombin (Thrombostat; Parke-Davis Canada Inc., Scarborough, Ont.) to current therapy, bipolar microcautery, with respect to efficacy and safety. The results of these procedures are consistent with those of other reports using rabbits for models of tubal microsurgery, particularly with reference to survival from general anesthesia.[10] Nonoperative mating controls were not included in this efficacy trial, yet the numbers of implantations per patent tube in the cautery group did not differ appreciably from those in other studies of mating rabbits.[11]

The crude pregnancy rates were similar in both groups. Thrombostat, however, was associated with a measurable reduction in the number of implantations per patent tube. The mechanism of the reduction is not apparent from our data. It does not appear to be a consequence of either tubal obstruction or ovarian adhesions. Contrary to previous reports, there was no difference in the percentage of the area of submucosal tissues between groups.[8] Significantly more rabbits with patent tubes who were treated with topical thrombin had nonovarian adhesions, and the reduction in implantation rate in thrombin-treated animals may be a consequence of disordered tubal motility. Alternatively, the adhesions may be unrelated to the outcome and could suggest other nonspecific and poorly defined factors regulating pregnancy.

Ovarian biopsy was associated with a substantial reduction in implantation per patent tube, particularly in the cautery group. This reduction was possibly due to ovarian adhesions which consistently occurred with greater frequency on the side of the ovarian biopsy. Such observations are in agreement with studies of fertility after ovarian wedge resection.[12]

In summary, topically administered thrombin is associated with a significant reduction in implantation per patent tube, possibly because more frequent nonovarian adhesions are associated with its use. These data do not support the application of this agent as an adjuvant to microsurgical tubal reconstruction. Moreover, the presence of a measurable reduction in fecundity, as measured by implantation per patent tube, suggests that the reproductive toxicity of an adjuvant may not be fully appreciated without an evaluation of the effects on mating outcome.

We acknowledge the help provided by Jane Bennett, Marge Gibbons, Karen Gourlay, Dr. Joanne Johnson, Avril McMahon and Dr. Nabil Namis. Sutures were supplied by Ethicon Ltd., Peterborough, Ont.

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SESAP V Critique

ITEMS 51-53

Crohn's disease and tuberculous enteritis may mimic each other's clinical and roentgenographic manifestations. Both chest roentgenogram and purified protein derivative, which may be negative in a significant number of cases of intestinal tuberculosis, are unreliable diagnostic aids. For the patient described, Crohn's disease was initially the most likely diagnosis. This disorder is much more common than tuberculous enteritis and no absolute clues pointed to the diagnosis of tuberculous enteritis. The patient was treated with the usual supportive measures plus corticosteroids, but her condition rapidly deteriorated, necessitating celiotomy.

With the other findings, the presence of subserosal nodules or granulomas should have made the surgeon strongly suspicious of tuberculous enteritis. Excision of a lymph node with immediate examination was indicated. The slide showed caseation necrosis in the node, which confirms the disease, and no further definitive operation is indicated. The patient should be treated with antituberculous drugs postoperatively. Sarcoidosis, small bowel lymphoma, and Whipple's disease have clinical and roentgenographic manifestations that do not resemble Crohn's disease and tuberculous enteritis.

51 [B] 52 [C] 53 [E]

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continued from page 15

description of pelvic anatomy and a fine discourse on the value of the extraperitoneal approach to pelvic surgery. The account of abdominal hysterectomy does not mention the intrafascial hysterectomy but digresses into the treatment of endometriosis and the staging of endometrial cancer.

In our experience, far less than 50% of patients with ectopic pregnancy are admitted to hospital in shock. This was true as far back as 1970 and it is certainly true today. Postoperative management should mention the use of RhoGAM rather than concentrating on the need for concurrent appendectomy. The differential level of human chorionic gonadotropin is 6500 mIU/ml not 65 mIU/ml as described. In our experience, far less than 30% of pelvic abscesses merit colpotomy.

I found most worthwhile the description and illustrations on the recognition of the submucosa of the intestine by its resistance to, and the white circle it causes to form at, the point of the penetrating needle.

There are a number of areas in the section on urology that engaged my interest. I have never before seen two types of the Burch procedure described, one in which the urethra is compressed and one in which this is avoided; it is interesting to find that the first Marshall–Marchetti–Krantz procedure was done on a man who suffered urinary stress incontinence after an abdominoperineal resection. The operation described for urethral lengthening is old-fashioned, as is the use of 2-0 chromic suture for the urethral suspension. End-to-end ureteric anastomosis has better results today than the 20-year-old reference quoted suggests.

