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HISTORY OF CANADIAN SURGERY

ALEXANDER PRIMROSE
1861 - 1944

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FOR MORE THAN half a century, Alexander Primrose occupied a unique position in the world of surgery. He came to Toronto from Nova Scotia, a young man in his late twenties. He achieved eminence as a pathologist, an anatomist, a surgeon, a teacher, a soldier and as a leader in organized medicine. He died beloved and mourned by generations of doctors who had come under his influence as students and by hundreds of patients and soldiers and honoured by his peers and colleagues.

He was born in Pictou, Nova Scotia, in 1861. When a youth, the plan that he should enter the tea planting business in India where there were family interests was changed by an accident. He used to say with relish: "I was kicked into surgery." An accident with a horse resulted in a broken leg, and in the long convalescence which followed he was taken to John Stewart of Halifax for advice. Stewart must then have been at the beginning of his great career as the leading surgeon of the Maritimes. He was Lister's clerk when Lister moved from Edinburgh to London in 1877. He was chosen by Lister to assist him in London. He walked all the way from Edinburgh to London, not because it was economically necessary, but because he was fond of walking. He returned to his native Halifax to initiate antiseptic surgery in Canada and he lived to see the development of modern aseptic surgery and finally the return to modified antiseptic surgery in the management of wounds in the 1914-1918 war.

Alexander Primrose's contact with John Stewart opened his eyes to a vision—the world of surgery—which must have been fascinating indeed to any young man in the days when the whole world of medicine was being revolutionized by antisepsis and the new approach to a host of diseases due to infection. The result was that he decided to become a doctor. India lost a good tea planter, the Empire a nabob, but Canada and the world gained a great surgeon and a wise administrator of medical affairs.

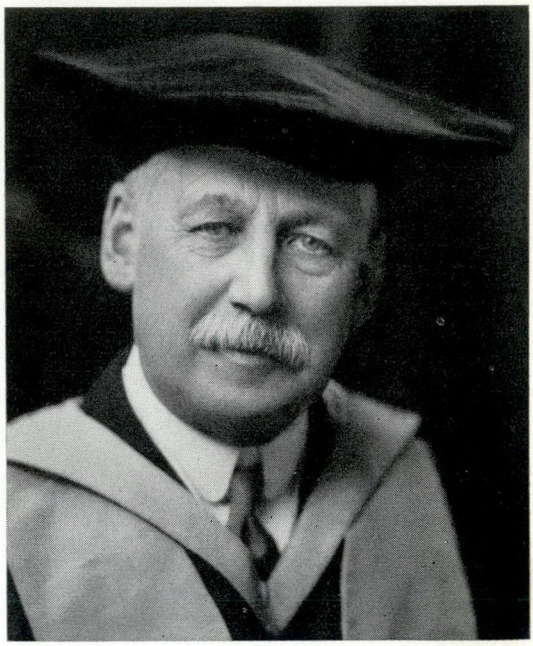

Fig. 1.—Alexander Primrose, 1926, LL.D. Edinburgh.

Like John Stewart and most young men from Nova Scotia, he went to Edinburgh for his medical education. He graduated from there M.B., C.M., in 1886 and then went to London to study at the Middlesex Hospital and the Great Ormond Street Hospital for Children. He came to Toronto in 1888 and there began his great career in surgery.

It is said, and I believe it is correct, that at some stage during his medical education, he failed in an anatomy examination. In view of his subsequent achievements as an anatomist this is ironical but in later years it enabled him to console those of his students who had similar misfortune and to encourage them to retrieve themselves by greater effort.

In his early days of practice, he distinguished himself by preparing and cutting the pathological sections from his own cases. Probably it was this interest in pathology which led to his appointment as President of the Pathological Society in 1898. From 1896 till 1907 he was Professor of Anatomy at the University of Toronto School of Medicine. It was in this capacity that he made one of his greatest contributions to medical teaching. He was an excellent anatomist, well trained in the Edinburgh school. He developed teaching methods which are still remembered, especially his summary of anatomy at the end of the term when the essentials of anatomy were reviewed in twelve lectures illustrated by blackboard diagrams in coloured chalks, drawn with both hands simultaneously while he lectured on the problem he was illustrating. The combination of lucid description, ambidextrous illustration in colour and synopsis of essentials made such an impression upon his students that years later in his retirement he was invited from time to time to take them back to their student days by repeating his fascinating survey of anatomy.

With all these and many other activities he was a practising surgeon. From 1918 to 1931 he was Professor of Clinical Surgery. He read widely and was a keen observer. He was a good teacher, not only because of the orderly presentation of facts, but also from the diversity of his interests, the breadth of his knowledge and his enthusiasm for every aspect of surgery. He managed to transfer some of his enthusiasm to his students. I can well remember his inspiring me to sit up all night to obtain samples of blood at hourly intervals from a patient with elephantiasis and to examine these under the microscope for *Filaria sanguinis hominis* which he said swarmed in the peripheral blood vessels only at night (but that night they did not swarm). There was warmth and humanity in his relations with students and his colleagues which won their admiration and friendship.

He went to Salonika in the First World War with the University of Toronto General Hospital (No. 4) as officer in charge of surgery. In 1916 his only son was killed in France. He was granted compassionate leave to return home because of this. He returned to England in 1917 as Consulting Surgeon of the Canadian Forces. He was made a Companion of the Order of the Bath (military division) in 1918 for his services in the war.

He had a strong sense of responsibility for the problems and duties of organized medicine and placed all his energy and ability at the disposal of the medical and surgical associations with which he was in contact. In 1921, when the Canadian Medical Association was so enfeebled and so deeply in debt that it was proposed that it give up its charter and abandon its existence, he played an important part in the re-organization of its constitution and the transfusion of new life and energy into the nearly defunct body. He was the first Chairman of the General Council of the Canadian Medical Association under the revised Constitution and he held this position for six years, 1924-30. He was President of the Canadian Medical Association in 1932. He was a good administrator and a strong committee man, quick to grasp the essentials of a problem, tactful of the opinions and feelings of committee members, hard-working and successful in keeping the problem in focus until a decision was reached. His equanimity and unfailing good humour tided his committee meetings through many a crisis. These qualities, in addition to his great interest in the scientific side of surgery, made him an asset in medical and surgical bodies. He was President of the American Surgical Association in 1931, the second Canadian to hold this office; President of the Academy of Medicine in Toronto in 1918 as well as previously holding the presidency of two of the bodies which united to form the Academy of Medicine—the Pathological Society of Toronto in 1898 and the Toronto Medical Society in 1900.

The greatest tribute to his administrative ability was his appointment as Dean of the Faculty of Medicine of the University of Toronto in 1920. He occupied this post for twelve years.

In his early youth he acquired the habit of keeping a record of his day's work and he continued this throughout his life. These were not diaries but rather notes concerning his work and his responsibilities. More-

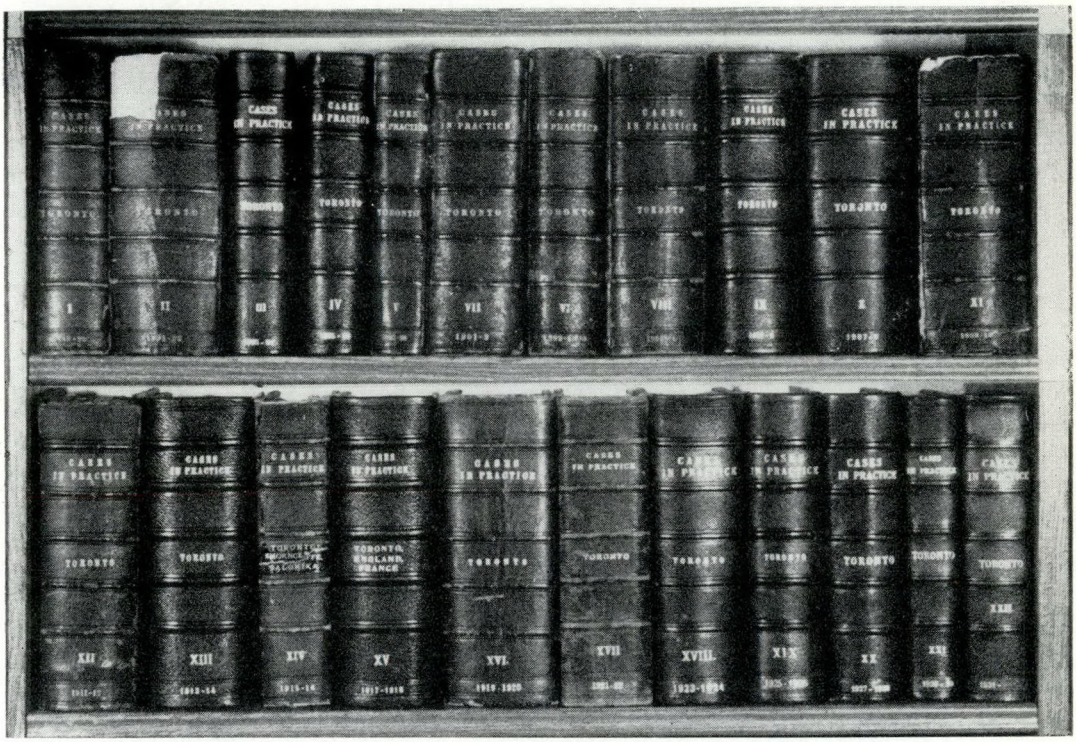

Fig. 2.—Dr. Primrose's Records of Cases in Practice from 1888 to 1943, now in the Academy of Medicine, Toronto.

over, he kept these memoranda. His family has a great mass of this material all written in his neat, minute hand, sometimes the notes of a journey, sometimes accounts of money spent or records of letters written, or some item he thought interesting or important. An amusing example of the latter is the correspondence between the headmistress of a girls' school in Toronto and Dr. Primrose in 1909. A certain medical student had disgraced the proprieties by waylaying the queue of schoolgirls returning from church on a Sunday evening to thrust into the hand of one of them a note to be delivered to another girl attending the school. The shocked headmistress wrote to Dr. Primrose, who was at that time the school doctor as well as a member of the Faculty of Medicine, asking him to demand of the medical student an explanation and apology. This he did but the apology the student wrote was facetious, insincere and anything but humble. It drew from Dr. Primrose a stinging note of reprimand. It was agreed that he was a disgrace to the medical school and would come to no good and that he had seriously compromised the reputations of the two girls. For some reason Dr. Primrose kept this correspondence. Written in the handwriting of Dr. Primrose across the foot of the copy of his letter to the student is an excerpt from Who's Who dated 1940, concerning the culprit. He had won a D.S.O. in the first war and was mentioned in dispatches; had done postgraduate work in London, Edinburgh and Vienna, had married a girl from Brussels (who had not attended school in Toronto) and was successfully practising in England. I can imagine the chuckles that Primmy enjoyed as he recorded the success of the renegade who so many years before had seemed headed for perdition.

His habit of note keeping is seen at its best in the bound volumes entitled, "Cases in Practice" which contain the records of his patients (Fig. 2). These were started when he commenced practice in Toronto in 1888 and continued until he ceased to see patients in 1943. In a series of small books he made notes each day on every new patient and every operation he performed. These were bound together

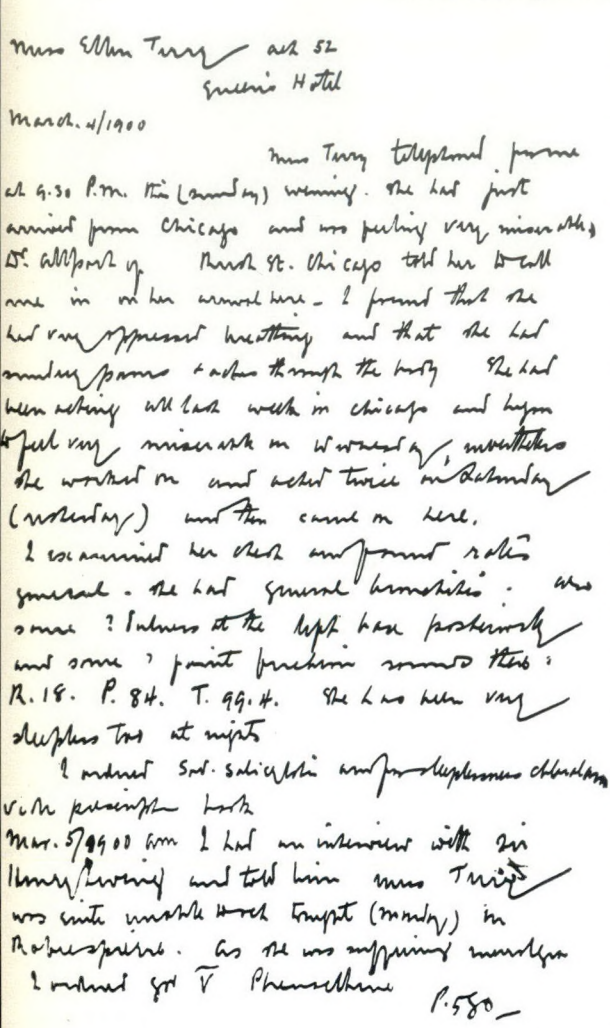

Fig. 3.—A page from one of the case books. This is the beginning of the account of the illness of the famous Shakespearean actress, Ellen Terry, when she arrived in Toronto from Chicago, March 4, 1900.

every two years and indexed and cross-indexed so that it is easy to find the record of any patient. The complete set is now in the Academy of Medicine, Toronto. The last entry in his case books is dated June 15, 1943, and is a record of the good condition on that date of a 54 year old man whom he had operated upon at the age of 13 for a brain abcess with Jacksonian fits, the result of a punctured fracture of the skull. In Toronto he must surely have been the first surgeon to pay attention to careful clinical records. His justifiable pride in this is reflected in the title of his presidential address to the American Surgical Association, "A Study in Records". It was an account of interesting surgical problems gathered from his surgical case books.

His interest in surgery was catholic. In every field he found something which concerned him. He had a mind receptive to new ideas and new measures for the cure of disease. He frequently was the first in Toronto to see the merit of a new operation or procedure and the first to introduce it into our practice. I can recall seeing him perform an Albee spinal bone graft for Pott's disease which must have been the first such operation performed in the Toronto General Hospital. He had no electric saw. The graft was removed from the tibia with a hammer and chisel cutting from drill hole to drill hole. I believe he was the first in Toronto to conduct a blood transfusion. He used the difficult and uncertain technique of Crile which was all that was available at that time. But his greatest achievement as a surgeon derived not so much from his technical skill as from his wide knowledge of surgical disease and the literature concerning it and from his sound judgment based upon his accurate knowledge of the results of his own surgical efforts derived from his records. Seventy-five surgical papers and addresses are included in his bibliography, the last of which was the Balfour Lecture on the "Interrelationship of Anatomy and Surgery and its Historical Background".

Some inkling of his feeling for his work is gained from this excerpt from a letter he wrote to his daughter Olive in 1922 when she was a nurse in training at the Royal Victoria Hospital in Montreal. "It seems so extremely interesting to me that you are beginning to work 'on the wards'. That is where your Daddy has spent a lifetime and anything I have ever done worth while has been done 'in the wards'. I loved it and am only sorry now that I have to retire from the public wards of the General Hospital because of the age limit. It is a great satisfaction to me that my girl is taking the job on in her Daddy's place and helping to do some service for the poor sick folk."

Many honours came to him. The Royal College of Surgeons of England elected him a Fellow in 1925. His alma mater, the University of Edinburgh, awarded him an

LL.D. in 1926. Of this he was very proud. He became an LL.D. of Dalhousie in 1930. He reached the rank of Colonel in the Army and was awarded a C.B. Many surgical organizations recognized his great qualities by electing him their president and he often delivered endowed lectures in surgery at various universities.

In 1887, immediately before settling in Toronto, Dr. Primrose married a friend of his boyhood, Clare Christina Ewart. His Edinburgh note books record that he was writing to her regularly while he was studying medicine there. They had five children: Dorothy, who married Grahame Joy; Agnes, who married the Honourable Justice Norman Macdonnell; Howard Primrose who was killed in action in France in 1916; John Ewart who died in infancy and Olive Clare, now Mrs. John Coulter and the only surviving child. Mrs. Primrose died in 1919, heartbroken over the death of her son Howard. In 1921, Dr. Primrose married Elizabeth Britton, the widow of Mr. Charles Moss. He was blessed in both marriages. His home on College Street where his children grew up was the centre of a warm family life and its close proximity to the Hospital for Sick Children and the Toronto General Hospital made it almost an annex to these institutions where young doctors learned they might obtain advice and encouragement for the seeking. His later home on Forest Hill Road is remembered for its hospitality to old and young. For many years Sunday luncheon was the occasion for entertaining university students, and is still happily remembered by them. This was only one of its many friendly activities. In the summer, Dahwamah, his home in Muskoka, was open house to his friends, and many are the happy holidays they spent there with him and his family.

Dr. Primrose had a great zest for life and a great love of people. His profession, his patients, his students, his colleagues, the university, the medical and surgical associations to which he belonged, his church, his summer home at Muskoka, the Medical Arts Building all were sources of satisfaction and happiness to him. I never saw him dour or downcast. Reading his case records reveals the enthusiasm and interest which he had for his work and the satisfaction he derived from a difficult problem satisfactorily diagnosed, a new operation, a successful surgical result or an important person for a patient. There was a warmth and friendliness in his relations with students and young colleagues. To the end of his days he had as many young friends about him as he had friends of his own age. There was no bitterness in his nature and he harboured no ill will. He was a man of great character who for a long time wielded a powerful influence for good upon the surgical and social life of Toronto and Canada.

Mr. John Coulter, the playwright and author, has expressed in moving verse his feeling for the great man whom he came to know through marriage to his daughter. His appreciation of Dr. Primrose will stir the memories of students and colleagues for he records with singular fidelity and clarity those qualities of Dr. Primrose which made him a great surgeon, an inspiring teacher, a warm friend and a character of great strength. I cannot better close this tribute to Dr. Primrose than to quote from "Elegy for Alexander Primrose" which John Coulter wrote to his memory.

"He was a great anatomist," whispered a great anatomist
As we turned from the graveside. "A great teacher and pathologist,"
And I listened to praise of a pioneer in surgical technique:
I could but speak of the sense in which to me he was unique.

And spoke of him as a man who being in himself so serene
Generous and fulfilled, could bestow on the troubled or mean
As it seemed by his mere touch, his presence, some share
Of his own humane dignity, his genial philosophic air.

He was debonair, noble by blood lineage and by intellectual stature
But most by the fine tempered mettle of his moral nature,
Yet a creature gentle, warm and quick with compassion,
Uncensorious, caring chiefly that, each in his fashion,

Men should live in frankness decently together and be
At last ripened, fulfilled, as I have said of himself that he
Was ripened, fulfilled: an ageing tree that had borne
Blossom and fruit in abundance till this mid-winter storm

Struck him down. The great wheel of the universe spins on, the eternal
Sequence in circle or gyre recurring: by some internal
Impulsion kernel grown sapling grown tree, the tree stricken;
And it may be some spiritual kernel likewise does quicken.

ACKNOWLEDGMENTS

I am grateful to Mrs. John Coulter for the information regarding Dr. Primrose's family life and for access to his letters which she possesses. Also to Mr. John Coulter and the Ryerson Press for permission to quote from "Elegy for Alexander Primrose" from *The Blossoming Thorn*. Dr. T. C. Routley has given me much information regarding Dr. Primrose and his association with the Canadian Medical Association. Many other friends and students have helped me with their memories of their colleague and teacher.

609 Medical Arts Building.

UNIVERSITY TRIBUTE TO PRIMROSE

The Council of the Faculty of Medicine of the University of Toronto on February 5, 1932, paid tribute to Professor Primrose on his retirement. After a biographical survey, they said:

"It was as a teacher perhaps that Professor Primrose will best be remembered by hundreds of students in all parts of the world as an outstanding personality in this University. It is no exaggeration to say that for a period of nearly twenty years as a teacher of anatomy he had no superior in any medical school and very few could be regarded as his equal. To his teaching, both in anatomy and surgery, can be attributed in no small measure the general agreement as to the sound training afforded medical undergraduates of the University of Toronto. As an administrative officer of the Faculty of Medicine, first as Secretary and then as Dean, he rendered notable service and was unsparing of time and energy in his efforts to promote the welfare and best interests of the Faculty of Medicine. The great traditions of the Edinburgh School of Medicine which he brought to this University have left an impress for good that is quite inestimable. His energy and enthusiasm have continued unabated through the years, and during the period of his Deanship there has been a remarkable expansion and growth in the Faculty of Medicine, both in the quality of the work done on the side of scientific research and investigation and in medical teaching.

"In no small measure the splendid influence which he has exercised on colleagues and students alike has been the result of his sterling character, those qualities of heart and mind which have endeared him to all. While he is at this time withdrawing from active participation in work within the University, he carries on, in many important capacities, in the organized medical profession of this country and elsewhere. To the service of these and other important interests may he long be spared. In the years to come may he have every happiness. This is the sincere wish of all his colleagues and associates."

PRIMROSE ON "STANDARDIZATION"*

"I would like to urge the undesirability of uniformity of the curriculum in our universities. It has been suggested, for example, that licensing bodies should issue schedules of study in each of these sciences, e.g., physiology, anatomy, etc. Not only so, but to stipulate the method of instruction, e.g., so many didactic lectures and so many hours of laboratory work. There is a craze for standardizing everything, including industries and education. The inevitable result will be to kill initiative and to destroy individuality. If we take the subject of physiology, for example, it is surely conceivable that of two effective and efficient teachers, one may cover ground and utilize methods of instruction of an entirely different character from the other. Both have the same ultimate goal, namely, to teach the student the principles of physiology in such a fashion that he may later be able to approach a clinical problem fully equipped to use physiological methods in his bedside work. This end may be gained with equal success by very different methods of approach in the teaching of the particular science. The teacher should be free to use his own peculiar faculties for the attainment of the ideal result. Here again, in my opinion, the standardized water-tight compartment of a fixed schedule is to be condemned outright."