In summary, the text is beautifully produced and interesting to read. Resident staff in gynecology would especially gain from its purchase.

MARK E. BOYD, MD, FRCSC,
FRCOG, FACOG

Vice chairman,
Department of Obstetrics and Gynecology,
Royal Victoria Hospital,
687 Pine Ave. W,
Montreal, PQ
H3A 1A1

ROB & SMITH'S OPERATIVE SURGERY. 4th ed. Edited by Hugh Dudley and David Carter. Thoracic Surgery. Edited by John W. Jackson and D.K.C. Cooper. 380 pp. Illust. Butterworth and Co. (Publishers) Ltd., London; Butterworth Publishers, Stoneham, Mass., 1986. $99.95 (US). ISBN 0-407-00661-3.

Readers will note an important change in this the fourth edition of the series *Operative Surgery*, namely, the division of cardiac and thoracic surgery into two separate volumes.

The volume on thoracic surgery is divided into three sections: general thoracic, pulmonary and esophageal surgery. The objective of the general editors to give this book an international flavour is definitely achieved; well-known authors from many countries have contributed. Most chapters have an identical pattern which makes quick reference easy. There is little critique and few descriptions of alternative methods, except for the many variations

Instructions to Contributors

All initial communications should be addressed to the Coeditors, Canadian Journal of Surgery, *PO Box 8650, Ottawa, Ont. K1G 0G8.*

Manuscripts of original articles and other contributions, including a limited number of case reports, should be submitted, in triplicate, *in English or French, with a covering letter requesting consideration for publication. Authors must also include a statement indicating that the manuscript is not under consideration by any other journal and has not been published previously. The manuscript should be typed on one side of plain paper, double spaced with wide margins. Measurements should be expressed according to the* Système international d'unités.

Illustrations (e.g., photographs of clinical material, roentgenograms, photomicrographs, graphs and diagrams), in triplicate, *should be in the form of glossy, unmounted and untrimmed prints, not larger than 20 × 25 cm. A legend must be supplied for each; the legend(s) should be typed on a page separate from the text of the article. For a roentgenogram submit a print rather than the original; for a photomicrograph include details of the stain used and the magnification in the legend. Lettering identifying parts of the illustration should be large enough to remain visible when the illustration is reduced in size for publication. A patient must not be recognizable unless written consent has been obtained; otherwise facial features may require blocking. Colour work can be published only at the author's expense. If an illustration is taken from a source other than the author's, letters of permission to reproduce must be obtained from the original publisher and author.*

Tables, the design of which is best considered in regard to the rectangular format of the Journal, should be submitted separate from the text, one to a page.

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An abstract in English, and in French if possible, about 125 words long, should accompany each article, on a separate page.

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Un résumé, en français et aussi en anglais, qui ne doit pas dépasser 125 mots doit accompagner chaque article sur une feuille séparée.

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in thoracic drainage found throughout the book — from the historic use of the Tudor-Edwards empyema trocar to the simpler and safer hemostat and finger method, which is our preference. There is no mention of helpful adjunctive measures such as fluoroscopy, echography or computerized tomography for localizing loculated fluid.

The book is abundantly illustrated. Most of the drawings are very good and many are excellent but a few, such as those in the extended chapter on hydatid cyst, are not worthy of a quality publication.

Most chapters in the general thoracic section have been rewritten or updated. The chapter on management of blunt thoracic injuries is excellent.

In the pulmonary section, the investigative techniques are well described and illustrated. Although most chapters are new, there is much emphasis on techniques that are less in use today, such as bronchography and scalene-node biopsy. The excellent sections on tracheal resection for stricture and thoracoplasty have changed very little. Many chapters, such as those on tracheotomy, decortication of the lung, excision of empyema, mediastinoscopy and resection of the lung, have a completely new face — new text and new illustrations. In the section on management of spontaneous pneumothorax, the popular axillary thoracotomy approach is not mentioned. There are some completely new chapters on thoracoscopy and thoracostomy for permanent chest drainage. Although some subjects are treated rather briefly, this section covers pulmonary surgery adequately.

The essentials of esophageal surgical techniques are well described with the exception of those related to the cervical esophagus. In our opinion, surgery of the cervical esophagus, related to diverticula or cricopharyngeal dysfunction should be included in order to have a more comprehensive coverage of esophageal surgery. The chapter on esophagoscopy has been entirely updated, taking into consideration the great strides made in flexible endoscopy and the palliative treatment of tumours by this method. Unfortunately, the better chapters are not necessarily the ones covering more frequently used techniques, such as treatment of gastroesophageal reflux without stenosis or short esophagus, and, often, the illustrations in chapters describing more frequently used techniques are less numerous and less explicit. The best pages in this section concern esophageal stenosis, covering the more recent knowledge and use of autosutures. Esophagectomy without thoracotomy is well described but unfortunately has no critique or discussion.

From our point of view a book on surgical technique should be useful to the surgical resident who must acquire knowledge and gradually mould opinions and to the practising surgeon for use as a reference tool. Although the objectives are not necessarily reached in all chapters for the student, this book will be useful to the surgeon.

ARTHUR PAGÉ, MD, FRCSC
MICHEL ALLARD, MD, FRCSC

Département de chirurgie,
Hôpital du Sacré-Coeur de Montréal,
5400, boul. Gouin ouest,
Montréal, PQ
H4J 1C5

SILVERGIRL'S SURGERY. THE VEINS. Edited by Harold Laufman. 273 pp. Illust. Silvergirl, Inc., Austin, Tex.; Year Book Medical Publishers, Inc., Chicago, 1986. $39.95 (US). ISBN 0-941432-18-1.

This book is a collection of papers, in English, French or German, relating to venous disease over the centuries. Except to present the papers, the editors have made no comment.

The layout of the book is good and the headings are appropriate. The editor has set himself a huge task in trying to cover the development of treatment and surgery of the veins from their beginning to the present, and has unfortunately fallen short of the stated objectives. He would have done better to look at the history of venous surgery and offer a better presentation. The more recent papers selected are not sufficiently representative of the development of a scientific basis for the treatment of venous disease in the last 30 years. The obvious papers that were omitted were those relating to injection treatment of varicose veins, one by Fegan and the other by Hobbs, the former being a landmark paper in the treatment of varicose veins.

This book will be of interest to vascular and general surgeons who deal with venous disease and are also interested in its historical aspects. It may also be useful for medical libraries as a reference book only, thus limiting its audience. It is unfortunate that the editor did not select more appropriate papers and provide some editorial comment with each, which would have been useful.

Overall, I would not recommend this book for a general medical audience.

F. MICHAEL AMELI, MB, CH B, FRCS(EDIN), FRCSC, FACS

Ste. 313,
E.K. Jones Building,
The Wellesley Hospital,
160 Wellesley St. E,
Toronto, Ont.
M4Y 1J3

SKELETAL METASTASES. C.S.B. Galasko. 160 pp. Illust. Butterworth and Co. (Publishers) Ltd., London; Butterworth Publishers, Stoneham, Mass., 1986. $115.00 (US). ISBN 0-407-00409-2.

Drawing on 20 years' experience of research in the field, Galasko, professor of orthopedic surgery at the University of Manchester in England, has written a slim monograph that compiles the current information on this distressing condition.

Skeletal metastases are the commonest forms of malignant bone tumour. They may cause severe pain and major complications but are seldom fatal. The aim of this book is to describe recent advances in the understanding of these lesions, to indicate methods of detection and to discuss treatment.

The book breaks down into two sections. The first half contains a description of the origin of metastases and possible explanations of the targets chosen by a particular tumour, and its local and general reaction. Professor Galasko also discusses in detail the detection of skeletal metastases by radioactive isotopes

and other ancillary devices. This section is obviously of interest to oncologists and specialists in nuclear medicine.

The last half of the book is devoted to local and general manifestations of skeletal metastases and their treatment. This section is of interest to residents, orthopedic surgeons and oncologists who have to deal with these conditions.

The book is well written and lavishly illustrated with roentgenograms. It is essentially a "why to" book, covering the reasons behind the choice of a specific implant in a particular situation. The numerous references at the close of every chapter help to provide an easy solution to the "how to".

Professor Galasko has succeeded in his objectives and I think that this monograph is a worthwhile endeavour.

HUGH U. CAMERON, MB, CH B, FRCSC

Ste. 318,
43 Wellesley St. E,
Toronto, Ont.
M4Y 1H1

STROKE. Pathophysiology, Diagnosis, and Management. 2 volume set. Edited by Henry J.M. Barnett, Bennett M. Stein, J.P. Mohr and Frank M. Yatsu. 1293 pp. Illust. Churchill Livingstone, Edinburgh; Academic Press Canada, Don Mills, Ont., 1986. $254.50 (set). ISBN 0-443-08260-X (set).