*Canad. M. A. J., **15**: 252, 1925.

ORIGINAL ARTICLES

THE WRINGER INJURY

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Definition and Introduction

A WRINGER INJURY is the result of catching an upper extremity between the rollers of a washing machine. It should be thought of as but one member of that broad group of mutilating arm and hand injuries referred to as crush injuries. The wringer injury is but one of the many preventable household accidents occurring during the accident-prone period involving children in the toddling and pre-school group. The injury is the result of a mother's unguarded moment or unawareness of the potential hazard of the machine together with the child's natural urge to explore.

The purpose of this report is to outline the Hospital for Sick Children method of evaluation and treatment of these injuries. The report covers the period from 1953 to 1956 (Table I). The nature of this injury appears to be misunderstood and consequently the treatment is sometimes of an indifferent nature. Delay in adequate treatment can be detrimental to the crushed extremity.

TABLE I.—Wringer Injuries Treated at The Hospital for Sick Children, Toronto

	1953	*1954*	*1955*	*1956*
Out-patients	89	105	83	72
In-patients	10	19	25	16

Etiology and Pathology

The actual wringer mechanism is fairly constant but the tightness of the wringer, the duration of the exposure, and the amount of voluntary countertraction applied to the limb vary the degree of damage. The sites at which the rollers are most likely to stop their forward progress are: the dorsum of the hand, the wrist, the elbow region and, finally, the axilla. These areas, unfortunately, could not be more vulnerable with respect to the destruction of vital structures. There are three primary forces, each causing its own particular type of damage: contusing, friction, and avulsing forces. There is one secondary or delayed force, that of an expanding hæmatoma.

The contusing or crushing force may affect all layers. The blood vessels of the skin are ruptured or thrombosed producing varying degrees of ecchymosis. The subdermal fatty tissue is crumbled and the fat cells are ruptured. The large amount of free fat one sees in the hæmatoma is perhaps an explanation of the intense acute reaction with slow resolution that is characteristic of deep crush injuries. The muscle masses, usually those in the flexor compartment of the forearm, may be contused and a picture not unlike that of Volkmann's ischæmic contracture may develop. Neurapraxia, or contusion of a nerve, may occur.

The milder friction force produces a superficial abrasion. This force when more severe produces a discrete burn. The friction damage always combines with the other forces to impair the viability of the tissues.

Most wringer injuries have considerable separation of the skin from the underlying fascia, caused by the avulsing or shearing force. This produces a large space for the collection of blood and tissue fluid. The extent of this separation is never recognized until one has the opportunity of passing an instrument under the flap. In its more severe form, this force may tear the separated tissue and produce an avulsed skin-fat flap.[1] If the arterial inflow to this type of flap is better than the venous drainage, black gangrene of the flap develops. Other avulsion damage consists of dislocations and fractures, particularly of the thumb, and neurotmesis or nerve interruption.

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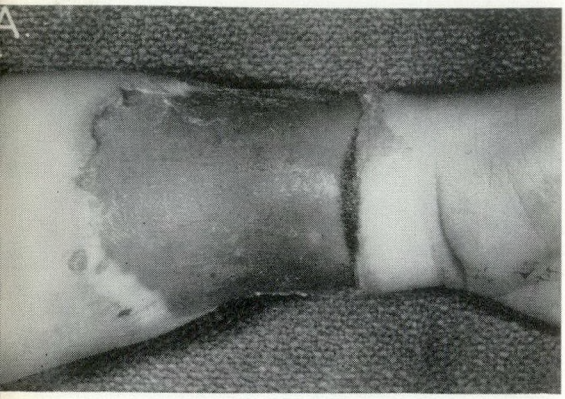


Fig. 1A.—This critical injury shows an excavated flexor surface of the wrist that had been in the wringer 15 minutes. The friction burn eschar was tight and restricted venous return from the hand. The hand was anæsthetic and paralyzed.

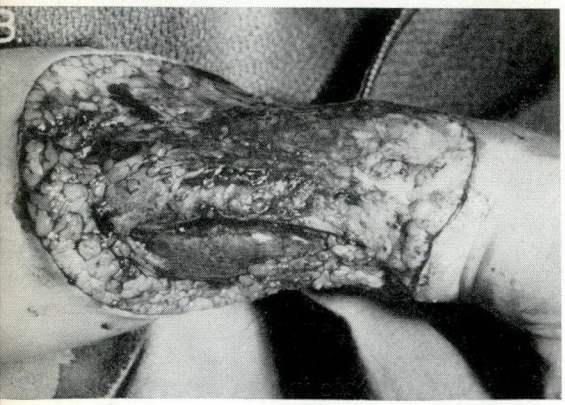


Fig. 1B.—The hard eschar was removed immediately to relieve the constriction, revealing all deep structures to be hæmorrhagic and badly contused, yet it was impossible to say whether they were alive or dead. Note incisions in deep fascia allowing swollen muscles to protrude.

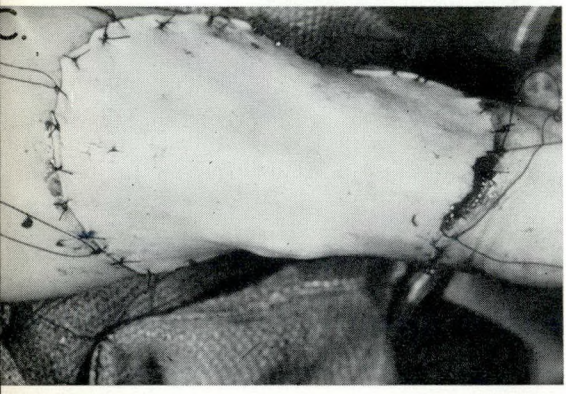


Fig. 1C.—Split skin graft dressing to close the wound and allow time for the deep structures to demarcate.

Fig. 1D.—Four weeks after injury with slough of vital structures and both bones exposed. The lower end of the ulna was necrotic and was excised. The wound was resurfaced with an abdominal pedicle graft.

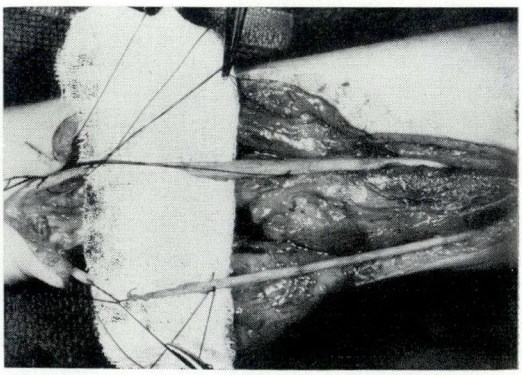


Fig. 1E.—Median and ulnar nerves and flexor pollicis longus were sutured directly after mobilizing them a distance of 5 cm. A mass suture of the digital profundus tendons was done.

Fig. 2.—To demonstrate typical *cutaneous* and *complex* wringer damage. **Fig. 2A.**—*Complex*—dermal abrasion and contusion to varying degrees with full thickness tissue necrosis at the centre. The necrotic tissue is near the posterior axillary fold and will produce contracture. It was excised and resurfaced with a regional rotation flap.

Fig. 2B.—Near the elbow the red area is *cutaneous* dermal abrasion and contusion. There are scattered small purple-black areas throughout which are necrotic. This area, by itself, would not require grafting if no subcutaneous hæmatoma developed beneath it, but healing would be slow. Near the axilla—the white leathery skin is the site of *complex* or third degree friction burn and is a suitable lesion for primary excision and grafting.

Fig. 3A.—A complex wringer injury in which the forearm was desleeved. The avulsed skin-fat flap was attached by a narrow pedicle. This was detached, defatted by placing on a dermatome and reapplied as a free full thickness graft.

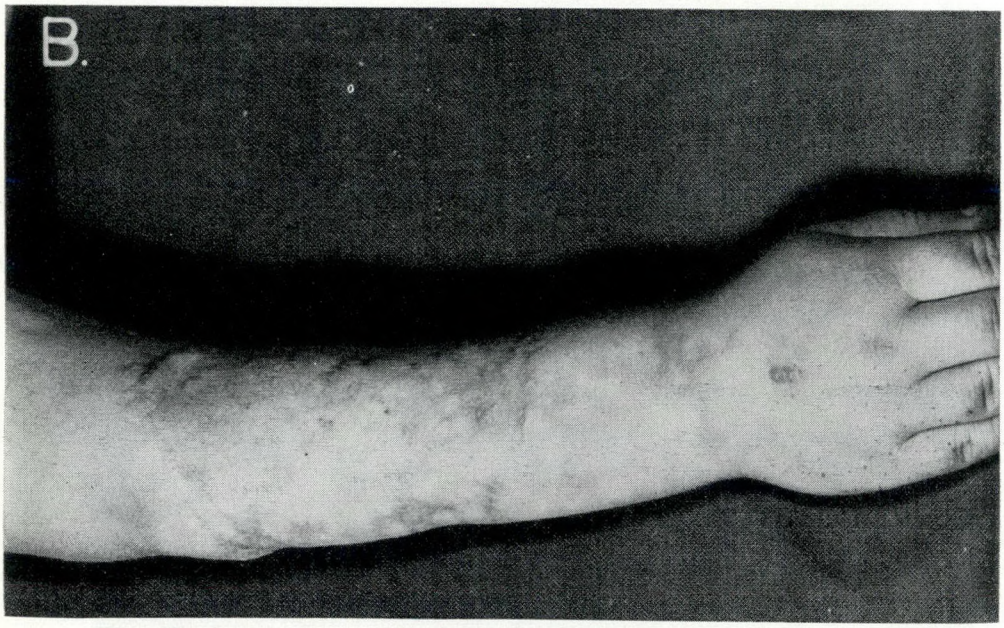


Fig. 3B.—Postoperative result showing some depression and surface irregularity characteristic of free grafts to defects with loss of substance.

The secondary force is an expanding hæmatoma. This occurs beneath the widely separated skin. It occasionally occurs deep to the investing fascia of the flexor compartment. Hæmatoma forms insidiously in these spaces. The resulting internal pressure may be sufficient to cause strangulation of the avulsed skin or pressure damage to nerves and muscle.

Diagnosis

The history of a tightened wringer, a new machine, prolonged exposure, or frantic countertraction leads one to anticipate more severe damage. The time interval between injury and examination is important because the real signs of damage or hæmatoma may not appear for a matter of hours. If the injury is recent it is essential to get a baseline for future reference as to the degree of dermal damage, muscle or subfascial hæmatoma. Pain on passive extension of the fingers is indicative of subfascial or muscle hæmatoma. Sensory and motor nerve function of the extremity should be examined. Radiography is routinely carried out to satisfy the parents but is not considered an essential part of the examination because fractures are rarely seen. There were only two fractures, both at the base of the proximal phalanx of the thumb and two dislocations, both of the thumb metacarpo-phalangeal joint, in our series. A representative picture most frequently seen is that of swelling and bruising with or without varying degrees of abrasions or friction burns (Fig. 2).

Classification

Wringer injuries may be usefully classified into three groups. The categories are somewhat arbitrary and tend to overlap but will be found useful for descriptive and management purposes: (1) Cutaneous, (2) Complex, (3) Critical.

The majority of wringer injuries are *cutaneous*, or start as such. There will be swelling of the involved portion of the limb. The prominent areas that have been involved, or the point at which the wringer stopped, will be the site of abrasions or contusions varying in colour from red to purple. There may be small white streaks of friction burn throughout. Hæmatoma may be present beneath the most swollen portion, or may develop in the first 24 to 48 hours. The course of *cutaneous* injuries is fairly typical. The œdema subsides spontaneously. The point of maximum skin damage resolves slowly, although small streaks or circumscribed areas of slough may occur which are not large enough to require grafting.

The *complex* wringer injury likewise has varying degrees of œdema of all of the involved portions of the extremity but the key point of damage will be the site of discrete full thickness loss—black or purple contused ecchymotic tissue (Fig. 2A), or white friction burn (Fig. 2B). There will be more extensive avulsion or separation of the skin. This skin is usually intact but on occasion may be lacerated or torn (Fig. 3). An expanding hæmatoma may be present or may develop and in addition this category of lesion may have a subfascial hæmatoma. *Complex* lesions require more extensive treatment.

The *critical* wringer injury has more extensive skin loss and the death of tissue extends into muscle, tendon, nerve, vessel or even bone. The extent of the damage may not be definite at the time of early examination but can be anticipated when the history and findings on examination are severe (Figs. 1 and 4).

Treatment

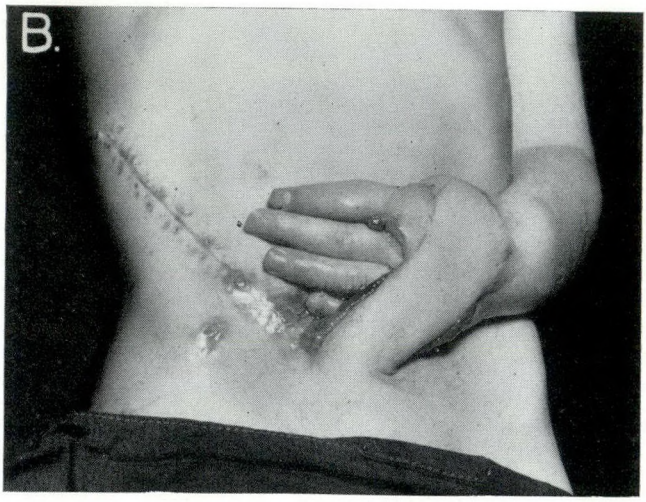
First-aid management consists of putting the member at rest in a sling and preventing contamination by covering with a loose clean dressing.

The definitive treatment of most wringer injuries is simple because most are of the *cutaneous* type and can be treated in the emergency department as out-patients. Some authors do not support this method of management[2-4] and strongly recommend hospital admission for 48 to 72 hours regardless of the severity of the injury. Therefore in adopting this method of treatment it is extremely important to realize that a few of these cases will develop progressive swelling, subcutaneous or subfascial hæmatoma. All cases must be re-examined in 12 to 24 hours.

Each case is treated aseptically with operating-room technique. The limb is

Fig. 4.—An example of a *critical* wringer injury. **Fig. 4A.**—Two weeks after injury by which time the thumb had fallen off. There was full thickness loss over the dorsum of the radial half of the hand and the flexor aspect of the index finger. **Fig. 4B.**—The index finger was resurfaced with a thick free skin graft while the hand was resurfaced with an abdominal pedicle graft.

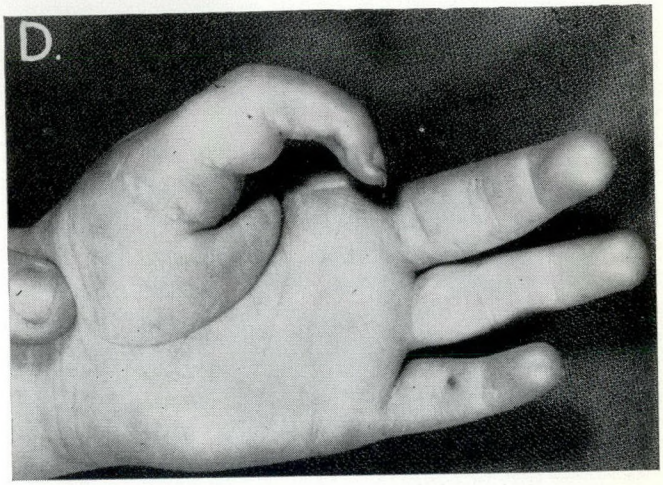
thoroughly and widely cleansed with detergent or soap and rinsed with sterile water. An aqueous antiseptic is applied, followed by bland sterile Vaseline and gauze dressing to the open areas. Lacerations are sutured primarily, the commonest site being a tear in the web space at the base of the thumb. A dry bulky dressing of absorbent or fluffed gauze is applied from the finger tips to a point well above the damage followed by an occlusive pressure bandage including a shoulder spica if necessary. Elevation of the injured member is recommended. The patient's tetanus immunization is brought up to date.



At the time of the second visit in 12 to 24 hours' time the occlusive dressing is completely removed and the extremity thoroughly re-evaluated comparing with the initial baseline examination. If the findings are satisfactory a new occlusive pressure dressing is applied and the patient is requested to return at the end of another 24 hour period. After this last examination one can feel fairly certain of not overlooking the formation of a developing hæmatoma. The last dressing is left in place for a week. If the findings are not satisfactory it follows that the injury must be treated as a *complex* lesion.

Complex and *critical* injuries are admitted to hospital. It is usually necessary to treat these lesions, at first, as cutaneous lesions (see above) and to await the demarcation of dead tissue. Hæmatomata are adequately drained. Small rubber drains are placed in ½ inch incisions for 24 to 48 hours under sterile technique. This procedure was necessary in 18 cases in this series. In some cases, the necrotic tissue will be well demarcated at the time of initial or early examination and primary excision with partial thickness graft resurfacing will be possible (Fig. 2B). Such primary or early finalization of a wringer injury, although possible in relatively few cases, decreases the patient's morbidity and expenses and speeds resolution of the wound.

Fig. 4C.—The scarred index finger was pollicized to permit opposition. **Fig. 4D.**—The transposed index finger serves as a functional, although as yet contracted, thumb.



We have seen no value in the prophylactic use of antibiotics[2, 3] and they are not used. The use of ACTH,[5] or hyaluronidase,[3] as has been recommended by some to diminish fibrosis and œdema, has not been tried by this group. In fact the clinical use of ACTH or cortisone to diminish fibroplasia generally has not been proven worthwhile, and indeed at least one author[6] condemns it.

Reconstructive measures have included: free skin grafts in 39 cases—four lesions being finalized primarily; local rotation and distant pedicle grafts in five cases; nerve and tendon repair in five cases; shortening of the humerus to remove exposed bone and allow median and ulnar nerve suture in one case; pollicization of index finger in one case. In the case of widely avulsed tissue which is of doubtful viability because of inadequate base and consequent poor venous return, removal of the tissue, defatting and return as a free full thickness graft is indicated (Fig. 3). If flexion crease areas are involved, pedicle or skin-fat coverage is necessary to avoid subsequent contracture and is obtained by local rotation flaps if the surrounding tissue is satisfactory. If the repair of nerve, tendon or bone defects is necessary, pedicle coverage is mandatory and frequently distant flaps are required (Figs. 1 and 4).

In addition to the critical involvement noted above, secondary hæmorrhage from the ulnar artery occurred in one case, and fibrosis of the flexor muscle mass in another case. One case was admitted seven days after injury *in extremis* with convulsions, hyperpyrexia and shock. He died six hours after admission. The cause of death was not ascertained but cerebral anoxia following aspiration of vomitus was suspected.

Summary

The wringer injury should never be considered a trivial injury. A detailed history of the mechanism of injury will frequently give helpful information which when added to one's physical examination will make it possible to decide whether or not a wringer injury is of *cutaneous, complex* or *critical* involvement. The majority of patients can

be managed on an out-patient basis if one is careful with the initial examination and treatment and one is thorough with 24 hour follow-ups. Eighty per cent of this series were managed as out-patients. More complicated reconstructive work in the form of skin grafts, pedicle grafts, nerve and tendon reconstructive work was necessary in 13% of the cases. Immediate excision of obviously necrotic tissue with primary grafting, when feasible, is of the greatest value in decreasing morbidity, time and expense.

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Résumé

Ce travail montre l'évaluation et le traitement de 419 cas de blessures par essoreuse qui se sont présentés à l'Hôpital des Enfants Malades de Toronto de 1953 à 1956 inclusivement. La gravité dépend de la force de l'essoreuse, de la durée de l'application de cette force, et des efforts déployés pour dégager le bras; il en résulte de l'érosion cutanée, de la contusion avec formation d'hématome parfois important, de l'éclatement cutané, et même de l'arrachement des tissus. Dans quelques cas on peut avoir des luxations et fractures, et l'arrachement des nerfs. L'hématome, s'il est important, peut causer la nécrose de la peau, des muscles et des nerfs.

Les lésions d'écrasement dues à l'essoreuse peuvent être divisées, suivant leur gravité, en trois groupes: lésions cutanées, lésions compliquées et lésions critiques; dans cette dernière, catégorie, il y a perte étendue de tissu cutané, avec nécrose étendue des tissus musculaires, nerveux, même osseux. Une lésion qui peut paraître moins importante le premier jour peut nécessiter une reclassification dans une catégorie plus grave les jours suivants. Le premier traitement consiste à mettre le membre au repos et à prévenir la contamination par un pansement aseptique; on administre aussi du sérum antitétanique.

Comme la plupart des lésions sont du type cutané, le traitement est en général simple et ne requiert pas l'hospitalisation; on fait une désinfection cutanée et un pansement compresseur occlusif. La blessure sera revue entre 12 et 24 heures après l'accident et une fois encore 24 heures plus tard.

Dans les cas compliqués ou critiques, (20%), le patient sera hospitalisé. On traitera d'abord les lésions cutanées et on attendra la démarcation des tissus dévitalisés, qui seront excisés précocement et recouverts de peau greffée. Les hématomes seront drainés.

Les auteurs n'ont vu aucun avantage à employer les antibiotiques ou l'A.C.T.H. La radiographie leur a rarement paru nécessaire, sauf pour satisfaire les parents qui l'ont réclamée.

COMPRESSION DRESSING IN WRINGER INJURY, ETC.*

"Compression dressings are easy to apply and have been recommended over and over again by alert and experienced surgeons of trauma. Nevertheless, many surgeons have failed to appreciate their value and have neglected to make use of this procedure. I shudder to think of the sins of omission which I committed during the earlier years of my practice when I failed to apply a compression dressing to the foot, hand, arm, or leg of a patient who sought my help after a crushing injury. A child whose arm had been caught in the wringer of a washing machine, and pulled through the rollers to above the elbow, when seen within less than half an hour showed no fracture and little evidence of injury. The patient was permitted to go home without any definitive treatment. The next morning the arm was markedly swollen. Circulatory blisters and cyanosis were followed by gangrene, and amputation above the elbow was necessary. Comminuted fractures of the ankle or of the os calcis also may be followed by marked swelling, circulatory blisters, sloughs of skin, or gangrene, requiring amputation. Early application of a compression dressing will prevent destructive œdema and will save most of these extremities."