The various aspects of stroke have provided much excitement over the past two decades because of expanding knowledge and the pace of technologic change. This encyclopedic work, dealing with the genesis and management of cerebral disease, is, therefore, timely and welcome.

The pathophysiology, clinical manifestations, investigation, medical and surgical management of the various entities falling under the heading of stroke are covered in detail in two volumes. Sixty-one chapters by authoritative authors deal with the common as well as the less-common but interesting and important causes of ischemic and hemorrhagic stroke such as fibromuscular dysplasia and Moyamoya disease.

The text is well organized, detailed, concise and readable. Illustrations are appropriate and references are extensive and well chosen, guiding the interested reader deeper into areas of particular concern.

The clinical epidemiologic sections are detailed and will be of interest, particularly in regard to the declining incidence of stroke. to readers in many disciplines. Chapters on specific disease entities and on medical disorders associated with stroke stand alone and are readily referred to in the course of everyday practice.

The therapeutic sections are current and detailed. Surgical treatment is well covered, including specific indications for surgery and surgical complications. In most instances, controversial matters are well and extensively handled. The chapter on cerebral bypass operations, for example, includes the findings of the International Cooperative Study of Extracranial to Intracranial Anastomosis and the chapter on asymptomatic carotid stenosis is an excellent summary of current epidemiologic findings and presents clear conclusions. Some controversial areas, for example intraoperative monitoring and intraluminal bypass in carotid endarterectomy and consideration of emergency thromboendarterectomy for internal carotid occlusion, might have been dealt with less dogmatically by means of balanced discussion.

Most sections of these two volumes will be of great interest to, and deserve detailed reading by, practising neurologists and neurosurgeons, to interested vascular surgeons and to trainees in these disciplines. Internists and general practitioners will find investigation and current therapy well covered, and the sections on particular lesions like intracranial aneurysms serve as a concise and well-organized reference for emergency physicians and others who are required to deal with cerebrovascular problems occasionally but not on a daily basis. Chapters like "coagulopathy and stroke" and "stroke and substance abuse" may interest a wide range of practitioners.

These two volumes fill a real need for an extensive but readable work on all aspects of cerebrovascular disease, and the editors and authors are to be commended on meeting this need superlatively.

D.W. ROWED, MD, FRCSC

Head, Division of Neurosurgery,
Sunnybrook Medical Centre,
University of Toronto,
2075 Bayview Ave.,
Toronto, Ont.
M4N 3M5

SURGERY OF THE FOOT. Kent K. Wu. 537 pp. Illust. Lea & Febiger, Philadelphia, 1986. $86.50. ISBN 0-8121-0995-3.

The author of this book is a member of the orthopedic staff of the Henry Ford Hospital in Detroit. He trained under C. Leslie Mitchell, who popularized the Mitchell's bunionectomy, and took over Dr. Mitchell's busy practice. He writes on his experience with tens of thousands of patients suffering from various congenital and acquired foot problems.

Although entitled *Surgery of the Foot*, the text deals with all aspects and principles of nonsurgical treatment. It encompasses the clinical symptoms and signs, radiologic manifestations, pathologic anatomy and treatment of each foot disorder.

All conditions of the foot are covered; the final 145 pages are presented as an atlas of common, unusual and rare foot disorders, along with a brief discussion of the clinical manifestations.

The text is well planned and organized. The author uses hundreds of detailed line diagrams and provides extensive, up-to-date references at the end of each chapter for easy access to more-detailed information.

I think the information in the book is accurate and I highly recommend it as an authoritative reference for the family practitioner and specialist.

MAX VECHTER, MD

Department of Orthopedic Surgery,
Ottawa Civic Hospital,
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L'UNIVERSITÉ D'OTTAWA ouvre un concours pour le poste de directeur de la division de chirurgie vasculaire. Les personnes qualifiées devront avoir un certificat du Collège royal des médecins et chirurgiens du Canada et être admissibles aux permis d'exercer du Collège des médecins et chirurgiens de l'Ontario. La personne choisie aura la responsabilité de voir au développement du programme de recherche en plus de voir à la surveillance des programmes de formation au niveau prédiplômé et postdoctoral et à la coordination des programmes d'enseignement intégrés dans les hôpitaux affiliés, soit à l'Hôpital général d'Ottawa, l'Hôpital Civic d'Ottawa, l'Hôpital pour enfants de l'Est de l'Ontario et le Centre médical de la défence nationale. Conformément aux exigences prescrites en matière d'immigration au Canada, cet avis de concours s'adresse aux citoyens canadiens et aux résidents permanents. Prière de faire parvenir votre curriculum vitae et la liste des références avant le 15 février 1988 à l'attention de: **Dr W. J. Keon, Directeur, Département de chirurgie, Clinique Parkdale - pièce 111, Hôpital Civic d'Ottawa, 1053, avenue Carling, Ottawa, Ontario, K1Y 4E9.** —S88-12