*Compere, E. L.: Research, serendipity, and orthopedic surgery, *J. A. M. A.*, **165:** 2072, 1957.

ARTERIAL INJURIES DUE TO BLUNT (NON-PENETRATING) TRAUMA: EXPERIENCES WITH FIFTEEN PATIENTS

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THROUGHOUT THE PROFESSION, improved surgical techniques have resulted in an aggressive approach to the correction of those arterial injuries which result from penetrating trauma. Progress to an equal extent has not been achieved in the management of patients whose arterial injuries are sustained by blunt trauma. This deficiency does not stem from a technical deficit as much as it does from a less aggressive approach.

After a penetrating injury, the wound is characteristically explored with the intent of identifying the site of injury and restoring the continuity of arterial flow. A more conservative, indirect approach is too often taken both in the diagnosis and treatment of blunt injuries. Continued observation, sympathetic nerve blockade, and fasciotomy, as preferential treatment, represent the regimen of a previous era.

The purpose of this report is to focus attention on the frequent deviation from principles in the diagnosis and treatment of arterial injuries incurred by blunt trauma and to suggest an approach of immediate arteriography followed directly by surgical restoration of arterial flow.

In reviewing the last 188 patients with arterial injury treated on this service, 15 were found to have experienced blunt injury.

ANATOMIC DISTRIBUTION AND MODE OF INJURY

The sites of the arterial injuries are shown in Table I. Traffic accidents were responsible for 10 of the injuries, falls for two, surgical contusion, a direct blow, and torsion of an old ununited fracture for one each. Fractures or dislocations were the only associated injuries of major importance except for peripheral nerve injuries in one patient. Of the 13 patients with injuries of the extremities, nine had associated fractures or dislocations.

The relatively high incidence of arterial injury of the lower extremities is apparently due to the frequency of associated fractures in traffic and pedestrian-automobile accidents and to the magnitude of the force required to fracture the pelvis, femur

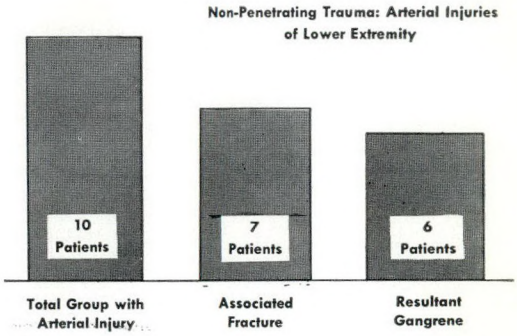

Fig. 1.—In the lower extremity, an arterial injury in association with a fracture led to gangrene because of the indirect diagnostic and therapeutic approach.

or upper part of the tibia.[3, 4] The mechanism of arterial injury with an adjacent fracture would appear to consist of one of the following: (1) contusion; (2) direct laceration by the osseous fragments; (3) as a result of angulation of the fragments, undue stretching and consequent tearing of the artery. Of the 10 patients with arterial injuries of the lower extremity, seven had associated fractures (Fig. 1). In only one of these 10 patients was the injury simply a direct blow over the femoral artery. The majority of vascular injuries seemingly occurred when compression in two planes, or angulation by fracture, prevented the artery's escape from injury.

Injury of the axillary artery occurred in two patients, and of the brachial artery in one. Each was sustained in an automobile accident, the two axillary injuries being associated with fractures of the upper ex-

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TABLE I.—Arterial Injuries Due to Blunt Trauma

Artery	*Lesion*	*Associated injury*	*Time lag*	*Treatment*	*Result*
Aorta	Thrombosis at level of 6th dorsal vertebra	Dislocation of hip	5 days	Thrombectomy	Died during operation, cardiac arrest
Axillary	Complete separation and thrombosis	Dislocation of humeral head	7½ hrs.	Ligation	Died on 10th post-operative day (viable limb)
Axillary	Complete occlusion due to separation and retraction of intima and media	Multiple fractures, peripheral nerve injuries, soft tissue lacerations	12 hours	Vein graft	Good pulses
Brachial	Thrombosis distal to circumflex	None	2 hours	Resection and anastomosis	Good pulses
Internal carotid	A-V fistula to cavernous sinus	Fractures of mandible and base of skull	6 weeks	Ligation of common carotid	Satisfactory
External iliac	Thrombosis	Multiple fractures (tibia, fibula, pelvis)	8 hours	Thrombectomy	Died, gangrene of lower extremity
Superficial femoral	Thrombosis	Severely comminuted fracture of femur	4 days	Paravertebral blocks, spinal anæsthesia, fasciotomy	Gangrene
Superficial femoral	Thrombosis	None	7 weeks	Thrombectomy	Good pulses
Superficial femoral	Avulsion of branch	None	1 hour	Transverse suture	Good pulses
Superficial femoral	Complete separation and thrombosis	None	3 hours	Resection and anastomosis	Good pulses
Popliteal	Thrombosis with distal embolus	Old fracture of femur (non-union)	3 days	Paravertebral blocks, anticoagulants	Gangrene
Anterior and posterior tibial	Thrombosis	Fracture tibia, fibula	—	Paravertebral blocks	Gangrene
Posterior tibial	Disruption and thrombosis	Fracture tibia, fibula	4 days (fasciotomy)	Paravertebral block, fasciotomy	Gangrene
Anterior and posterior tibial	Thrombosis	Fracture tibia, fibula	2 hours	Paravertebral block	Good pulses

tremities. One of the axillary injuries was associated with major injuries of the brachial plexus. The mechanism of injury to these vessels was not quite the same as that in the lower extremity. In one patient the axillary artery was completely avulsed by a severe dislocation of the humeral head. In another the artery was almost severed by the forward thrust of the patient in an automobile collision, the artery being crushed (distal to the clavicle) between the ribs and the framework of the automobile.

One patient sustained injury to the thoracic aorta as a result of an automobile accident. Thrombosis at the site of injury was followed by distal extension of the clot. The mechanism of this injury is difficult to explain but one might speculate that it too was based on the deceleration phenomenon described in aviation experiments.[1] By throwing the more mobile descending aorta forward, the force of deceleration might partially rupture the fixed proximal portion, incomplete rupture leading to thrombosis without external rupture.

Diagnosis

Many blunt injuries are not diagnosed until the damage of distal ischæmia is irreparable. All too often a diagnosis is made of arterial spasm, extrinsic compression by hæmatoma or constriction by a plaster cast when, in fact, the continuity of the vessel has been lost.

Further difficulty in diagnosis may result from the fact that collateral channels may be adequate to maintain a warm extremity or even arterial pulsation distal to the site of injury. As thrombosis extends, collateral channels may be secondarily obstructed with resultant progression of the ischæmia.

The lack of appreciation of arterial trauma associated with fractures has been impressive. Out of the seven patients with associated fractures of the lower extremity, immediate surgical exploration was performed in only one. Five were treated by sympathetic nerve blocks, anticoagulation or fasciotomies, and one by a delayed thrombectomy. Of the seven patients, six developed gangrene. Treatment of the arterial injury, whether it was to be a direct or indirect attack, was delayed for hours or even days.

Although the greatest reliance must be placed on the clinical evaluation of these injuries, the value of arteriography in the diagnosis and delineation of these injuries has only recently been appreciated.[2]

Arteriography was performed in nine of the 15 patients. Unequivocal evidence of injury was present in all of these nine cases. Had immediate arteriography been employed instead of prolonged observation, the time lag could have been appreciably shortened. Immediate arteriography should be almost routine when the diagnosis is in doubt. Even if surgical exploration is anticipated, anatomic and pathologic diagnoses are essential for optimal care in many of the patients with this type of injury. If all other diagnostic measures fail, the wound should be explored. Fear of osteomyelitis at the site of fracture is not as compelling as fear of a gangrenous limb.

Pathology

The nature of the arterial wound could be judged by the findings at operation, the arteriographic pattern or the dissection of the amputated limb. As opposed to the findings in penetrating injuries, fewer vessels were lacerated. Most of the vessels appeared to have been initially contused because of the blunt force of injury. The end result as seen at operation or in the amputated limb was usually arterial thrombosis. Thrombosis, alone or with additional demonstrable injury, was present in 12 vessels. Three of these vessels were completely severed—one axillary vessel, one superficial femoral and one posterior tibial. In these three, in addition to the complete disruption, thrombosis occurred in the proximal and distal stumps. One axillary vessel, although not completely separated, had complete disruption of the intima and media. The intima and media retracted within the adventitia, resulting in a horizontal hour-glass appearance.

One superficial femoral branch was avulsed, resulting in a large hæmatoma. This lesion was demonstrated by arteriography. In another patient, an occlusion by arteriospasm was demonstrated after an injury to the anterior and posterior tibial vessels with a tibial and fibular fracture. Originally, the pulses were absent at the foot and arteriography demonstrated the point of obstruction. Following reduction of the fracture under spinal anæsthesia, a second arteriogram revealed continuity of arterial flow.

Treatment and Results

As this experience developed, the full significance of occult injuries to the arteries was not immediately appreciated. Even more significant was the lack of an aggressive approach toward those arterial injuries which were complicated by fractures. Whereas, originally, emphasis was placed on indirect treatment (fasciotomy, anticoagulation and sympathetic blockade), more recent treatment has consisted of a direct localization by arteriography followed by restoration of arterial continuity.

Of the 10 patients with injuries to vessels of the lower extremities, three were treated by an immediate, direct attack on the vessel. One of these patients had a superficial femoral artery which was completely severed; it was repaired and distal pulsation was restored. Another sustained an

injury of the popliteal artery, the artery being found at operation to be thrombosed. In spite of resection of the thrombosed segment and end-to-end anastomosis, the patient developed gangrene of the leg. The third vessel was found to have been torn where a muscular branch was avulsed from the superficial femoral artery; this was repaired with a satisfactory result. In two other cases there was a delayed but direct attack on the problem. One developed gangrene following thrombectomy of the external iliac, another had a good result after delayed (seven weeks) resection of a thrombosed portion of the superficial femoral artery. Each of the remaining five patients treated by indirect methods had a sympathetic blockade; four developed gangrene.

The adjuncts of fasciotomy, paravertebral sympathetic block and anticoagulation, although useful in situations otherwise irretrievable, are no substitute for arterial reconstruction. Furthermore, there is very little need for these adjuncts after proper arterial reconstruction.

Of the two patients with axillary injuries, both were explored. In one patient the critical condition of the patient necessitated ligation of the artery. The distal circulation was adequate for viability, but the patient died of post-traumatic renal insufficiency on the tenth day. The second patient had a restorative operation and good pulsation was maintained. In the patient with traumatic thrombosis of the brachial artery, the occluded segment was excised and flow was restored.

Summary and Conclusion

The failure to recognize those arterial injuries which result from non-penetrating trauma is due to the indirect diagnostic and expectant therapeutic approach which has characterized the previous era. As an adjunct to the clinical evaluation of all cases of suspected occult arterial trauma, immediate arteriography aids in delineating the site and type of injury.

Thrombosis is the most frequent finding at the time of operation.

Treatment should be directed toward early exploration and re-establishment of arterial continuity. The more diffuse type of injury and the resultant thrombosis will probably necessitate resection and grafting more frequently than has been required in the repair of penetrating wounds.

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Résumé

Les blessures artérielles qui résultent des grandes contusions et des fractures avec avulsion vasculaire sont très souvent méconnues. Fréquemment on ne croit qu'à un spasme vasculaire, alors qu'en réalité il y a solution de continuité artérielle.

Au début, la circulation dans les vaisseaux collatéraux peut retarder l'apparition des symptômes d'ischémie, mais à mesure que la thrombose s'étend à ces branches secondaires, la circulation dans la partie distale diminue et l'ischémie s'établit avec gangrène consécutive.

Alors que la conduite classique est basée sur des moyens indirects tels que: fasciotomie, anticoagulants, blocage du sympathique périi-artériel, les auteurs croient que les résultats seront infiniment meilleurs si l'on adopte une ligne de conduite plus directe, à savoir l'artériographie précoce et la reconstitution vasculaire avec greffe artérielle au besoin.

Corrigendum

It is regretted that in error the case report entitled "Periureteral Fibrosis", by Drs. S. A. MacDonald and I. J. de Domenico, was omitted from the contents list in the January 1958 issue of the *Canadian Journal of Surgery*. The article appeared on pages 162-166 of that issue.

FUSIONS ABOUT THE TALUS IN CHILDREN*

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THIS REPORT is based on 301 fusions performed by the senior author at the Hospital for Sick Children from 1947 to 1956. These include 193 triple arthrodeses (83 of the Lambrinudi type), 61 Grice-Green subtalar fusions, 31 pantalar arthrodeses and 16 ankle fusions.

Patients with a short (less than two years) or inadequate follow-up have been excluded from this review (Table I).

TABLE I.—FUSIONS ABOUT THE TALUS

Operations	*Interviewed*	*Histories reviewed*	*Total*	*Excluded because of inadequate follow-up: Less than 2 years*	*Performed in 1955-1956*	*Total*
Triple	60	10	70	8	32	110
Lambrinudi	50	23	73	2	8	83
Green	27	7	34	1	26	61
Pantalar	17	5	22	5	4	31
Ankle	8	2	10	4	2	16
Totals	162	47	209	20	72	301

The indications for surgery and the surgical technique were consistent; these arthrodeses therefore lend themselves to comparison and an analysis of results is justified and significant.

THE GRICE-GREEN SUBTALAR ARTHRODESIS

First reported in 1952, this operation was originally performed by Grice[1] at Green's suggestion. It was designed to correct a paralytic valgus foot in patients who were too young for a triple arthrodesis. It was later performed to correct deformity in congenital hypermobile valgus feet. No subsequent report however has stressed its useful application for a varus heel. In this series, the operation was performed on 34 patients, mostly for the effects of poliomyelitis (29 occasions); but also for cerebral palsy (three) and spastic flat feet (two) (Table II). The average age of the patients was 7½ years (Table III).

The procedure is an extra-articular, subtalar arthrodesis (see Figs. 1a and 1b). An osteotome is inserted into the sinus tarsi to determine the length and direction of graft that will best maintain the desired alignment. Two tibial cortical grafts are then inserted "back to back" in a trough extending from the calcaneal tuberosity to the neck of the talus. No subtalar articular cartilage is removed; the height of the foot is undisturbed.

This operation can be performed at a relatively young age as fusion is easily obtained and further growth of the foot is not impaired. Of our patients 25% now wear a smaller shoe on the affected side, but the parents usually volunteered the information that the foot was smaller preoperatively (see Fig. 2). It is interesting to note that the incidence of a small foot

TABLE II.—GRICE-GREEN SUBTALAR FUSION: PREOPERATIVE DIAGNOSIS

Diagnosis	*Cases*
Poliomyelitis	29
Cerebral palsy	3
Flat feet (spastic)	2
Total	34

TABLE III.—GRICE-GREEN SUBTALAR ARTHRODESIS

	Range (years)	*Average (years)*
Age	5-8	7½
Follow-up	2-4	2½

*From the Department of Surgery and Research Institute of the Hospital for Sick Children.
This study was aided by a grant from the Canadian Foundation for Poliomyelitis.
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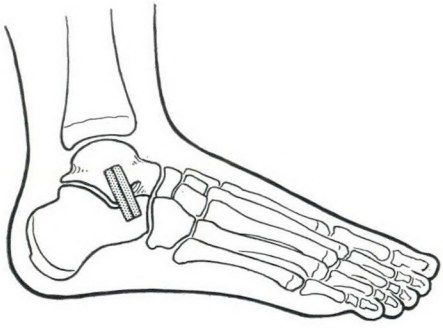
Fig. 1a.—Grice-Green arthrodesis. Note correction of valgus.



Grice-Green Subtalar Arthrodesis

Fig. 1b

was the same (25%) after triple arthrodeses (143) which were performed on older patients.

There are three general indications for this operation: (Table IV)

1. *Correction of deformity.*—Preoperatively the heel was in varus in more than 50% of patients (varus 19, valgus 15). In those patients, a medial release through a separate incision usually preceded the Grice-Green fusion.

Postoperatively, the subtalar alignment was good in 19 patients. Undercorrection, or a recurrence of the preoperative deformity, was noted in one-third of all cases. Overcorrection was occasionally noted with varus heels but never with valgus heels. This is desirable, as a valgus heel is desirable. Overcorrection of a valgus heel, however uncommon, is possible and should be studiously avoided.

The muscle imbalance should always be corrected to prevent a recurrence of the deformity at the subtalar joint; it will also protect the midtarsal joint, since the uncorrected deforming force will exert its greatest effect at this point after the subastragalar joint has been stabilized. This is particularly true of paralytic valgus feet which later develop marked forefoot abduction.

Subtalar fusion was combined with tendon transfer in two-thirds of the cases; the best results were noted with equinovalgus feet treated by Grice-Green fusion and peroneus transfer to the dorsum.

2. *Stabilization of subtalar joint and prevention of deformity.*—Most candidates for this operation had contracted poliomyelitis at a very young age. In such patients the following factors are noted for their moulding effects on growing bones: dynamic imbalance, instability and pre-existing deformity. By correcting these factors during the growth period, the procedure also prevents further deformity and as such

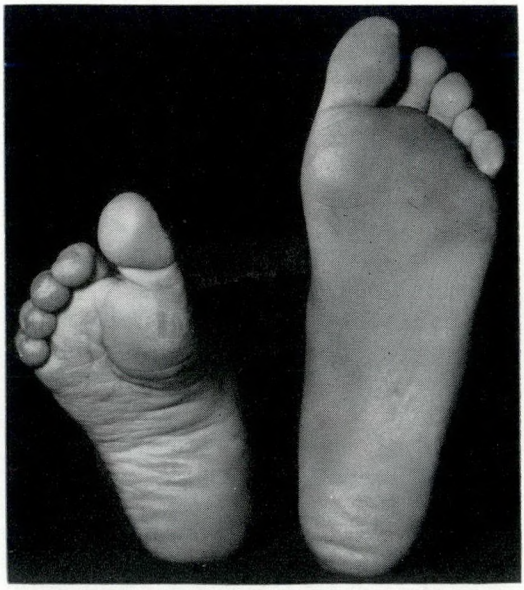


Fig. 2.—Small foot due to poliomyelitis.

TABLE IV.—GRICE-GREEN SUBTALAR ARTHRODESIS: INDICATIONS FOR SURGERY

1. Correction of deformity.
2. Stabilization and prevention of deformity.
3. To discard a brace.

TABLE V.—GRICE-GREEN SUBTALAR ARTHRODESIS: RESULTS IN 34 OPERATIONS

Good	26
Poor (recurrences)	8

has a prophylactic quality which may prove to be its best feature. In almost 50% of patients the resultant stability was sufficient and no further stabilizing procedure has been necessary. In 14 cases however, a triple arthrodesis has been necessary or is anticipated. In such cases, the Grice-Green fusion helped the patient over a difficult period until a triple arthrodesis was possible.

There were no cases of painful talo-navicular arthritis but the follow-up is admittedly not long enough. Similar grafts were inserted across the talo-navicular joint on two occasions at the time of the Grice-Green fusion; interestingly enough, these disappeared while the subtalar joint fused solidly (see Fig. 3).

3. *To discard a brace.*—Any brace used preoperatively was always discarded in this group of cases. The procedure should not be carried out if a brace will still be necessary after operation. However important for the patient's morale and rehabilitation, the shedding of the brace may be more wisely postponed on certain occasions. A triple arthrodesis will undoubtedly provide more stability to the foot. In a child over eight years of age, it is probably wiser to postpone fusion until a triple arthrodesis can be done.

The operation was assessed as good when the patient or parent was satisfied, the deformity was permanently corrected, the fusion was solid and the stability improved. On that basis 76% of operations were good, leaving eight recurrences (24.0%) as poor results. Bony union was secured in all but one instance (Table V).

TRIPLE ARTHRODESIS

The operation has known many variations since it was first described by Ombrédanne in 1911.[2]

The operation performed in this group of cases is often referred to as a Ryerson[3] triple fusion. Through an Ollier, dorso-lateral, transverse incision, the articular cartilage from the subtalar, talo-navicular and calcaneo-cuboid joints is eradicated. Depending on the pre-existing deformity, adequate bone wedges are excised to obtain proper alignment. Staples were used across the subtalar and calcaneo-cuboid joints as suggested by Kennedy[4] and were subsequently removed on one occasion (see Figs. 4 and 4a). The internal fixation ensured maintenance of good bony contact as the plaster cast was applied. Plaster immobilization was secured by a below-knee cast for six weeks followed by a walking plaster for another six weeks.

This report includes 143 cases of triple arthrodesis; 73 were of the Lambrinudi type and will be discussed separately.

When considering this operation, the age of the patient is an important factor. If a triple arthrodesis is performed on a very young child, adequate bony contact is more difficult to realize and too much growth is sacrificed. Admittedly, paralysis alone can produce a small foot but nevertheless this type of fusion should not be attempted before eight years of age.

The average age of this group of patients was 12 years. The follow-up period varied from two to 10 years (Table VI). The preoperative diagnosis was: poliomyelitis on 35 occasions, spastic flat foot on 13 occasions; the remaining 22 diagnoses included spina bifida, club feet, idiopathic cavus feet, septic arthritis and cerebral palsy (see Table VII). The most common

TABLE VI.—TRIPLE ARTHRODESIS

	Range (years)	*Average (years)*
Age	8-16	12
Follow-up	2-10	5

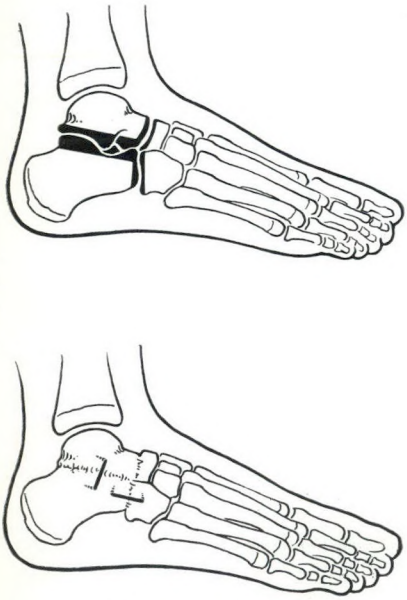
TABLE VII.—TRIPLE ARTHRODESIS: PREOPERATIVE DIAGNOSIS

Diagnosis	*Cases*
Poliomyelitis	35
Spastic foot	13
Miscellaneous (spina bifida, club foot, idiopathic cavus foot, cerebral palsy)	22
Total	70

Fig. 3.—Note disappearance of talo-navicular graft, growth of the hind foot and varus deformity of forefoot.

indication (60%) for surgery was instability; pain and deformity were two other frequent complaints. The incidences of varus and valgus deformities were almost identical. The deformity recurred in 15 cases. It was severe in five of those recurrences (7%) where muscle imbalance had not been corrected preoperatively. The postoperative deformity was always in the same direction as the preoperative type. There were no cases of overcorrection. More than 50% of poliomyelitis patients had no postoperative limp. All persons with peroneal spastic flat feet still had a flat-footed gait but no pain.

The operation was rated as successful if the patient was pleased and free from pain, and the condition improved; if the fusion was solid, the deformity was well corrected, and any limp was minimal. There were 60 such cases (83.0%). There were 10 poor results (14%) (see Table VIII). Six patients had serious recurrences of the preoperative deformity; a brace was still necessary on one occasion and three patients had a painful foot. The pain was



Triple Arthrodesis

Fig. 4

Fig. 4a (right).—Union at three months postoperatively.

TABLE VIII.—Triple Arthrodesis: Results (70)

Good	54
Fair	6
Poor	10

due to aseptic necrosis of the talus in one patient, non-union in another and a severe wound infection in the third. There were three cases of wound slough and one scar neuroma was excised surgically.

Lambrinudi Fusions (73)

The only reason for distinguishing this operation[5] from a regular triple arthrodesis is the manner in which the talus is cut. Depending on the degree of equinus one wishes to correct, varying amounts of the head of the talus are excised. With the foot in its equinus position, the cut in the talus is almost parallel to the ground. A ridge is then curetted in the postero-inferior surface of the navicular. The operative procedure is completed as in a routine triple arthrodesis. The foot is then dorsiflexed to meet the talus; there should be good bony contact and the distal end of the talus locks in the groove of the navicular. Staples are inserted across the subtalar and calcaneo-cuboid joints. The foot should then be stable and in good position (see Figs. 5 and 5a).

This group of patients included: 38 cases of poliomyelitis with a kinetic or fixed equinus deformity, 21 cases of cerebral palsy, and 14 others making up a miscellaneous group of equinus feet–spina bifida, Charcot-Marie-Tooth disease, club feet, arthrogryposis–(Table IX). In children, if there is complete absence of any dorsiflexors (transferred or otherwise) a Lambrinudi type of triple arthrodesis will only temporarily correct a drop foot. The deformity soon recurs because of stretching of the anterior capsule of the ankle joint and equinus at the anterior tarsal joints.

If some dorsiflexor power is present, however, the mechanical advantage of the foot at right angles to the tibia is usually sufficient to correct a drop foot.

The results are better if plantar flexion is strong, as is usually the case with cerebral palsy; a Lambrinudi fusion in the presence of a weak calf will aggravate the tendency towards an unsightly calcaneus gait and should not be performed under those circumstances. Two other relative contraindications are quadriceps muscle weakness and leg shortening, where some equinus is desirable.

The operation was uniformly good to correct fixed deformities. The idiopathic cavus foot can be well corrected by a Lambrinudi arthrodesis combined with an osteotomy of the first metatarsal bone. The advantage of this operation over a regular triple arthrodesis is that a midtarsal bony wedge is not excised and a longer foot is possible (see Figs. 6 and 6a).

TABLE IX.—Lambrinudi Triple Arthrodesis: Preoperative Diagnosis

Diagnosis	*Cases*
Poliomyelitis (equinus deformity and paralytic drop foot)	38
Cerebral palsy (mostly with an equino-varus foot)	21
Miscellaneous (spina bifida, Charcot-Marie-Tooth disease, club foot, arthrogryposis)	14
Total	73

The operation was found successful in 80% of cases, fair in 12% and poor in 8% (see Table X).

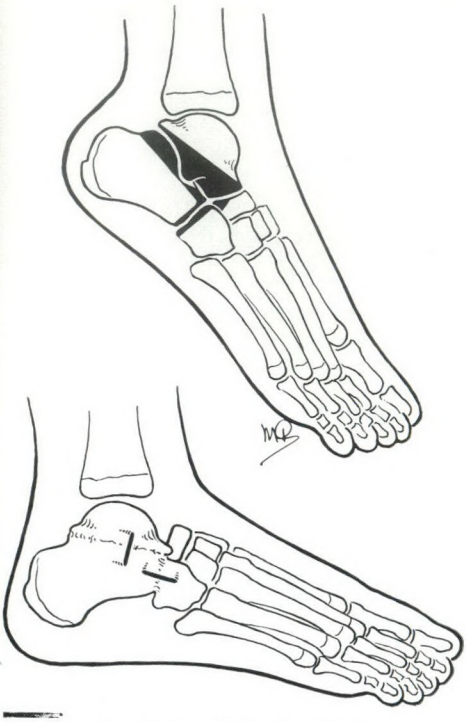
TABLE X.—Lambrinudi Triple Arthrodesis: Results in 73 Operations

Good	59
Fair	9
Poor	5

Ankle Fusions

Indications for ankle fusion alone in children are few except for eradication of disease in the ankle joint. Fusion is rarely indicated for paralysis. A flail foot usually develops a varus deformity through the subtalar joint, which cannot be corrected by an ankle arthrodesis in children who have had poliomyelitis. Furthermore, a fusion of the ankle joint alone often results in subtalar instability. In adults, however, the operation is well tolerated and a limp is barely noticeable.

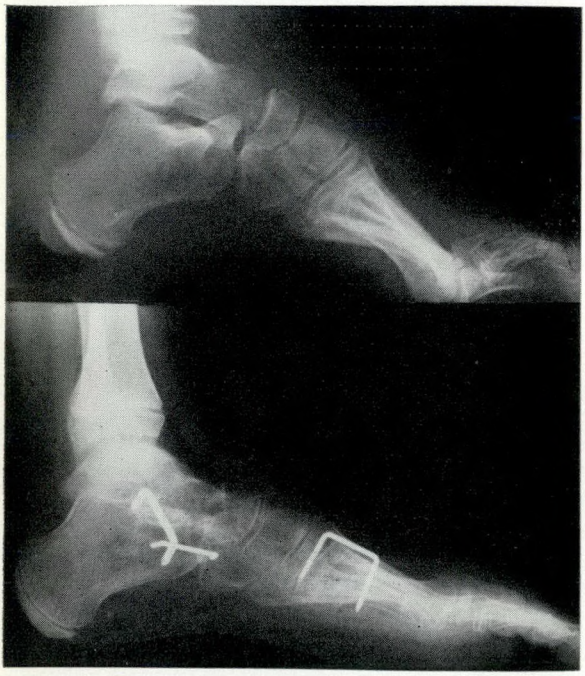
The Gallie fusion[6] has been preferred in this series (see Fig. 7). Autogenous cortical grafts are inserted across the talo-crural joint without further disturbing the articular cartilage or traversing the lower

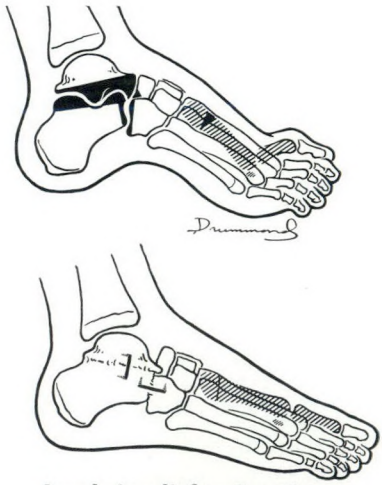


Lambrinudi Arthrodesis for Equinus Foot

Fig. 5

Fig. 5a (left).—Lambrinudi arthrodesis enhances the dorsiflexor power.





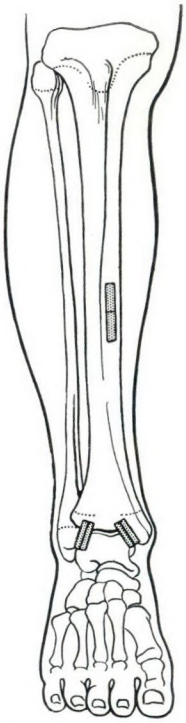
Lambrinudi for Pes Cavus (may be combined with osteotomy of first metatarsal)

Fig. 6

Fig. 6a (left).—Lambrinudi arthrodesis and osteotomy of first metatarsal for pes cavus.

tibial epiphyseal plate. For that reason it may be possible to fuse the ankle joint at an early age.

In all 10 cases the joint was solidly fused after 14 weeks; one poor result had to be revised because of an excessive calcaneus deformity. It is better to err on the side of equinus, as a raised heel will readily correct any undesirable equinus. No cases of painful plantar calluses were encountered.



Gallie Ankle Fusion

Fig. 7

Pantalar Fusions

This operation was first described in 1911 by Lothior[7] as a pan-astragaloid arthrodesis. The calcaneo-cuboid joint is now included as well as the three joints about the talus (see Figs. 8 and 8a).

The operation is reserved for completely flail legs below the knees. If the indications for this operation are doubtful, a triple arthrodesis is first performed; the case is then re-assessed at a later date. Another advantage of a two-stage pantalar fusion is that it permits greater accuracy in obtaining the desired amount of equinus. The incidence of aseptic necrosis of the talus and of pseudarthrosis are also reported to be lower if the ankle fusion and triple arthrodesis are performed on different occasions.

The secret of a successful pantalar fusion is an adequate degree of equinus. Leg length, knee stability and the sex of the patient are the main considerations (Table XI).

1. *Leg length discrepancy.*—Fixed ankle equinus will compensate for some leg shortening. A raised heel, however, should protect a flail knee against recurvatum leaving just enough equinus to lock the knee.

2. *Sex or height of heel desired.*—A woman needs more equinus to accommodate for high heels. It has been estimated that a ¾ inch heel corresponds to 5 degrees of equinus beyond 90 degrees. Most women require 105 degrees of equinus and men 100 degrees of equinus.

TABLE XI.—Pantalar Arthrodesis: Considerations for Degree of Equinus

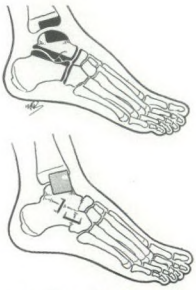
1. Leg length discrepancy.
2. Sex of patient.
3. Knee stability.

TABLE XII.—Pantalar Arthrodesis

	Range (years)	*Average (years)*
Age	9-16	12½
Follow-up	2- 7	5¼

3. *Knee stability.*—To bear weight on a flail knee one has to lock it in extension. Knee flexors such as the gastrocnemii and hamstrings may become knee extensors once the foot is stable on the ground; hip extensors will produce a similar effect. Such beneficial action on a flail knee is impossible in the absence of a tight heel cord or the fixed equinus of a fusion. Any pre-existing flexion deformity in a flail knee must first be corrected; otherwise any weightbearing on that limb can only be performed with a long leg brace or with a hand on the thigh. Pre-existing genu valgum or recurvatum should also be corrected before a pantalar fusion.

To determine preoperatively the exact degree of equinus and its effect on a flail



Pantalar Arthrodesis
Fig. 8

Fig. 8a (left).—Pantalar arthrodesis. Men—100 degrees of equinus; women—105-110 degrees of equinus.

knee, a below-knee walking cast is first applied. The resultant gait and the optimal degree of equinus can then be observed.

Twenty-two pantalar procedures were performed on 22 flail limbs below the knee (20 poliomyelitis, two meningocele). Ankle fusion and triple arthrodesis were performed in the manner already described. The average age was 12½ years and the average follow-up period is 5¼ years (Table XII). The operation was usually a two-stage procedure. The average time in plaster was 4½ months. The degree of equinus was 100 degrees for males and 105 degrees for females.

A possible complication of pantalar fusion is genu recurvatum. The greatest safeguard against this complication is good hamstring function; in its presence, a considerable degree of equinus may be tolerated. This was illustrated by the nine cases of genu recurvatum in which hamstring function was absent but in which excessive ankle equinus was not always noted.

There were no cases of aseptic necrosis of the talus. All were solidly fused and the appearance of the foot was always satisfactory. There were no cases of plantar calluses (see Fig. 9).

There were 17 good results (73%); two were fair, and three were poor results (see Table XIII). The three poor results were noted in patients with a completely flail leg in whom the hips were still unstable. It would appear that, in dangle legs, the result from a pantalar fusion will be disappointing unless the hip is also stabilized. Three patients with a completely flail limb now walk well without a brace, after pantalar and hip fusions. A pantalar arthrodesis is most successful if there is power in the hamstring and gluteus maximus muscles. The former will protect the knee against recurvatum and the latter will supply some take-off. Lateral transfer of the iliopsoas muscle will aid in hip stability.

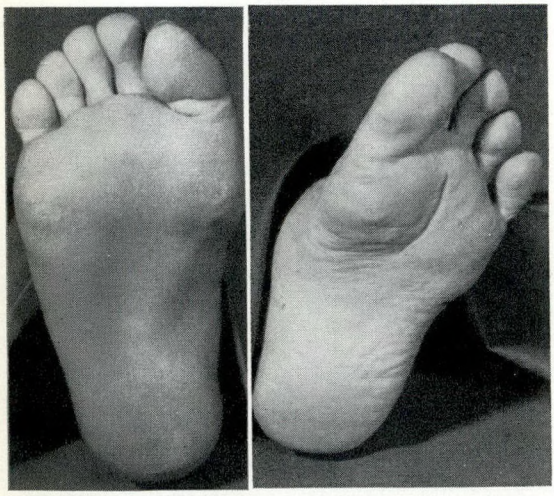


Fig. 9.—The plantar callosities are on the normal foot.

TABLE XIII.—Pantalar Arthrodesis: Results in 22 Operations

Good	17
Fair	2
Poor	3

With good to fair hip and knee musculature, hardly any limp may be noticeable with a pantalar fusion.

Summary

A series of 209 fusions about the ankle and foot in children have been reviewed two to 10 years after operation.

Good results were obtained in 76% of subtalar fusions, 77% of regular triple arthrodeses, 80% of the Lambrinudi triple arthrodeses, 90% of ankle fusions (small series) and 73% of pantalar fusions. The techniques were discussed briefly and certain conclusions were drawn from the above cases.

1. The extra-articular subtalar fusion as described by Grice[1] is easily and safely obtained at the age of five. It should be performed to maintain subtalar alignment and stability after correction of a valgus or a varus deformity. Overcorrection of a valgus foot is undesirable and fortunately difficult to produce. The operation may also be performed at a young age in order to discard a brace. After eight years of age, however, fusion is best deferred until a triple arthrodesis is possible.

2. Triple arthrodesis should be deferred until age 12. When it is performed, it should be remembered that internal fixation with staples is useful and that, although overcorrection is rare, a recurrence is almost inevitable if muscle imbalance is not corrected.

3. A Lambrinudi fusion will provide good correction of an idiopathic cavus foot without sacrificing length; it should never be performed for a paralytic cavus foot, however, as calf weakness is a contraindication for this operation. A Lambrinudi fusion will provide good correction of dynamic and fixed equinus, secondary to poliomyelitis or cerebral palsy.

4. Ankle fusions alone are rarely indicated for paralysis in children. When necessary, they can be performed by the Gallie[6] technique without disturbing growth. Short of perfection, it is safer to err on the side of excessive equinus rather than fuse the ankle in some calcaneus.

5. Pantalar arthrodeses give excellent results in children with flail legs below the knees. A pantalar fusion however is not enough if the hip is unstable. The danger of genu recurvatum due to the equinus of a pantalar fusion is minimal in the presence of good hamstring function.

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Résumé

Les auteurs rapportent les résultats obtenus dans 301 cas de fusion du talon chez l'enfant durant une période de 10 ans, de 1947 à 1956, à l'Hôpital des Enfants Malades de Toronto. On a obtenu de bons résultats dans 76% des fusions sous-tarsiennes, 77% des arthrodèses triples de type classique, 80% des arthrodèses triples de Lambrinudi, 90% des fusions de la cheville, et 73% des fusions totales du talon. Après avoir exposé les détails des différentes techniques et des indications, les auteurs en viennent aux conclusions suivantes:

1. La fusion médio-tarsienne extra-articulaire telle que décrite par Grice s'obtient facilement et sûrement à l'âge de 5 ans; on l'exécute pour maintenir l'alignement médio-tarsien et la stabilité du pied après correction d'une déformation en valgus ou en varus; on doit voir à ne pas exagérer la correction du valgus. L'opération s'exécute aussi dans le bas âge pour permettre à l'enfant d'abandonner son attelle métallique—Après l'âge de 8 ans, il est préférable d'attendre et de faire plus tard l'arthrodèse triple. (2) L'arthrodèse triple classique de Ryerson, préconisée par Ombrédanne en 1911, se fait après l'âge de 12 ans—l'agrafage métallique interne rendra de grands services et assurera une meilleure coaptation des os durant l'application du plâtre; la rechute est presque inévitable si l'on ne corrige pas le déséquilibre musculaire. (3) La fusion triple de Lambrinudi, dont la variante consiste dans l'avivement des surfaces médio-tarsiennes, donne une bonne correction du pied creux idiopathique, mais ne sera pas utilisée pour le pied creux paralytique à cause de la faiblesse des muscles postérieurs de la jambe; on obtiendra de bons résultats dans le pied équin stabilisé secondaire à la polio ou la paralysie cérébrale. (4) Les fusions de la cheville seule sont rarement indiquées dans la paralysie chez les enfants; dans ces cas, la technique de Gallie avec greffe en dehors de la tibio-tarsienne sera employée. Si la correction n'est pas parfaite, il vaut mieux obtenir un excès d'équinisme que de talus. (5) Les arthrodèses totales du talon donnent de bons résultats dans les pieds ballants; l'intervention toutefois n'est pas suffisante s'il y a instabilité de la hanche—et on devra au préalable y remédier; si les muscles fléchisseurs du genou fonctionnent normalement, il y a bien peu de risque de "genu recurvatum".

ACTINOMYCOSE MAMMAIRE PRIMITIVE

FLORIAN TREMPE, M.D.,* *Québec, Qué.*

La localisation de l'actinomycose à la glande mammaire est extrêmement rare.

Sanford et Voelker, dans une revue complète de la distribution anatomique de l'actinomycose couvrant 680 cas, n'en signalent aucun d'invasion mammaire.

Les traités les plus récents de pathologie chirurgicale n'en disent rien ou y consacrent quelques lignes.

Même des monographies sur les affections du sein ont sur l'actinomycose à peine une demi-page.

Dans mon cours de pathologie chirurgicale, je me trouve généreux puisque j'ai un sous-chapitre d'une douzaine de lignes sur cette affection.

En glanant ici et là dans la littérature médicale, on finit par établir qu'il existe deux formes d'actinomycose mammaire: secondaire et primitive.

La forme secondaire est, si l'on peut dire, la moins rare, alors que le sein est envahi de proche en proche par un foyer primitif d'actinomycose pleuro-pulmonaire qui a gagné la paroi thoracique.

L'actinomycose pulmonaire étant déjà rare et la propagation au sein ne se faisant que dans 5% à 6% des cas, on peut juger de la rareté de la forme secondaire.

Quant à *la forme primitive,* on peut dire qu'elle est rarissime.

Cette rareté de la forme primitive chez la femme fait cependant contraste avec sa fréquence relative chez la vache et la truie. Mais, chez ces animaux, on le comprend, c'est la litière qui infecte le mamelon et l'infection se fait par voie canaliculaire, la seule voie qui semble d'ailleurs admissible chez la femme aussi.

On ne peut invoquer, comme l'ont voulu certains auteurs, la voie lymphatique, car, si l'actinomycose peut, par voie sanguine, atteindre à peu près tous les tissus et tous les organes, même les os, seuls *les lymphatiques restent indemnes.*

Dans les rares cas authentiques d'actinomycose mammaire primitive qui ont été rapportés, il s'est toujours agi de paysannes adonnées aux travaux des champs.

Chez deux malades de Muller, l'actinomycose primitive était survenue après des abcès ordinaires, ouverts et pansés avec des cataplasmes de graine de lin et de farine quelconque: c'est là un argument à retenir contre l'emploi de tels cataplasmes.

Mais peut-on dire que ce sont là des formes vraiment primitives?

On arrive à pouvoir trouver à l'actinomycose du sein trois périodes d'évolution:

1. *La phase de tuméfaction* dure, à limites imprécises, avec rétraction du mamelon toujours précoce et de la peau; c'est à cette phase que le diagnostic avec un cancer est presque impossible.

2. Puis vient *la phase d'envahissement total* de la glande qui devient d'une dureté ligneuse avec une peau infiltrée, de couleur violacée; ici, on pourrait peut-être commencer à y penser.

3. Enfin, *la phase où la peau s'ouvre et se crible de fistules*, laissant échapper un séro-pus contenant les grains jaunes caractéristiques; à cette période, il est moins permis d'ignorer le diagnostic.