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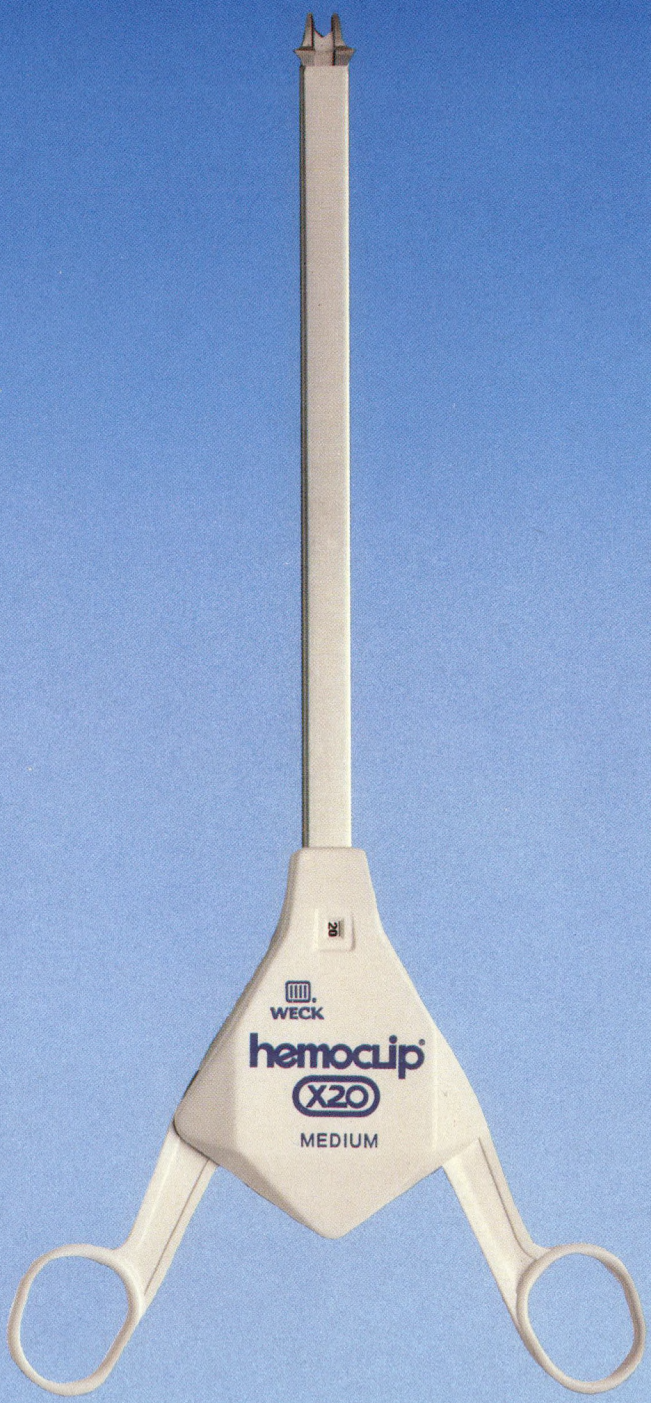

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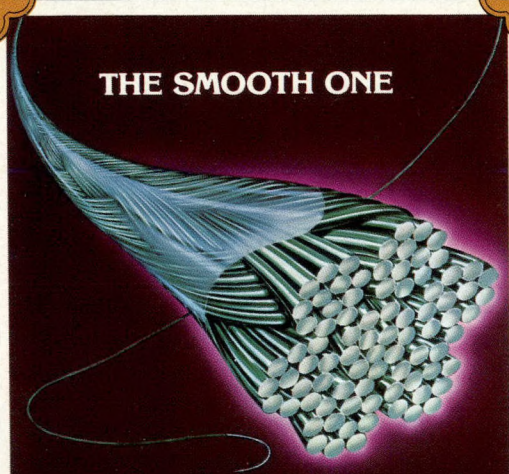

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