A n'importe quelle phase de l'affection, c'est-à-dire en supposant qu'on en ait fait le diagnostic, le traitement ne doit pas consister en demi-mesures qui ne font que faire traîner la maladie et risquent de la disséminer ailleurs, mais en une mastectomie radicale.

La mastectomie simple est insuffisante, car elle expose à laisser des fusées mycotiques dans les muscles pectoraux, donc à des récidives; il est cependant inutile de faire le curage de l'aisselle.

Observation

Mme. H.M., une paysanne de 48 ans, est admise dans le service de chirurgie de l'Hôpital St-Sacrement, le 13 septembre 1956.

Elle présente tous les signes cliniques d'un épithélioma du sein droit: tumeur sous-mamelonnaire, empiétant sur le quadrant supéro-externe, de la grosseur d'une petite orange. sans contours nets, immobile dans la glande,

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légèrement douloureuse à la pression, rétractant le mamelon et produisant une rétraction cutanée du côté externe.

Je me souviens, lors de la tournée des salles, d'avoir donné devant les élèves une des plus belles démonstrations de la valeur de la méthode "de se pencher en avant" ayant pour but d'accentuer la rétraction mamelonnaire et cutanée pour faire la preuve de la malignité de la tumeur.

Or, chez cette malade, la manœuvre amputait littéralement la partie avant du sein et faisait loucher à l'extrême, du côté externe, un mamelon très rétracté.

Il y avait bien la notion de l'évolution un peu rapide (un mois, au dire de la patiente) et d'une certaine sensibilité au palper de la tumeur, mais que devenaient ces dires de la malade devant une lésion aussi cliniquement et typiquement cancéreuse, surtout chez une femme ayant l'âge du cancer?

Je demande donc à l'assistant de la salle, le Dr. Jean Couture, de lui faire une mastectomie radicale avec évidement de l'aisselle, sans même recourir à une section congelée extemporanée.

En effet, si ce n'était pas là un cancer, à quoi bon les signes cliniques?

Ne pas avoir fait de section congelée fut une bonne chose dans ce cas, car, autrement, le pathologiste nous aurait fait le diagnostic d'une lésion inflammatoire sans caractère spécifique, négativant par là même celui de cancer.

Nous n'aurions pas su au juste comment nous comporter au moment de l'intervention.

Ce n'est que le lendemain de la mastectomie que le pathologiste nous a fait savoir qu'à la coupe, le sein enlevé contenait plusieurs petits abcès au centre de la masse.

Cette nouvelle fut accueillie avec un désappointement compréhensible; mastectomie radicale pour une mastite!

Heureusement que, quelques jours plus tard, le même pathologiste, le Dr. Robert Garneau, nous donnait le rapport histopathologique suivant:

"La glande mammaire examinée présente de nombreux foyers purulents constitués par une grande quantité de polynucléaires, de plasmocytes, des histiocytes et plusieurs macrophages à cytoplasme vacuolaire. Ces abcès sont centrés par des *grains actinomycosiques typiques.*

"Les ganglions axillaires examinés, au nombre de six, présentent de l'atrophie graisseuse et un peu d'hyperplasie réticulaire et médullaire.

"Conclusion: Actinomycose de la glande mammaire."

Une culture confirma aussi l'actinomycose.

Une radiographie pulmonaire fut faite pour éliminer l'origine pulmonaire de l'affection.

Nous avions donc été en présence d'une actinomycose primitive mammaire à la première phase de son évolution.

Heureusement qu'à part l'évidement de l'aisselle, le traitement avait été celui qui est indiqué.

C'est donc cette déconfiture clinique, du moins en ce qui concerne le diagnostic, qui nous permet d'enrichir d'un cas de plus la si maigre bibliographie sur l'actinomycose mammaire.

Summary

Localization of actinomycosis to the mammary gland is so very rare that only a thorough study of textbooks and reviews reveals the fact that there are two types of actinomycosis of the breast: secondary and primary. The *secondary* form represents contiguous spread in continuity to the breast of a pleuro-pulmonary actinomycosis.

The *primary* form in which the infection is of canalicular origin is even rarer. The suggestion of lymphatic spread made by some authors is inadmissible, because it is now proved that actinomycosis may affect all tissues and organs, even bones, *except the lymphatic system.*

There are three stages in the evolution of primary actinomycosis of the breast:

1. *The stage of hard and diffuse swelling* with early nipple and skin retraction, resembling a cancer.

2. *The stage of total invasion of the gland* with woody hardness and infiltrated purplish skin; here, actinomycosis may be suspected.

3. *The phase in which the skin is riddled with fistulas* secreting sero-pus containing the typical yellow particles; at this stage the diagnosis is obvious.

In any stage the correct treatment is by radical mastectomy, without dissection of the axilla.

In the case described a 48 year old woman was admitted to the surgical service of St. Sacrement Hospital, on September 13, 1956. She had all clinical signs of cancer of the right breast, all these signs being accentuated to the extreme by the "forward bending manœuvre". A radical mastectomy was done, without resorting to biopsy and rapid frozen section, since the clinical signs so clearly indicated cancer. A few days later the pathologist's report indicated the unexpected diagnosis of actinomycosis.

Fortunately the correct treatment had been applied, except for dissection of the axilla, which should not have been done. This diagnostic error enables us to add a case to the very meagre bibliography on actinomycosis of the breast.

THE ANTERIOR TIBIAL COMPARTMENT SYNDROME

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DURING THE PAST 10 years ischæmic necrosis of the anterior tibial muscles has been described with increasing frequency and is usually reported under the caption of "anterior tibial syndrome". Vogt, in 1943, is given credit by Horn[12] for having first reported the condition, which is characterized clinically by pretibial pain and tenderness followed by paralysis of the dorsiflexor muscles of the foot and numbness or hypæsthesia in the first interdigital cleft. All degrees of the syndrome may be recognized ranging from simple "shin splints"† to frank necrosis and sloughing of the muscles of the anterior tibial compartment. Since the authors have had personal experience of six patients suffering from the condition, it was felt that a brief review of the subject with a tentative classification based on these cases, and those from the literature, might be useful.

CLASSIFICATION

It is generally agreed[9–11, 13, 14] that the anterior tibial syndrome follows interference with the circulation in the anterior tibial compartment of the leg, and it has been aptly described as a "Volkmann's contracture of the lower extremity".[9] A review of the literature together with a study of our own cases would indicate that the causes of the circulatory disturbance may be classified as follows:

A. Traumatic—direct—1‡
—indirect—1

B. Vascular—arterial thrombosis—2
—arterial embolism—2
—arterial spasm—0

It could be reasonably argued that such a separation of causes is not necessary, as the basic cause in all is vascular. This is so but the above separation acknowledges that in some instances the vessel itself is damaged, in others compressed and in others occluded in the presence or absence of inherent disease of the artery itself.

ANATOMY

The anterior tibial space is defined as that space on the anterior surface of the leg which is enclosed by the lateral surface of the tibia, the interosseous membrane, the anterior surface of the fibula and the deep fascia of the front of the leg with its anterior crural intermuscular septum. It should be noted that the space described above is quite fixed and is capable of little, if any, expansion. Inferiorly the deep fascia is continuous with the extensor retinaculum; medially it blends with the periosteum covering the medial surface of the tibia; superiorly it is attached to the patella, ligamentum patellæ, the tubercle and condyles of the tibia and the head of the fibula. Laterally the deep fascia is continuous with the deep fascia of the back of the leg; however, it gives off two well-defined septa, namely, the anterior and posterior crural intermuscular septa, the anterior septa being inserted into the anterior border of the fibula and thus effectively closing off the anterior tibial space laterally.

ETIOLOGY

Ischæmic necrosis of the anterior tibial muscles may follow direct injury to the muscles in the compartment. We have seen this after a gunshot wound of the leg and it is well recognized as a complication of fractures of the leg. An unusual form of trauma to the muscles is that reported by

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†"Shin splints" is a term used to describe a common muscular affliction well known amongst athletes and by their coaches. It is manifest by pain and tenderness in the pretibial muscles of runners, broad-jumpers and other athletes at the beginning of their season. The anterior tibial muscles become firm and swollen, and active or passive flexion and extension of the ankle is painful. The suggested cause is recurrent minimal trauma of the out-of-condition muscles. Most athletes "train off" the complaint but if it is severe, rest and hot compresses may be required.

‡The numbers indicate the patients seen by the authors in each group.

Carter and his colleagues.[1] In two of their patients muscle necrosis followed extravasation of intravenous infusions into the compartment in the absence of any major arterial damage.

Indirect trauma accounts for by far the greatest number of reported cases. The syndrome usually follows severe muscular strain in untrained or out-of-condition men who have suddenly been called upon to undergo such unaccustomed exercises as long route-marches, running, or football. This form of anterior tibial syndrome may vary in severity from "shin splints", from which we have all suffered at some time, to necrosis of the anterior tibial muscles.

It has only recently been recognized that a typical anterior tibial syndrome may follow abrupt occlusion of the circulation to the compartment by embolism or thrombosis of the anterior tibial artery.[13, 14] This usually develops in the older subject whose vessels are rigid and perhaps atherosclerotic, and whose collateral circulation cannot expand rapidly enough to nourish the muscles during the acute phase of ischæmia. As a result the muscle deprived of an adequate blood supply undergoes necrosis—at first aseptic but prone to infection.

Ischæmia secondary to spasm of the anterior tibial artery has been suggested.[2] Although spasm may play a part in the development of the syndrome, we have not encountered a patient in whom we felt its role was pre-eminent. It may be that the milder degrees of "shin splints" are due to, or accompanied by, arterial spasm; however, this is difficult to verify.

Clinical Features

This clinical picture depends, to some extent, upon the cause of the ischæmia as well as upon the degree of ischæmia produced. The initial complaint is usually pain in the front of the leg. This may vary from the rather mild "shin splints" to severe excruciating pain.

In the acute vascular type the leg is pale, paralyzed, pulseless and painful. This initial picture is a feature of the intense arterial spasm associated with impaction of the embolus in the vessel. As the condition progresses local symptoms and signs become predominant and local examination of the affected leg reveals the pretibial region to be firm, swollen and painful to palpation. The skin overlying the compartment may be red and thus an acute inflammatory process may be suspected and the true nature of the condition overlooked. Cases have been reported where the compartment was incised as an abscess.

In the acute stage the anterior tibial pulse is weak or absent. Any attempt to move the ankle, actively or passively, produces exquisite pain in the front of the leg. Cutaneous sensation is diminished or lost in the first interdigital cleft. If the condition is untreated the skin over the compartment may slough and so leave a large necrotic ulcer. (Fig. 1).

The acute stage passes off in a period of days or weeks, the pain and swelling subside, and the power of dorsiflexion of the ankle remains weak. Contracture of the contents of the compartment occurs, which fixes the ankle and limits active plantar flexion and dorsiflexion. Cutaneous anæsthesia or hypæsthesia in the first interdigital cleft usually persists. The dorsalis pedis pulse may or may not be palpable, depending upon the original mechanism. It rarely returns when an acute vascular accident has been the cause of the syndrome.

Differential Diagnosis

Both the traumatic and the vascular types of anterior tibial syndrome develop abruptly. In the traumatic form the condition is more likely to be suspected and thus diagnosed. In reviewing the literature, however, one notes that the diagnosis is not often made early in the vascular types, no doubt because of the variation in the site and degree of occlusion of the arterial tree and consequent variation in the symptoms produced.[16] The acute anterior tibial syndrome may be confused with cellulitis, tenosynovitis, thrombophlebitis, lateral popliteal nerve lesions and acute osteomyelitis. If the suspicion index is high then the diagnosis should not be difficult.

Morbid Anatomy

We have examined the muscles histologically in only one patient whose anterior

Fig. 1.

tibial compartment sloughed after acute arterial occlusion. The picture was that of massive infarction of muscle with hæmorrhage. Descriptions of the microscopic findings of others may be summarized as follows:

1. Ischæmic necrosis or infarction of muscle.
2. Peripheral replacement fibrosis.
3. Evidence of old or recent hæmorrhage within the muscles.
4. Blood vessels are normal in the traumatic group.

The picture resembles closely that of Volkmann's ischæmic contracture, which indeed it is except that it occurs in the leg rather than the forearm. In the late or recovery stage the necrotic muscle is replaced by fibrous tissue. Hyalinization of tissue may occur.[8, 10]

Treatment

Although the form of treatment is modified somewhat by the cause of the anterior tibial compartment compression the common factor in management is early relief of the abnormal tension in the tissues before death of muscle supervenes. Thus if the patient is seen early, rest in bed with the leg elevated and splinted in the position of rest will allow the acute "shin splints" to subside. Once the acute condition has subsided, further episodes may be prevented by graduated physical training until the patient and his muscles are fully conditioned.

If the patient is not seen until the leg is painful, swollen and showing evidence of ischæmic compression of the anterior tibial nerve, then surgical decompression of the anterior tibial compartment must be considered or irreversible foot-drop will result. Fasciotomy is performed by incising the fascia over the anterior tibial compartment longitudinally from top to bottom. This latter procedure may also be carried out by introducing a fasciotome through a small skin incision as suggested by Harrison and Jackson.[14] Success with this method has been reported but if fasciotomy is not performed early sloughing of the compartment contents may ensue (Fig. 1).

In the late or recovery stage there is usually a residual foot-drop. Drop-foot appliances may be required and function well in this stage. Progressive contracture of the ischæmic anterior tibial muscles, however, may fix the ankle or may result in a dorsiflexion deformity which is best treated by excision of the fibrotic muscle mass and the performance of suitable tendon transfer to reinforce dorsiflexion. The tibialis posterior and the peroneus longus are the tendons most suited for substitution in this condition.

The only exception to the above outlined treatment is the anterior tibial syndrome seen as the result of an acute arterial embolism, thrombosis or spasm. If this is seen early the leg is elevated and splinted, and anticoagulant therapy (heparin and later dicoumarol derivatives) is instituted and continued until the acute process has subsided. A sympathetic block, plus the use of an intra-arterial vasodilator drug, i.e. Priscol 50 mg. six-hourly, may be helpful in overcoming any spastic component to the vascular insufficiency. Sympathetic block, of course, is not used in conjunction with anticoagulant therapy because of the danger of retroperitoneal hæmorrhage. Should there be no relief of symptoms in 8-12 hours then heparin is discontinued or counteracted with protamine sulphate, and fasciotomy is performed. Patients seen after a lapse of 12 hours should probably not be subjected to fasciotomy because by then the anterior tibial muscles will have become necrotic and thus highly susceptible to infection if explored. It is better in such an instance to treat the condition conservatively and allow fibrosis to occur. The late contracture may then be corrected by appliances or by tendon transplants.

Recently a "chronic form" of the anterior tibial syndrome has been described.[3] The patient described in the latter report, however, had fascial herniæ as well and it is hard to say whether correction of the herniæ by fascial transplant or whether enlarging the anterior tibial compartment led to the reported relief of symptoms. More careful study and reporting of the "chronic form" will be necessary before it can be accepted as a distinct and separate entity.

Discussion

The etiology of this syndrome has been the subject of much discussion. The clinical description includes anæsthesia or hypæsthesia in the cutaneous distribution of the anterior tibial nerve, which is the first interdigital cleft. The extensor digitorum brevis may be paralyzed. These signs are most likely due to a secondary compression neuropathy of the anterior tibial nerve in its passage through the rigid anterior tibial compartment.

The massive muscle necrosis of the anterior tibial compartment can only be due to ischæmia. The *modus operandi* of the anterior tibial syndrome is temporary reduction or complete cessation of blood supply to the muscles of a closed compartment as a result of indirect compression, of direct injury or luminal occlusion by embolism or thrombosis of the anterior tibial vessels. It has been shown that lack of significant vascular collaterals in this region may be a factor in the production of the syndrome.[16] In the vascular types the major arteries are abruptly occluded. This direct ischæmia is augmented by the œdema produced in the compartment as a result of increased capillary permeability subsequent to the ischæmia of the cells themselves. Thus the selective necrosis of the anterior tibial compartment that has been noted[17] can be accounted for regardless of the anatomical location of the occlusion.

In contrast to the direct ischæmia of vascular occlusion, the anterior tibial syndrome secondary to trauma is due to indirect occlusion of first the venous and then the arterial supply to the compartment. With direct trauma the syndrome is produced by extravasation of blood into the compartment with subsequent indirect pressure occlusion of undamaged vessels. With indirect trauma secondary to unaccustomed activity, the normal tendency of the muscles to swell because of accumulation of lactic acid and other metabolites may be complicated by strain or minor ruptures of muscle fibres with subsequent hæmorrhage or extravasation of fluid into the closed anterior tibial compartment. The tension in the space rises and, if untreated, leads to muscle necrosis. The arterial element may be the predominating factor as suggested by the work of le Gros Clark[6] who has been able to reproduce the lesion in rabbits by ligating the anterior tibial artery.

Thus the etiology of the syndrome is ischæmia of the muscles of the rigid anterior tibial compartment. The ischæmia is produced by direct or indirect occlusion of circulation—chiefly the intramuscular arteries and veins. There follows an impeded venous return, capillary exudation and increased swelling which produces a further rise in tension in the compartment. The end phase of this is serious circulatory obstruction at the arterial level. A secondary ischæmic neuropathy of the anterior tibial nerve completes the picture. If the tension is not relieved, irreparable myoneural damage will result.

Summary

The anterior tibial syndrome has been reviewed. A classification of the syndrome has been suggested and clinical features, morbid anatomy and treatment have been discussed. The vascular basis of the condition is re-emphasized.

Case Reports

Case 1.—W.S.: A 76 year old man with an 11-year history of intermittent claudication of left calf was suddenly seized by severe pain in right leg from the knee to the lateral aspect of the ankle. Upon examination five hours later the blood pressure was 180/105 mm. Hg, the heart was fibrillating, and an abdominal aneurysm was palpable. The right leg was cold, anæsthetic and pulseless. When he was seen by one of the authors two days later, the circumference of the right leg was three inches greater than the left; the anterior

tibial compartment was tender, swollen, hot and red. There was anæsthesia in the first interdigital space, foot-drop was present, and the dorsalis pedis pulse was absent. The syndrome resolved with anticoagulants and the patient was discharged three weeks later with foot-drop controlled by a toe spring. Dorsalis pedis pulse was still absent and there was persistent anæsthesia of the foot. This patient was considered to have had an acute embolic type of anterior tibial syndrome which would have benefited from early fasciotomy. The source of the embolus was probably the fibrillating left heart or perhaps a clot from the abdominal aneurysm.

Case 2.—M.R.: A 64 year old woman with a seven-year history of intermittent claudication of the right calf was admitted with an ulcer on the outer aspect of lower third of left leg following a bout of acute pain and anæsthesia of front of leg several weeks previously. Examination showed blood pressure 230/110 mm. Hg; no pulses were felt in the limbs below the femoral, and there was a large, deep, oblong ulcer on the anterolateral aspect of left leg, exposing muscles and tendons. This cleared gradually on conservative measures. This woman was considered to have developed a thrombotic type of anterior tibial syndrome secondary to sudden occlusion of an already atherosclerotic anterior tibial artery.

Case 3.—R.R.: A 48 year old R.A.F. officer was sent for consultation complaining of pain in front of both legs on walking one-quarter to one-half a mile. The pain could be "walked off" if the rate of walking was reduced. The patient was an obese man, blood pressure 120/90 mm. Hg, with no vascular or neurological abnormalities in the lower limbs. Arteriograms of both legs were normal. Enquiry showed that this officer indulged in no exercise and used a staff car for most of his duties. This was considered to be a case of severe "shin splints" and responded well to a regimen of weight reduction and "conditioning".

Case 4.—M.G.: A 61 year old woman was admitted in congestive heart failure with a five-day history of onset of acute pain and coldness of left leg. On the day of admission the left leg became discoloured and paralyzed.

She was a thin, dyspnœic woman with blood pressure 120/70 mm. Hg, fibrillating and in gross congestive heart failure. The left leg was pulseless and cold, with blotchy discoloration over the anterior compartment. There was complete foot-drop and anæsthesia over the dorsum of the foot. On anticoagulant therapy the anterolateral aspect of the leg became hot and swollen, and 10 days after admission the skin broke down (Fig. 1). This area was excised and skin grafted with complete healing in one month, at which time the posterior tibial and dorsalis pedis pulses could both be felt at the ankle. Persistent foot-drop was controlled by a toe spring. This was felt to be a case of acute embolic anterior tibial syndrome which would have benefited from early fasciotomy.

One year later she was re-admitted with a further embolus to the left leg; gangrene and amputation supervened.

Case 5.—F. M.: A 28 year old Negro was admitted after having been shot through the left calf by a small-bore (22 calibre) pistol. There was an entry wound posteriorly over the medial head of the gastrocnemius muscle and an exit wound anteriorly over the anterior tibial compartment. Somehow in its course the bullet missed the major vessels, since both anterior and posterior tibial pulses were initially present at the ankle. The injury was treated conservatively but within eight hours the leg had become cold, grossly swollen and paralyzed. Anterior tibial fasciotomy done 14 hours after the original injury revealed greyish, bulging muscles with extensive hæmorrhage into the compartment. Persistent foot-drop resulted. In this case earlier fasciotomy might have prevented permanent damage to the muscles.

Case 6.—J.B.: A 74 year old man was admitted to hospital following a severe attack of pain in his left leg which occurred as he was walking down some stairs.

On examination no pulsations were felt in the left leg or foot. The anterolateral aspect of the leg was swollen and tender. The foot could not be actively dorsiflexed.

Laboratory investigations were negative, and plethysmography on the left foot revealed normal resting blood flows.

The patient was treated with bed rest, elevation and antispasmodic drugs and lumbar sympathetic block. The limb improved steadily over a two-month period. The pain disappeared; however, his foot-drop remained. He was able to walk short distances on discharge from hospital. The left leg circumference was one inch less than the right, and the anterior tibial muscles were hard and rigid and the compartment concave in contour.

Check one year later showed the condition of the limb to be essentially unchanged. His foot-drop remained but he walked well without a brace.

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Résumé

Horn attribue la description princeps du "syndrome tibial antérieur" à Vogt (1943). Cet état se manifeste cliniquement par de la douleur prétibiale suivie de paralysie des fléchisseurs du pied, ainsi que par de l'engourdissement et de l'hypoesthésie du premier espace inter-digital. Le syndrome peut varier de la simple douleur du "shin splints" à la véritable nécrose suivie d'élimination des muscles de la loge prétibiale.

Tous les auteurs expliquent le "syndrome tibial antérieur" par un arrêt circulatoire dans la loge prétibiale à tel point qu'on le décrit comme une "contracture de Volkmann du membre inférieur." Cette lésion peut résulter d'un traumatisme direct: on l'a observée à la suite d'une blessure par balle de fusil, et comme complication d'une fracture. Le plus souvent, le syndrome provient d'un traumatisme indirect. La cause est alors un effort musculaire trop violent par suite d'exercices inhabituels accomplis par des sujets non entraînés.

L'intensité des phénomènes dans ces cas, est variable. Ce n'est que récemment qu'il fut reconnu qu'un "syndrome tibial antérieur" typique pouvait suivre l'occlusion de l'artère tibiale antérieure par embolie ou thrombose. L'athérosclérose serait alors un facteur favorisant. Il a été suggéré que les cas les plus bénins seraient le résultat d'un spasme artériel. Le tableau clinique varie selon la cause et le degré d'ischémie. A la phase vasculaire aiguë, la jambe est pâle, paralysée, non pulsatile et douloureuse. Suivent les symptômes locaux d'induration, de gonflement et de douleur à la palpation. La peau devient rouge et l'état peut alors simuler un abcès. Si le traitement n'est pas institué d'emblée, il se fait une élimination tissulaire qui produit un ulcère nécrotique. La douleur et le gonflement disparaissent en même temps que les phénomènes aigus après quelques jours ou quelques semaines, mais la dorsi-flexion de la cheville demeure faible et limitée. Le syndrome tibial antérieur aigu, surtout de type vasculaire, ne doit pas être confondu avec une cellulite, une ténosynovite, une thrombo-phlébite, des lésions du nerf poplité externe ou une ostéomyélite aiguë. Histo-pathologiquement, l'image est celle d'un infarcissement hémorragique musculaire massif.

Le principe du traitement relève de l'allègement de la compression anormale des tissus et le mode variera selon la période d'évolution de la lésion: au début, l'élévation de la jambe et son immobilisation pourront suffire, tandis que s'il y a déjà du gonflement et des signes de compression du nerf tibial antérieur, il faudra pratiquer une fasciotomie. A la période de récupération, nous sommes habituellement en face d'un "foot-drop" qui habituellement répond bien aux mesures désignées à cet effet. La contracture progressive des muscles qui limite les mouvements de la cheville, est traitée de préférence par l'excision de la masse musculaire fibrosée suivie d'une transposition tendineuse adéquate. Si le syndrome est causé par une atteinte vasculaire intrinsèque, il faut associer les anticoagulants. Un blocage du sympathique, de même que l'injection intra-artérielle de Priscol sembleraient agir contre l'élément spastique. Il semblerait donc que le *modus operandi* du syndrome tibial antérieur serait l'ischémie des muscles de la loge tibiale antérieure rigide, qui viendrait surtout de l'occlusion directe ou indirecte des vaisseaux intramusculaires et produirait secondairement une neuropathie ischémique pouvant laisser une atteinte myoneurale irréparable.

CHRONIC ULCERATIVE COLITIS AND CARCINOMA OF THE COLON AND RECTUM*

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CHRONIC ULCERATIVE COLITIS predisposes to the development of malignancy in the rectum and colon. In 1927, Yeomans,[1] in a paper on rectal adenoma, reported a case of carcinoma and ulcerative colitis. The first large series of cases, however, was published by Bargen[2] in 1928 when he reported on 17 cases from the records of the Mayo Clinic. Since then this serious complication has been recognized and reported with increasing frequency.

A review of 213 cases of ulcerative colitis from the records of the Winnipeg Clinic between 1945 and 1956 has revealed 17 primary carcinomas in eight of these patients. The incidence of malignancy in this medically and surgically treated series was 3.7%. This report is an analysis of eight cases of carcinoma of the colon and rectum complicating chronic ulcerative colitis.

The incidence of carcinoma complicating ulcerative colitis has varied greatly in reported series. This is not surprising since some calculations have been based upon patients treated surgically, others upon medical cases and still others upon post-mortem findings. The figures have ranged between 1% and 11%. The average incidence of carcinoma complicating ulcerative colitis in medical series, excluding surgical or pathological series, was found to be approximately 3%. In surgical reports the incidence was frequently higher. In a previously reported series from St. Mark's Hospital, London,[3] the author discovered 12 cases of malignancy in 182 consecutive colectomies for colitis, an incidence of 6.6%. Cattell and Boehme[4] have suggested that the low incidence of carcinoma in some reports was probably due to infrequent surgical intervention, and that in some cases death attributed to ulcerative colitis without post-mortem examination might actually have been due to malignant disease.

CASE REPORT

The following case report (Case 8, Table I) illustrates a number of observations that are frequently seen in the association of ulcerative colitis and malignancy.

N.C., a 52 year old woman, gave a history of intermittent attacks of diarrhœa for 23 years. In 1936 she developed a rectal stricture which was dilated from time to time until 1939. From 1953 to 1956 she remained fairly well, gained 10 lb. and had three to four bowel movements a day, at times with formed stool. Three years had intervened since the last examination of the patient. Recently the passage of blood per rectum was noted, associated with crampy abdominal pains.

Digital examination revealed a firm stricture situated in the mid-rectum which would barely admit the tip of the index finger. Combined vaginal and rectal examination indicated the presence of a mass situated at and above this level. The stricture was gently dilated with the finger to allow the passage of a small calibre proctoscope. Both digital and visual examination of the lesion after this dilatation revealed the presence of an ulcerating, nodular, friable mass. However, the distal surface of the strictured area at first seen through the proctoscope before dilatation showed the effects of long-standing ulceration, induration and fibrosis. Because of the long history (23 years) of ulcerative colitis, recent changes in the clinical picture and the awareness of possible malignant change in the quiescent stage of the disease, it was suggested that the danger of malignancy in this case was very real. Biopsy of the stricture revealed squamous cell carcinoma. A barium enema indicated widespread ulcerative colitis.

A combined and synchronous excision of the rectum and left hemicolectomy were performed by the author. Five weeks later the remainder of the colon was removed and an ileostomy fashioned. The patient was alive and well with no sign of recurrence over a year and a half later.

The operative specimen revealed chronic ulcerative colitis and a constricting tumour of the rectum 7 cm. in length, the lower edge being 2 cm. above the pectinate line. A sec-

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ondary primary ulcerating carcinoma was discovered 3.5 cm. above the lower lesion. The mucosa of the colon and rectum was atrophic in appearance and on section (Fig. 2). Microscopic examination showed the distal tumour to be a squamous cell carcinoma of low grade malignancy penetrating muscularis only. The proximal tumour was a colloid carcinoma of average grade extending into muscularis mucosæ. No metastases were discovered in the regional nodes. The appendix was the site of a carcinoid tumour.

Discussion

It has been observed that carcinoma is likely to develop in patients who have had ulcerative colitis for 10 to 15 years or more. The average duration of ulcerative colitis in these eight patients was 17 years. Of the 182 cases of colectomy for ulcerative colitis reported by the author[3] from St. Mark's Hospital there were 46 patients who had been affected by the disease for 10 years or more. Of these nine developed cancer. Only three cases of malignancy were discovered in 136 patients with ulcerative colitis of less than 10 years' duration. Shands, Dockerty and Bargen[5] observed that, of 73 patients affected by carcinoma, 65% had symptoms of colitis for 10 years or more.

The average age at the time of diagnosis of carcinoma in these eight patients was 45 years. The oldest patient was 66, and the youngest was 22 years old. This average age is 10 to 15 years less than that found in the general population affected by carcinoma. Others[5-8] have placed this average at an even earlier age. Some authors[9] have noted that the incidence of malignancy is twice as high if the disease begins before 16 years of age. Two of the eight patients in our series were affected by ulcerative colitis before this age.

According to Warren and Sommers[7] ulcerative colitis affects equal numbers of males and females or perhaps a slight preponderance of females. The sex ratio in the cases from the Winnipeg Clinic was 112 females to 84 males. Of these, six females and two males developed carcinoma. Among 182 patients subjected to colectomy for ulcerative colitis from St. Mark's[3] the proportions were equal. However, in those associated with carcinoma the distribution was eight females to four males. In a previously reported series from St. Mark's by Counsell and Dukes[10] there were 10 females and three males. Sauer and Bargen[11] in 41 cases of carcinoma associated with ulcerative colitis found the ratio to be 21 females to 20 males. According to the Registrar General of Great Britain, males are affected more commonly by carcinoma of the large bowel. Ascherman[12] reviewed 461

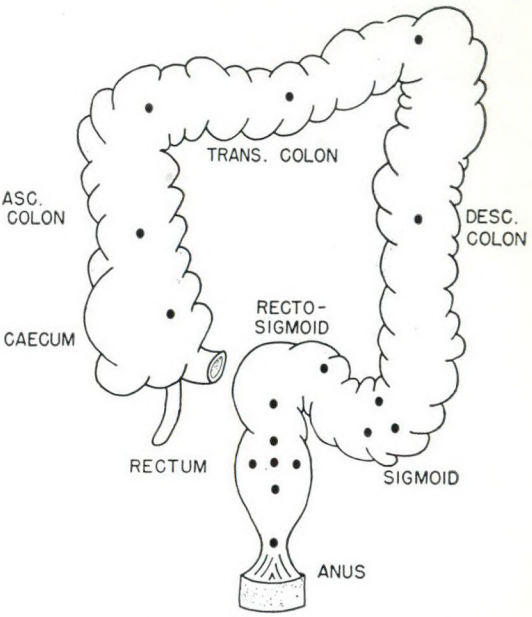

Fig. 1.—Diagram showing the distribution of 17 primary malignant tumours discovered in eight cases of chronic ulcerative colitis.

autopsy cases of carcinoma without ulcerative colitis and reported a ratio of 65% males to 35% females. The sex ratio, therefore, in cases of ulcerative colitis complicated by malignancy is in sharp contrast with the usual sex incidence of two males to one female for carcinoma of the colon and rectum in the general population. It is probably not wise to speculate as yet, whether or not the apparent increase in the proportion of females with carcinoma associated with ulcerative colitis is of significance.

There were 17 primary carcinomas discovered in the series of eight patients, and the sites of these lesions have been plotted (Fig. 1). Their distribution approximated to the generally accepted pattern of carcinoma of the colon and rectum in subjects not affected by ulcerative colitis. These

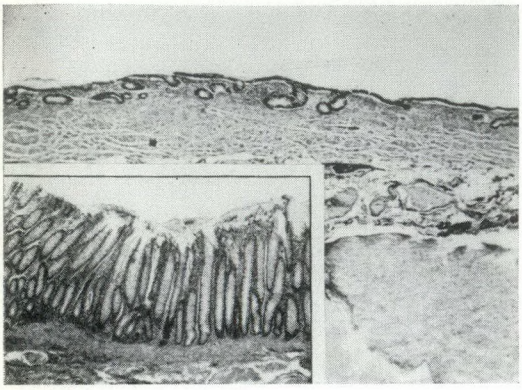

Fig. 2. (Case 8)—Photomicrograph of atrophic mucous membrane as often seen in cases of long-standing ulcerative colitis with carcinoma. Similar magnification of normal mucosa in insert.

tumours presented as distinct primary growths. In a case with multiple tumours, the lesions may or may not have the same histological grading. Occasionally, cases are discovered in which multiple malignant lesions are of different histological types. One such patient, from the present series, operated upon by the author,[14] had two carcinomas of the rectum. A squamous cell carcinoma had developed at the site of a long-standing stricture, while 3.5 cm. proximal to this area a colloid carcinoma was found. In five of the eight patients more than one malignant tumour was discovered and these tumours represented 14 of the total number of 17 primary ones. Three of the 12 patients from St. Mark's had multiple malignant tumours. This incidence of multicentric growth would indeed appear extremely high when compared with the incidence of multiple carcinomas in patients not affected by ulcerative colitis. This incidence of multifocal carcinoma of the large bowel has been estimated to range between four and seven per cent[13, 16] by a number of writers reporting carcinoma in the general population. Others have given a higher figure. Because of this much higher incidence of multicentric growth in ulcerative colitis, Shands, Dockerty and Bargen[5] have recommended the removal of all parts of the large bowel affected by disease when malignancy was also present. Multiple minute foci of carcinoma may sometimes be found if the bowel is examined closely, and suspicious areas sectioned after colectomy for ulcerative colitis. Random biopsies may occasionally reveal these areas of early carcinoma. However, microscopic differentiation may be difficult against a background of acute or chronic inflammation. Dukes[17] has observed that fragments of mucosa may become detached and buried in the submucosa or even muscle coat. He believes that this misplaced epithelium may be a predisposing factor in the development of malignancy. These benign downgrowths of mucosa described by Dukes must be distinguished from small focal carcinomas. The prognosis of these focal lesions when not associated with a clinically evident carcinoma is, of course, much better than in cases of gross carcinoma associated with chronic ulcerative colitis in general.

Some writers[10, 15] have painted a pessimistic picture of ulcerative colitis associated with carcinoma. They have stated that these tumours are usually of a high grade of malignancy associated with early lymphatic spread leading rapidly to death. These observations were not confirmed in this series, or in the previous series reported by the author. Of the 17 tumours found, 14 were histologically graded as of average or low grade malignancy. Eighteen of the 23 primary tumours from the cases from St. Mark's were of average or low grade malignancy. In three patients from the Clinic series no lymphatic spread was discovered and, in the cases from St. Mark's, seven of the 12 cases reported showed no lymphatic metastases. This compares favourably with Dukes' observations that of cases of carcinoma of the rectum and colon not affected by ulcerative colitis approximately 50% show no lymphatic metastases.

It has been observed[3, 10] that malignancy often appears in the quiescent stage of the disease when clinically the patient seems to have improved. The mucosa is frequently atrophic in appearance and on histological examination. These findings were confirmed in this series (Fig. 2).

Several interesting observations have been made recently by Gabriel[16] of St. Mark's Hospital, London, on the association of ulcerative colitis and carcinoma. He believes that these cases of colitis and carcinoma are "becoming very much more rare" and he notes that he has not en-

TABLE I.—Summary of Findings in Eight Cases of Carcinoma Complicating Ulcerative Colitis (The Winnipeg Clinic)

No.	Sex	Age at diag. of carcinoma (years)	Duration of Ulc. colitis before finding carcinoma (years)	How carcinoma diagnosed	Site of carcinoma	No. of malignant lesions	Histology and grading	Stage (Dukes' classification)*	Operations performed	Outcome
1	F	56	25	Clinically (biopsy)	Rectum and sigmoid	3	Adenocarcinoma (in part colloid) (2 high and 1 low)	C	Stage 1: Colostomy Stage 2: Abdomino-perineal resection.	Death 7 months
2	M	50	12	Clinically (biopsy)	Rectum	1	Colloid carcinoma (average)	B	Stage 1: Ileostomy and abdomino-perineal resection. Stage 2: Colectomy.	Death 3 years (enteritis) (no cancer at autopsy)
3	F	22	20	Unexpected (pathologist)	Cæcum and descending colon	2	Adenocarcinoma and colloid carcinoma (average)	C A	Stage 1: Ileostomy and colectomy Stage 2: Abdomino-perineal resection.	Alive and well 7 years
4	F	29	15	Primary suspected	Transverse colon and sigmoid	2	Colloid carcinoma (average)	C (liver and peritoneal deposits)	Stage 1: Cæcostomy. Stage 2: Palliative colon resection and restoration of continuity.	Death 7 months
5	F	66	20	Clinically	Multiple	5	Adenocarcinoma (low and average)	A B	Proctocolectomy	Death 1½ years
6	F	45	14	Unexpected (laparotomy)	Ascending colon	1	Colloid carcinoma (average)	C (liver and peritoneal deposits)	Laparotomy only.	Death 2½ months
7	M	45	5	Clinically (biopsy)	Rectum	1	Squamous cell (average)	C	Abdomino-perineal resection (refused further surgery).	Alive and well 2 years
8	F	52	23	Clinically (biopsy)	Rectum	2	Squamous cell carcinoma (low) Colloid carcinoma (average)	B	Stage 1: Left colectomy and abdomino-perineal. Stage 2: Ileostomy and right colectomy.	Alive and well over 1½ years.

*Dukes' classification—Low grade = Broders' grade one.
Average grade = Broders' grades two and three.
High grade = Broders' grade four.

countered this complication since November 1950. Since then, he has performed 22 colectomies after an ileostomy and 55 colectomies with ileostomy in one stage. No carcinoma was discovered in these 77 surgical specimens. In addition, he has performed 91 perineo-abdominal excisions of the rectum as a final stage of total colectomy since January 1949 without encountering a malignant tumour. In these two large series there was no mortality.

The appearance of polypoid projections in chronic ulcerative colitis has led to much discussion. Counsell and Dukes[10] have classified these projections into three distinct varieties: (1) mucosal tags; (2) inflammatory polyps; (3) adenomatous polyps. They believe that the first two entities are in no way precancerous. Warren and Sommers[7] also have stated that in their opinion no convincing case has yet been found in which inflammatory pseudopolyposis has undergone malignant change. Pseudopolyposis indicates long-standing ulcerative colitis and it is well known that carcinoma is likely to develop in patients who have been affected by the disease for many years. Adenomatous polyps, on the other hand, are occasionally found coincidentally in cases of ulcerative colitis. They are less common than pseudopolyposis, but being true adenomas are as precancerous as those found in colons not affected by ulcerative colitis. However, the associated inflammatory process may conceivably hasten a potential malignant change. One of the cases from St. Mark's[3] had eight separate carcinomas arising in adenomatous polyps. The presence of these lesions in cases of ulcerative colitis is an added in-

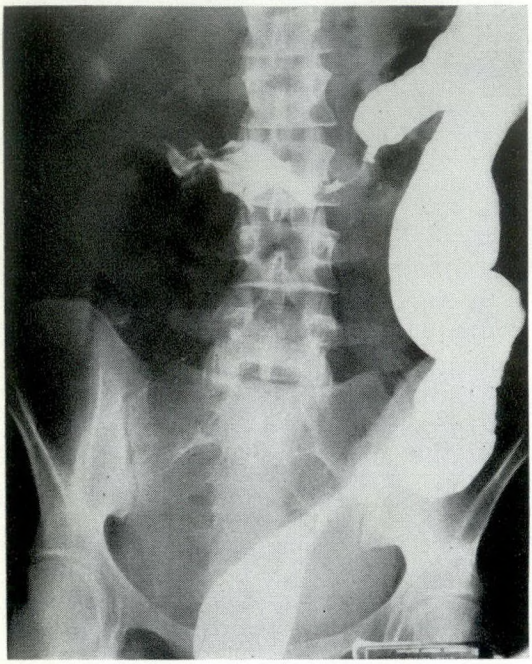

Fig. 3. (Case 4)—Radiograph showing an annular carcinoma of the transverse colon near the splenic flexure in a 29 year old female. Symptoms of colitis for 15 years. A malignant ulcer was also discovered in the sigmoid colon by the pathologist.

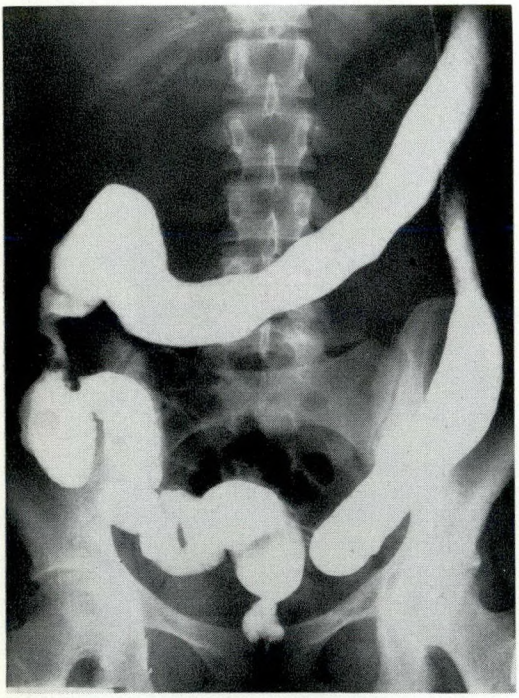

Fig. 4. (Case 3)—Radiograph of a carcinoma of the ascending colon in a patient aged 22 years with colitis for 20 years.

dication for earlier radial surgery before malignancy supervenes.

The gross characteristics of the majority of carcinomas in this, as well as the author's previous report, were found to parallel the type of malignancy in rectums and colons not affected by ulcerative colitis. A high proportion were of the annular or constricting type (Fig. 3). As inflammatory stricture or marked spasm[17] is a common finding in ulcerative colitis, these areas of constriction should be closely observed clinically and radiologically, especially in cases of long standing. A carcinoma may develop at the site of an inflammatory stricture or present as an annular or constricting type of lesion which may be difficult to distinguish at times from a simple stricture (Fig. 4). Dennis and Karlson[18] have pointed out the difficulty of roentgenological diagnosis because of the rigidity of the affected bowel. Some workers[19] have advocated the use of exfoliative cytology as an aid in the diagnosis of malignancy. As can be seen from Fig. 1, many of the lesions may be reached by a small bore sigmoidoscope, and biopsies should be taken from suspicious areas. Of the reported cases, eight of 17 primary growths were situated in the rectum or rectosigmoid.

Occasionally, a malignant lesion may appear in an atypical form. In two of the cases in this series a squamous cell carcinoma of the rectum was discovered (Fig. 5). When the stage of carcinoma is far advanced as seen at laparotomy or post mortem the malignancy may be of high grade and the tumour may show submucosal spread. However, the diffuse submucosal spread over a wide area which has been reported[5, 10] was not observed in this series.

Some authors have reported an approximate incidence of 12% of colloid carcinoma in malignant tumours of the large bowel in patients not affected by ulcerative colitis. Review of the histology of the tumours in the cases from the Winnipeg Clinic revealed an unusually high proportion of this histological type. Six of the eight patients had colloid carcinoma (Fig. 6). Of the 12 patients reported from St. Mark's, five were found to have colloid malignancy. Wilkie and Wood have distinguished two

forms of colloid carcinoma. In the first form the mucoid material is intracellular. In the second, the colloid material is mainly extracellular. They feel that the intracellular type is more malignant than adenocarcinoma proper and the extracellular less so.[20] Others believe that colloid carcinoma is usually a mixture of both forms and that the general prognosis is worse than in other types of adenocarcinoma of the large bowel. Boyd[22] has reported that "mucoid degeneration" of malignant tumours of the colon is not uncommon. However, he has observed that only 5% of carcinomas of the rectum are of the mucoid type. He feels that these rectal growths have a greater tendency to recur than mucoid tumours of the colon

It was noted with interest that among the cases treated surgically from the Winnipeg Clinic two had a carcinoid of the appendix. One patient had colitis for 23 years and also had two carcinomas of the rectum. The second patient had experienced symptoms of colitis for only three years before colectomy. Ackerman[21] has observed that carcinoid tumours are found in one out of 500 routine appendectomies.

Fig. 5. (Case 8)—High power view of a squamous cell carcinoma occurring in a long-standing stricture of the rectum in a case of chronic ulcerative colitis.

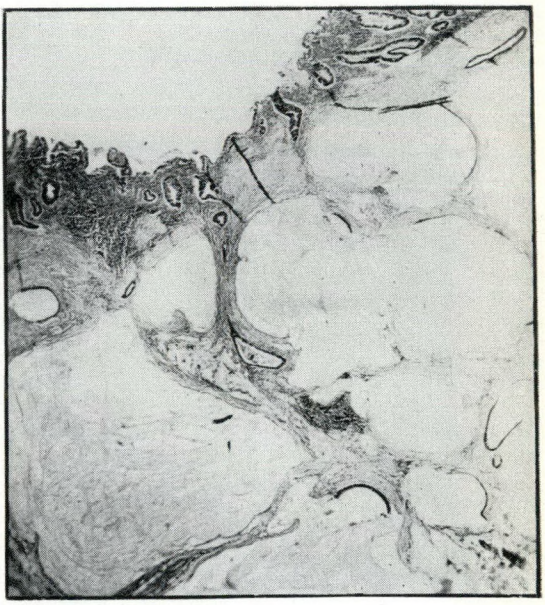

Fig. 6.—Photomicrograph of colloid carcinoma seen in an unusually high proportion of cases (six out of eight) of malignancy associated with ulcerative colitis at the Winnipeg Clinic.

Boyd[22] has noted that carcinoid tumours of the appendix are rarely, if ever, seen in a normal appendix other than those removed surgically and that the organ is thickened and fibrosed, apparently the result of previous inflammation. Whether an actual increase exists in the incidence of carcinoid in ulcerative colitis is debatable.

Carcinoma of the large bowel and ulcerative colitis, especially in the quiescent stage, are disease entities with a somewhat similar symptom pattern. Possibly, this is the prime reason why the diagnosis of carcinoma complicating ulcerative colitis is frequently delayed or missed, thus giving the association such a bad prognosis. Bleeding from the rectum, abdominal cramps or any change in bowel function in the quiescent phase, especially in long-standing disease, should suggest to the clinician that the possibility of malignancy is very real. Six cases in this series were diagnosed as carcinoma clinically, radiologically or by positive biopsy before operation. Three patients are alive and well at the time of this report. One patient died three years after operation, from enteritis with no secondary tumour found at autopsy.

Two patients of the remaining four had metastatic disease at the time of the original operation.

The policy of earlier colectomy for ulcerative colitis adopted in recent years and a more general awareness of the dangers of malignant changes in cases of long standing should, in the future, do much to reduce the incidence of malignancy and improve the former hopeless prognosis of these patients.

Conclusions

1. Carcinoma associated with ulcerative colitis developed from 10 to 15 years earlier than in the general population.

2. In patients who had had ulcerative colitis for 10 years or more, the incidence of carcinoma was much higher than in patients of the same age and sex who had not had colitis.

3. "Stricture" areas may be due to inflammatory fibrosis or to muscle spasm. However, malignancy may develop in an inflammatory stricture or appear as an annular carcinoma. Close supervision of these areas is indicated, especially in long-standing cases.

4. The distribution and characteristics of the tumours in this series tended to follow the general pattern of ordinary carcinoma of rectum and colon. However, the incidence of multicentric growth was found to be extremely high. It was also observed that a higher proportion of primary tumours than usual were of the colloid type. Two cases of squamous cell carcinoma of the rectum were noted.

5. Malignant changes often first appeared in the quiescent stage of the disease when clinically the patient seemed to have improved.

6. Earlier colectomy for chronic ulcerative colitis and a greater awareness of malignant change should reduce the incidence of carcinoma and improve the prognosis in cases of ulcerative colitis complicated by malignancy.

Acknowledgments

I wish to express my appreciation to Drs. P. H. T. Thorlakson, K. R. Trueman and J. E. Isaac for permission to include their cases in this study. I would also thank the Department of Pathology of the Winnipeg General Hospital; Dr. Joseph Penner for the pathological reports on the surgical specimens, and Dr. Hugh Ross for the photomicrographs.

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Résumé

La recto-colite ulcéreuse et hémorragique (R.C.U.H.) favorise le développement du cancer du colon et du rectum. La revision de 213 cas de recto-colite vus à la Winnipeg Clinic, entre 1945 et 1956, a démontré 17 cancers primitifs chez sept de ces malades, soit une fréquence de 3.7%. La maladie existait chez ces huit malades depuis 17 ans en moyenne, et leur âge moyen était de 45 ans. La série comprend 112 femmes et 84 hommes chez qui la R.C.U.H. s'est compliquée de cancer six et deux fois respectivement.

De ces huit cas, cinq ont présenté plus d'une tumeur à la fois de type histologique identique ou différent. Cette fréquence de néoplasie multicentrique, si on la compare à celle qui existe chez les malades non atteints de recto-colite et dont le taux varie de 4 à 7%, milite fort en faveur de l'énoncé initial.

Des 17 tumeurs réséquées, 14 furent considérées de malignité histologique moyenne ou faible. La présence de polypes adénomateux associés à la recto-colite devrait, à cause de leur caractère précancéreux, constituer une indication de chirurgie précoce. La surveillance clinique et radiologique minutieuse doit s'exercer à dépister les lésions sténosantes dans la R.C.U.H. car elles peuvent être d'origine inflammatoire ou néoplasique. Pour ce qui est des lésions basses, 8 des 17 tumeurs de la série actuelle ont été trouvées au rectum ou au recto-sigmoïde, de sorte que la proctoscopie et la biopsie des zones suspectes est fortement recommandée.

Le cancer du gros intestin et la recto-colite constituent des entités morbides à symptomatologie en quelque sorte superposable. On pourrait voir dans cette coïncidence la raison primordiale du retard apporté au diagnostic des transformations malignes qui surgissent quelquefois dans cette affection et du mauvais pronostic qui en résulte.

La colectomie précoce et la notion des risques de néoformations dans les cas de longue durée devraient dorénavant réduire la fréquence de malignité et améliorer par conséquent le pronostic dans les cas où la recto-colite est compliquée d'un cancer.

RECTAL BIOPSY IN ULCERATIVE COLITIS

After a study of 271 rectal biopsy specimens from 236 cases of ulcerative colitis, Lumb of Memphis, Tennessee (*Dis. Colon & Rectum*, 1: 37, 1958) states that the value of these biopsies is twofold:

1. It provides a method of studying the morphology of the disease in fresh, fixed material.

2. It has proved of diagnostic value to clinicians, particularly in quiescent phases of the disease where superficial epithelial repair may make sigmoidoscopic appearances difficult to interpret.

Correlation between histologic appearance and clinical and sigmoidoscopic findings was close in most cases. However, in a few cases ulcerative colitis was absent or quiescent in the lower part of the bowel but active in the proximal colon, and in 23 cases mucosal healing had progressed sufficiently to produce a normal appearance on sigmoidoscopy while still showing characteristic histologic changes. Damage and repair tend to go hand in hand in acutely diseased areas, hence a single biopsy may show all stages from early ulceration to repair.

Biopsy is of particular clinical interest in quiescent ulcerative colitis, and it is emphasized that various degrees of quiescence seen in specimens give no indication of the subsequent course of the disease. Areas showing repair may at any time break down again and ulcerate. Biopsy is therefore valuable in demonstrating the existence of areas still capable of ulceration, and diagnosing the disease even in the absence of ulcers. When an exacerbation begins, cells at the bases of the crypts break down and form an abscess. No one knows what causes an exacerbation.

A careful study of early lesions showed that these may be found in areas apparently normal radiographically or even on sigmoidoscopy or at operation. This must be borne in mind in determining the extent of operations.

THE BACTERIOLOGICAL EFFICIENCY OF AIR-CONDITIONING SYSTEMS IN OPERATING-ROOMS

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Introduction

The low incidence of postoperative infections is a happy reflection of the excellent quality of surgical technique in the lengthy operations now possible. Recent publication of fatal cases of tetanus and gas gangrene after elective operation has, however, dramatically called our attention to the fact that, in the installation of air-conditioning systems in operating-rooms, more consideration has been given to temperature and humidity than to bacterial content.

Some months ago, I was called upon to help investigate the origin of the perfringens bacillus (*Clostridium perfringens; B. welchii*) isolated by the hospital bacteriologist in a case of heart surgery complicated five days later by intestinal ileus and terminating fatally with infection of the pleural cavity. If a blood culture had been made when the complication set in, the probable endogenous origin of the germ could have been established; but, in the absence of this positive evidence, I felt it my duty to eliminate at least the possibility that the infectious agent might have come from the air of either the operating-room or of the recovery-room where pleural puncture had been performed.

Experimental Technique

For this purpose, swabs were stroked over several areas of both rooms, and placed immediately in tubes of freshly regenerated cooked-meat medium, which were then incubated at 37° C. and examined periodically thereafter.

Growth and gas formation were recorded visually. Gram-stained smears were examined under the microscope, subcultures into milk medium were sealed under vacuum, and guinea pigs were inoculated.

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Results

Results for this first hospital are given in Table I. It is apparent that *Cl. perfringens* was present practically everywhere, even on top of the operating lamp. It was not present, however, on the walls or in the window crevices. It was found regularly, on the other hand, in all the openings of the ventilating system. Subsequent tests confirmed my early suspicion that the ventilating system was entirely responsible for this situation, as we shall see later.

TABLE I.—Results of Tests for *Clostridium perfringens* in Operating-Rooms in Hospital No. 1

Operating-room	
Air inlet:	*Cl. perfringens.*
Top outlet:	*Cl. perfringens.*
Bottom out:	*Cl. perfringens.*
Lamp:	*Cl. perfringens*, Streptococcus sp.
Wall:	Gram-positive cocci.
Recovery-room	
Window:	No growth.
Floor:	*Cl. perfringens*, Gram-negative rods, large Gram-positive cocci.
Pleural puncture needles	
Needle No. 1:	No growth.
Needle No. 2:	No growth.

TABLE II.—Results of Tests for *Cl. perfringens* in Operating-Rooms in Hospital No. 2

Operating-room No. 1	
Air inlet:	*B. subtilis.*
Air outlet:	*B. subtilis, Cl. perfringens, Staph. albus, Staph. aureus, Ps. aeruginosa.*
Lamp:	No growth.
Floor:	No growth.
Operating-room No. 5	
Air inlet:	*Cl. perfringens.*
Air outlet:	*Cl. perfringens.*
Lamp:	*Cl. perfringens, B. subtilis.*
Floor:	No growth.
Humidifier:	*Cl. perfringens, B. subtilis.*
Window:	*B. subtilis.*
Delivery-room	
Air inlet:	*B. subtilis, Ps. aeruginosa, Staph. albus, Staph. aureus.*
Air outlet:	*Cl. perfringens.*
Lamp:	*B. subtilis, Staph. albus.*
Floor:	No growth.
Window:	*Cl. perfringens.*

TABLE III.—RESULTS OF TESTS FOR *Cl. perfringens* IN OPERATING-ROOMS IN HOSPITAL NO. 3

Operating-room No. 12 ("clean").

Air inlet:	No growth.
Air outlet:	Slight growth, no gas; few plump Gram-positive rods; *stormy fermentation of milk;* guinea pig survived.
Lamp:	No growth.
Floor:	No growth.

Operating-room No. 15 ("clean").

Air inlet:	Cloudiness, gas; numerous Gram + rods; *stormy fermentation of milk;* guinea pig survived.
Air outlet:	Cloudiness, gas; numerous Gram + rods; *guinea pig died in 20 hours from gas gangrene.*
Lamp:	Slight growth, no gas; few Gram + rods; acid coagulation of milk; guinea pig survived.
Floor:	No growth.
Wall ledge:	Cloudiness, no gas; large Gram + rods and cocci.
Fixture:	No growth.

Operating-room No. 2 ("clean").

Air inlet:	Cloudiness, no gas; large Gram + rods; acid coagulation of milk; guinea pig survived.
Air outlet:	Cloudiness, no gas; large Gram + rods; stormy fermentation of milk; *guinea pig died in 20 hours.*
Lamp:	Slight growth; numerous Gram + cocci, few Gram + rods; peptonization of milk; guinea pig survived.
Floor:	No growth.

Operating-room No. 4 ("clean").

Air inlet:	Slight cloudiness, no gas; no visible bacteria.
Air outlet:	Cloudiness, gas; few Gram + rods; stormy fermentation of milk; *guinea pig died in 20 hours.*
Lamp:	No growth.
Floor:	Cloudiness, no gas; large Gram + rods; Stormy fermentation of milk; *guinea pig died in 20 hours.*

Operating-room No. 9 ("clean").

Air inlet:	Cloudiness, no gas; no visible bacteria.
Air outlet:	Cloudiness, gas; large Gram + rods; *guinea pig died in 20 hours from gas gangrene.*
Lamp:	No growth.
Floor:	No growth.

Operating-room No. 11 ("working").

Air inlet:	No growth.
Air outlet:	Slight cloudiness, gas; few Gram + rods.
Lamp:	Not done for obvious reasons.
Floor:	No growth.

Although the surgeon-in-chief of this particular hospital reacted quite commendably to this report by cancelling all further operations until tests of repeated washings were satisfactory to both himself and his bacteriologist, it did not alter my conviction that similar conditions prevailed elsewhere. I therefore went ahead and checked other hospitals if they wished it.

A surprising state of affairs was found in all the hospitals tested, in recent as well as in older installations, in French-speaking as well as in English-speaking hospitals, as shown in Tables II, III, and IV.

In Hospital No. 2, *Cl. perfringens* was present in all three operating-rooms tested, and again on top of the operating lamp (Room No. 5). It will be noted that swabs from the floor were regularly sterile.

Six rooms were tested in Hospital No. 3. From four of them cultures of *Cl. perfringens* were obtained which killed the guinea pig in less than 20 hours from generalized gas gangrene. The air outlets seemed to be mainly responsible for these cultures while, here again, the floors were always sterile, with one exception.

Finally, two out of the three rooms tested in Hospital No. 4 contained highly virulent strains of *Cl. perfringens* which were recovered from the grille of the air outlet. The floor was practically sterile.

The main conclusion from this first series of tests would therefore be that *Cl. perfringens* shares with *Bacillus subtilis* the gift of ubiquity. Moreover, all these results point towards the ventilating system.

The next step was to test the bacteriological efficiency of the local installations with a view to suggesting methods or devices for remedying this urgent situation. Using the swab method already described, the ventilating plants of the operating-rooms were tested for *Cl. perfringens* at several locations. Table V shows the results obtained.

In Hospital No. 1, where this work originated and which was equipped first with one and then with two oil-trickle steel-wool filters as well as with a water-spray unit, *Cl. perfringens* was found throughout. In other words, the entire ventilating system seemed saturated with

the gas gangrene bacillus. The filters were then washed and oiled, operated for 24 hours at a time, washed and oiled again, after which they were tested daily for *Cl. perfringens* on both the outside and inside surfaces of the filter. It was found that even three days after cleaning, *Cl. perfringens* was finding its way through the filtering medium.

TABLE IV.—Results of Tests for *Cl. perfringens* in Operating-Rooms in Hospital No. 4

Operating-room No. 1.	
Air inlet:	No growth.
Air outlet:	Cloudiness, no gas; large Gram + cocci (some chains), rods; acid coagulation of milk; guinea pig survived.
Lamp:	No growth.
Floor:	No growth.
Operating-room No. 4.	
Air inlet:	Cloudiness, gas; large Gram + rods; peptonization of milk; guinea pig survived.
Air outlet:	Cloudiness, gas; large Gram + rods; stormy fermentation of milk; *guinea pig died.*
Lamp:	Slight cloudiness.
Floor:	Slight cloudiness.
Operating-room No. 11.	
Air inlet:	No growth.
Air outlet:	Cloudiness, gas; numerous Gram + cocci, few Gram + rods; stormy fermentation of milk; *guinea pig died.*
Lamp:	Slight cloudiness.
Floor:	Slight cloudiness.

Hospital No. 2 has no central filtering plant, but each individual operating-room has a small filter on both the inlet and the outlet. The mixed bacterial flora found on the grille of the air intake on top of the roof could be traced all the way in and out.

In Hospital No. 3, an enclosed steel-wool filter revolves continuously in an oil bath. From the results of the tests made, it will be realized that *Cl. perfringens* finds its way through just the same.

At long last, Hospital No. 4 has its steel-wool filters maintained every two weeks by the manufacturers themselves, ensuring thereby the best possible service. Here again, the tests show that *Cl. perfringens* flows right through.

Thus it becomes evident, after this second series of tests, that none of the present

TABLE V.—Bacteriological Efficiency of Ventilating Systems

Hospital No. 1.	
Outside surface of 1st filter:	*Cl. perfringens.*
Inside surface of 1st filter:	*Cl. perfringens.*
Inside of duct:	*Cl. perfringens.*
Outside surface of 2nd filter:	*Cl. perfringens.*
Water spray:	No growth.
Hospital No. 2.	
Air intake: on roof:	*Cl. perfringens, B. subtilis, Ps. aeruginosa,* large Gram + cocci.
Screen in duct:	*Cl. perfringens, B. subtilis, Ps. aeruginosa,* large Gram + cocci.
Hospital No. 3.	
Air intake:	*B. subtilis, Cl. perfringens.*
Oil filter:	*Cl. perfringens.*
Water spray:	*B. subtilis, Cl. perfringens.*
Hospital No. 4.	
Air intake:	*Cl. perfringens.*
Outside surface: of oil filter:	*Cl. perfringens.*
Inside surface of oil filter:	Bacillus sp.
Water spray:	*Cl. perfringens.*

installations (which are all of the mechanical type) seems to be efficient, bacteriologically speaking, unless they are cleaned twice weekly.

The last step I wish to report at this time consisted in checking the installations of some producers of biological or pharmaceutical products where, among other techniques, ampoules were filled under sterile conditions. In one of them, equipped with an oil-trickle steel-wool filter, not only was *Cl. perfringens* found along with numerous other types of aerobic and anaerobic bacteria, but also a live pigeon with its nest and two eggs, and a full two-inch thickness of calling cards from its relatives. However, air from this system is not used in aseptic rooms.

In the other installation, boasting an electrostatic precipitator, *Cl. perfringens*

TABLE VI.—Recommendations for Air-Conditioning Systems in Operating-Rooms

1. Air-intake above roof level.
2. Efficient bacteriological filter.
3. Plenum system.
4. Twenty air-changes per hour.
5. Filtered air inlet at ceiling level.
6. Exhaust ducts at floor level.
7. Pneumatic valves and vestibules (air-locks).
8. Easily-cleaned equipment.
9. Elimination of all dust-collecting installations.

could not be found in the ducts anywhere in the eight rooms tested, with a single exception; whereas it was conspicuously present on the outside surface of the air intake on top of the roof, along with at least three other anaerobic spore formers, apparently coming from a stable across the street; this filter had not been cleaned for one month.

Conclusion

From this bacteriological study of some 20 rooms in six local institutions, it would seem that only bacteriological tests can measure the efficiency of ventilating systems in operating-rooms. They may also indicate the proper moment for cleaning or renewing the filtering devices.

This means that, on top of his numerous other responsibilities, the surgeon must supervise, with the help of the bacteriologist as well as that of the architect and the engineer, not only the design but, foremost, the operation of the air-conditioning systems to be used for operating-rooms.

Table VI enumerates the recommendations I would be prepared to make along these lines.

Résumé

L'étude des bactéries aérobies et anaérobies trouvées dans 20 salles d'opération ou de mise en ampoules chez 6 institutions locales a montré que le système de ventilation était principalement en cause. Des épreuves bactériologiques pratiquées sur place seules peuvent renseigner sur le bon fonctionnement des installations; elles peuvent également indiquer le moment d'effectuer le nettoyage ou le remplacement des filtres.

Ceci veut dire qu'en plus de ses autres lourdes responsabilités, le chirurgien doit encore surveiller, avec l'aide du bactériologiste aussi bien que de l'ingénieur et l'architecte, non seulement l'installation mais surtout le fonctionnement des systèmes de ventilation des salles d'opération.

AIRBORNE BACTERIAL CONTAMINATION IN A SURGICAL DEPARTMENT

The extent of airborne bacterial contamination in a three-bed ward, an operating theatre and the central operating department corridor of a surgical department in a hospital in Gothenburg, Sweden, was investigated by Mollsted and Nilsson (*Acta chir. scandinav.*, 113: 333, 1957). Petri dishes containing blood agar medium were used as sedimentation plates; some were attached horizontally to wooden holders 50 cm. above the floor, and others were hung vertically at various levels, while some were suspended upside down to collect bacteria which swirled up from the floor. The plates were exposed for one to 12 hours, incubated for 24 hours at 37° C. and the number of colonies determined and used as an indication of the number of bacteria settling on the plates. A slit sampler apparatus designed by Bourdillon, with a chamber in which air is sucked by a vacuum cleaner through a narrow slit on to a slowly rotating blood agar plate, was also employed.

In the three-bed ward a higher bacterial count was obtained when the room was being cleaned and also during bed-making and dressing of wounds. In the operating theatre, the two most contaminated draughts of air were from a service door and alongside the operating table from the anæsthetist to the assisting nurse. As might be expected, highest counts were found when activity was taking place, both in the theatre and in the corridor outside. An analysis of findings taken during a gall-bladder operation and a colon resection indicated no significant difference related to the type of operation. Movements of individuals in the theatre caused minor air currents to swirl up from the floor carrying bacteria upwards.

On a long-term investigation, the highest bacterial counts were always correlated with greater activity. At nights and at weekends, both theatre and corridor had lower bacterial counts.

No attempt was made to identify pathogenic or non-pathogenic strains of bacteria, but it was found that collected bacteria belonged primarily to the flora usually found in the upper respiratory tract. This department was not air-conditioned, and it is suggested that traffic within the department should be kept at a minimum, and a work plan devised reducing the opening and closing of doors as much as possible, to decrease the number of bacteria-laden air currents. Contamination traps, i.e. vestibules between the operating department and the main part of the hospital, and between corridor and operating theatre, would reduce air exchange.

ANTERIOR SACRAL MENINGOCELE
REPORT OF TWO CASES AND REVIEW OF THE LITERATURE*

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THE ANTERIOR SACRAL MENINGOCELE is one of the few developmental malformations of the central nervous system which, when properly managed, is amenable to successful surgical treatment; it has proven almost invariably fatal when misdiagnosed and improperly managed. In an attempt to reach a better understanding of this rare condition, the literature has been reviewed, while two additional cases are reported.

CASE REPORTS

CASE 1.—C.J., a 32 year old white married woman, nurse by profession, was admitted to the Montreal Neurological Institute on April 21, 1953, complaining of severe low back pain of nine months' duration radiating down the left thigh and knee.

As a child she had always been constipated, having one "huge" bowel movement every three to four days which left her "weak for half a day". This constipation seemed to have become more stubborn in the past two years.

About the age of 17 her periods although regular were "more profuse and lasting longer than normal". This improved spontaneously, but in the few months before admission she developed a severe dysmenorrhœa. She had noticed at times some difficulty in starting the stream of urine, and at other times she had felt some urgency and often voided twice or three times a night.

In 1946 a "bicornuate uterus" was accidentally discovered during a laparotomy for ligamentopexy and appendectomy. In 1947 her first pregnancy ended in a prolonged labour due to dystocia of undiagnosed origin. The baby died during an internal rotation and extraction. In 1948 her second pregnancy terminated with a Cæsarean section. Two years later, at the end of her third pregnancy, a soft mass obstructing labour was discovered in the sacral cup. A second Cæsarean section was performed and shortly afterwards the patient was referred to Dr. W. V. Cone for assessment. The sacral mass was thought to be congenital in origin and the patient was advised to return in case any new symptoms appeared.

A year and a half later, she felt some pain in the left side of the lower back which gradually became more severe and radiated down the posterior aspect of the left thigh into the knee and at times into the calf, and was precipitated by bending, straining or standing for long periods of time. The pain increased during the week before menstruation and during the first two days of the menstrual flow. It was acompanied by crampy pains radiating into the lower abdomen.

On physical examination, motor power in the lower limbs was normal, the reflexes were equal bilaterally, the calf circumference measured the same on both sides, and no sensory changes could be mapped out on the buttock or legs. Rectal examination revealed a slightly relaxed sphincter. There was a soft, fluctuant, non-tender mass adherent to the left side of the ventral aspect of the sacrum over which the rectal mucosa moved freely. Pressure on the mass or on the sacrum and coccyx immediately to the right of the mass reproduced the pain complained of. On coughing, an impulse transmitted through the cyst wall was just palpable, and on straining the cyst seemed to become a little firmer. One could easily feel a curvature in the coccyx with the concavity to the left, but it was very difficult to palpate the border of a defect in the sacrum because each attempt produced so much pain in the thigh. A definite furrow was felt on the posterior aspect of the uterus extending down to the cervix. A vaginal examination revealed a uterus slightly higher than normal. No abnormalities were felt in the cervix.

Radiographs showed no abnormalities in the lumbar, thoracic and lower cervical vertebræ. The sacrum was sickle shaped with the concavity facing the left side. The bodies of the second, third, fourth and probably the fifth pieces of the sacrum were defective on the left side and the tip of the coccyx pointed to the left. The bone margins were covered with normal cortex and the texture of the bone was normal. An Ethiodan myelogram (Figs. 1A and 1B) showed that the lower end of the subarachnoid space was very narrow, deviated to the left and passed through what seemed to be an enlarged fourth sacral intervertebral foramen into a cyst lying anterior to the sacrum. The same pro-

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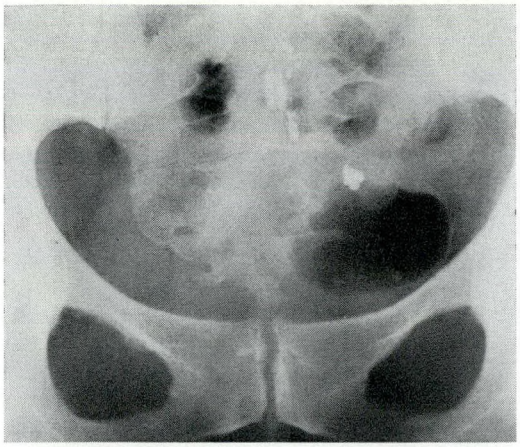

Fig. 1A.—Myelogram Mrs. G.J.—the lateral view shows a few droplets of Pantopaque in the meningocele, anterior to the sacrum.

cedure was repeated with oxygen instead of oil, and the oxygen also entered the sac. Cerebrospinal fluid obtained by lumbar puncture at the time of myelography contained 82 mg. protein per 100 c.c. Results of several previous radiological examinations were available, and the plain films of the pelvis showed no change in the appearance of the sacrum since 1944. Cystography in 1950 and again in 1953 had shown a soft tissue mass pressing forward on the bladder displacing it slightly to the right. Barium examination of the colon in 1950 showed the rectum to be displaced forwards and to the left.

The diagnosis of anterior sacral meningocele was made and the patient operated upon on May 2, 1953, by Dr. W. V. Cone. A transverse incision about five inches in length was carried through the skin and subcutaneous tissue over the lumbo-sacral region. The roof of the sacrum was cleaned of muscle and soft tissue and removed by rongeur from S1 to S4 inclusive. There was a small cyst measuring 1.5 cm. in diameter attached to the third sacral nerve. This was excised. The large anterior defect in the sacrum was identified, as well as the meningocele sac stalk entering the pelvis through it. The stalk was isolated from the adjoining fourth sacral nerve root to which it was adherent. The medial and posterior aspect of the meningocele was opened and clear fluid was drained out. This procedure gave additional room and improved the exposure. Three stainless steel ligatures No. 35 were passed around the neck of the sac at its proximal end, and as no fluid appeared from the stalk the closure was presumed to be watertight. The meningocele was pulled out of the pelvis piecemeal through the bony defect. Rectal examination confirmed the disappearance of the mass. The bed occupied by the meningocele was then filled with gelfoam and the wound was closed in layers without drainage. Microscopically the specimen removed was made up of collagenous and fibrous connective tissue, with no nervous tissue.

On the first postoperative day the patient got up. The pain in the leg had disappeared and no neurological deficit was demonstrable. The sutures were removed on the sixth postoperative day and the wound healed by primary union. At the time of discharge, 17 days after operation, she was symptom-free; she had a daily "normal" bowel movement without laxative and without discomfort. The urinary symptoms had disappeared and the patient was voiding normally. On rectal examination, one could feel a mass slightly smaller than the preoperative one in the hollow of the sacrum, constituted most probably by the gelfoam packing used at the time of the operation. The tenderness over the sacrum anteriorly had disappeared. A repeat barium enema examination and cystography failed to show the preoperative mass.

The patient was seen by Dr. Cone five weeks after operation, at which time she was still

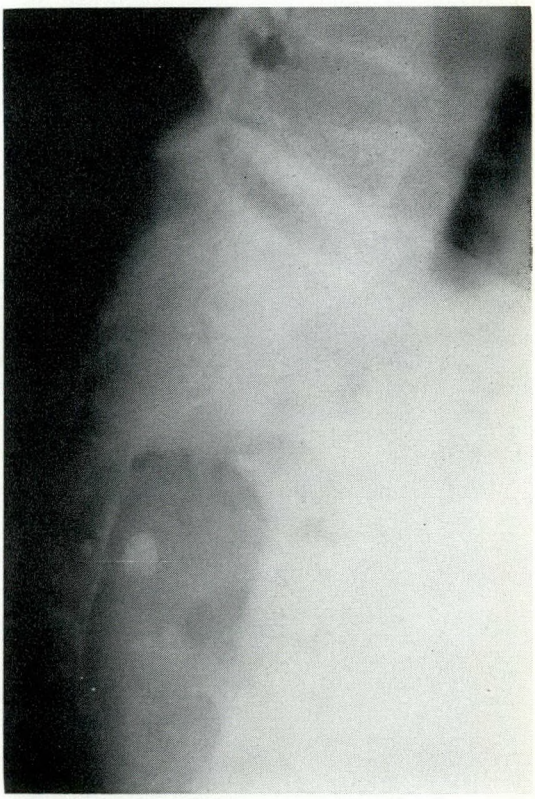

Fig. 1B.—AP view shows the sacral bone defect on the left.

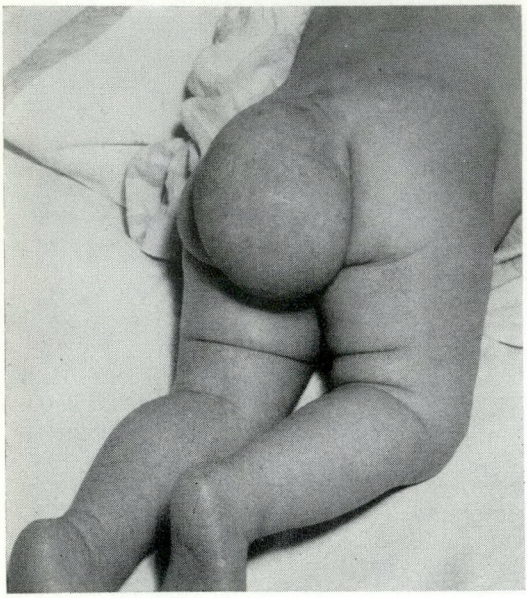

Fig. 2.—Case 2. Preoperative picture showing the meningocele. The coccyx was felt on the posterior aspect of its neck.

symptom-free and sign-free. Her pain, dysmenorrhœa, constipation, and frequency had disappeared. The pre-sacral mass had become smaller.

CASE 2.—W.S.G., a three month old white infant was admitted to the American University Hospital, Beirut, on May 9, 1955, because a low sacral mass had been present since birth.

The family, prenatal and natal histories were completely negative. At birth the mother noticed a small swelling the size of an egg, at the lower end of the spine. Gradually this mass increased in size and at the time of admission had reached the size of a large orange. There was a history of slight constipation, with one or two bowel movements a day, but there was no evidence of discomfort on urination or defæcation and no evidence of paralysis.

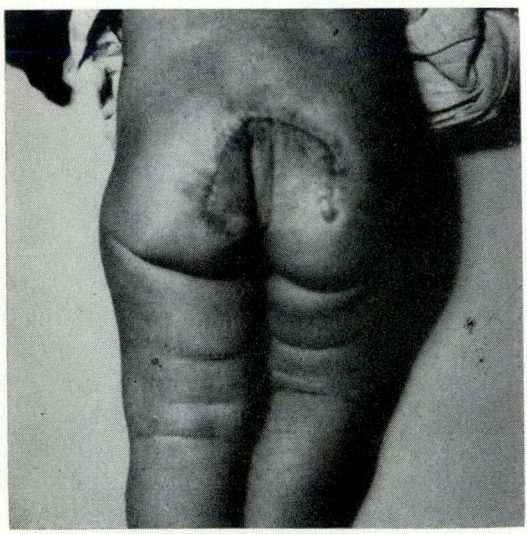

Fig. 3.—Postoperative picture showing the suture line.

On examination, the head was found to be of normal size and the fontanelles were not bulging. There were no neurological findings. At the lower end of the spine a mass 12 x 8 cm. was seen protruding from underneath the coccyx in the intergluteal fold and hanging over the anal opening (Fig. 2). This mass was soft and transilluminated. Pressure on the mass neither increased the fontanelle pressure nor induced crying. A rectal examination showed the rectal sphincter tone to be normal and one could feel the stalk of the mass passing in front of the coccyx into the sacrum. Bimanual examination showed that the mass was formed of two parts, one fluctuant and cystic and the other firm and soft.

Radiographs of the lower spine did not show any abnormality. Pantopaque, 1 c.c., was introduced by the lumbar route and radiographs were taken in the erect position; these showed no communication between the spinal canal and the mass.

An operation was advised and accepted. A semilunar incision was made over the superior margin of the mass. The skin was reflected from over the cyst, and at this point the cyst opened and clear fluid gushed out. The cyst was excised down to the stalk; the latter was found to enter the anterior surface of the sacrum through one of the foramina on the left side, probably the fourth. A probe was introduced through the stalk. This went into the canal without any resistance, but no fluid came back through the stalk. The stalk was then ligated and severed. A mass 2 x 3 cm. was closely adherent to the cyst but not in communication with it. This was removed *in toto*. Adherent to this mass was found another fibrous hard mass which, when opened, let out about 2 c.c. of greenish material similar to sebum. This latter mass, 1.5 x 2.5 cm. in size, was closely adherent to the rectum and the left lateral wall of the pelvis. With a finger in the rectum the mass was dissected free from its wall, no communication being found between them. The wound was then closed in layers without drainage.

The patient made an uneventful recovery, and seven days after operation the sutures were removed (Fig. 3). The patient was

seen a year and a half later. She has grown and there was no evidence of recurrence. At present she has no signs of urinary or fæcal incontinence, or neurological findings.

The pathologist reported a mixture of fibro-adipose tissue, striated muscles, islands of nervous tissue, and tortuous spaces lined by different types of epithelia (columnar ciliated goblet cells, papillary mucoid structures). The inner lining of the cyst was made up of nervous tissue (glia and nerve cells). The diagnosis of a teratoma and a meningocele was made.

Incidence

Anterior meningoceles are much rarer than posterior ones, and in the former group the sacral meningoceles are commonest probably because they are more compatible with life. To date a total of 53 cases have been reported including our own. Several cases mentioned in previous reviews are not included in this study because they represented cysts of the neurenteric canal,[19, 26] an anterior lumbar rather than a sacral sac,[12, 31] a pelvic meningocele arising from a posterior spina bifida,[2] and non-viable fetuses or stillborn children.

Sex.—Of the 53 patients, 45 are females (85%) and six males and in two cases the sex is not reported.

Age.—The majority of cases (43.4%) are diagnosed in the third decade. Another less impressive peak is noticed in infancy; the youngest patient is three months old and the oldest 55 years.

Side of meningocele.—There is no predilection for side, but laterally placed meningoceles are four times more numerous than those arising from the midline. Eighteen cases are reported arising on the left side of the sacrum, 16 on the right and only eight in the midline. In the remaining 11 cases no mention is made of the site of origin.

Symptomatology (Table I)

Initial symptoms.—The chief symptoms recorded in 43 cases are distributed as follows. Ten patients complained initially of symptoms referable to the back and/or lower limbs, nine of constipation, eight of symptoms in the reproductive system, seven of urinary disturbances, three of a gluteal mass, two of headache, and one each of the following: difficulty in swallowing; diarrhœa; nausea and pain in the side; and sudden swelling in the abdomen precipitated by a fall.

TABLE I.—Summary of Symptoms

Symptom	*Number of patients in whom symptoms were:* *Present*	*Mentioned*
Constipation	27	28
Reproductive system	20	28
Dysmenorrhœa	9	13
Dystocia	6	14
Menstrual irregularities	6	
Sterility	2	2
Vaginal discharge	2	
Urinary system	18	18
Incontinence	8	
Frequency	7	
Dysuria	4	
Retention	3	
Oliguria	1	
Cystitis	1	
Back and lower limbs	16	16
Miscellaneous:		
Headache	8	
Abdominal pain	5	

Constipation.—This is the most constant symptom. With the exception of one patient who died from a severe diarrhœa due to malnutrition, every patient whose bowel habits are mentioned suffered from constipation. Constipation, usually lifelong, tends to become more obstinate with time (Case 48), requiring powerful cathartics and enemas (Case 14 had a bowel movement every three or four weeks). The bulk of fæcal matter is greater than average, and in some cases great discomfort is experienced during and after defæcation (Cases 46 and 52).

Disturbances in the reproductive system.—These are limited to female patients. Dysmenorrhœa is usually present for a long time, very occasionally disappearing later in life, and the pain is not different from that of ordinary dysmenorrhœa. Dystocias occur, and five out of 14 patients pregnant prior to or during their investigation had definitely obstructed labours. (In Cases 1 and 5 the patient died from peritonitis following the extraction of the child, dead during a prolonged labour; in both the meningocele had ruptured at the time of delivery. Delivery was normal in Case 9 after aspiration of the cyst through the vagina. In Cases 42 and 52, the woman was pregnant three times; in each case the first child died because of prolonged labour;

the other two pregnancies were terminated by a Cæsarean section.)

Urinary symptoms.—A few patients show a disinclination to void, and strain to start the stream of urine. Gradually a residual urine accumulates and frequency sets in. Later some patients may develop an acute retention or a retention incontinence. On the other hand, as in Cases 33, 42 and 46, incontinence may be due to a relaxed sphincter.

Although the urinary disturbances, especially in their insidious form, may be present from early life (since birth in Case 23) they usually become noticeable later and progress at times rapidly, in many cases without apparent reason, in others with a definite precipitating factor (spontaneous rupture of the sac in Case 4, a fall in Case 2, resection of an accompanying posterior meningocele in Case 28, pregnancy in Case 22).

Symptoms referable to the lower back and lower limbs.—Six patients complained of pain in the back radiating to one or both legs, two of low backache alone, and another two of leg pain in the absence of backache. The pain is variously described as "lower backache", "lumbar pain", pain "in the sciatic distribution", pain radiating into "the knees" or into "the sacrum and thigh increasing on walking". In our Case 1 the pain started in the midline of the lower back and radiated along the posterior aspect of the left thigh into the popliteal fossa. Occasionally the pain went into the calf. It was shooting in character, of incapacitating severity, and precipitated by bending, by straining and by standing for long periods of time.

Rarely is the pain severe enough to compel the patient to go to bed (for two to three days in Case 35). In three cases where the pain radiated into one leg the meningocele was on the side of the affected leg, and in one case where the meningocele was in the midline the pain radiated into both knees. A laterally placed meningocele was responsible for bilateral leg pain in two cases and for low back pain in one case.

Numbness in the distribution of the lower sacral segments was complained of occasionally (Cases 24, 38 and 42) and in one case (Case 35) there was "paræsthesia of the left foot and leg" accompanied by pain. Numbness was accompanied by pain in Case 42 but not in Cases 24 and 38.

Weakness of the lower limbs was complained of in four cases. In Case 2 the patient, who was weak in both legs, had fallen into a ditch and her meningocele had increased in size since. The author does not specify the relationship of the fall to the leg weakness. In Case 4 bilateral leg weakness followed a spontaneous rupture of the sac, in Case 5 the right leg was congenitally weaker and shorter than the other, and in Case 13 there was a paraplegia, but the patient also had a posterior lumbar meningocele repair.

Miscellaneous symptoms.—Headache. In Cases 46 and 49 headache was associated with bowel movements; in Case 29 headache was caused by direct pressure on the cyst, and as the latter was presenting in the buttock, sitting became impossible because of the severe headache elicited; in Case 12 mild headaches followed a slip on the ice which provoked an increase in size of the tumour; in Case 52 the headaches were associated with nausea, vomiting and photophobia, which disappeared after extirpation of the tumour. No good description of the headache or its causation is given in the other three cases (Cases 9, 32 and 33).

Abdominal pain. This was due to acute appendicitis in Case 33 where the cyst was found accidentally at laparotomy. Cases 7, 16 and 34 had discomfort and pain in the lower abdomen probably due to the tumour mass. In Case 12, a very severe and incapacitating abdominal pain appeared about a month and a half after a fall, because of which the patient had to stop work. It spontaneously improved on bed rest and icebag application to the abdomen.

Signs (Table II)

A rectal examination usually reveals a cystic mass adherent to the hollow of the sacrum. The rectal mucosa slides freely over it. A slight impulse can be felt on coughing and the cyst may become a little tenser on straining. It is often slightly compressible and tends to become softer

TABLE II.—Summary of Signs

Signs	Number of patients in whom signs were: Present	Mentioned
Tumour	49	49
Pelvic	38	
Abdominal	5	
Gluteal	5	
Rectal polyp	1	
Displaced organs	23	
Rectum	20	
Uterus	18	
Bladder	4	
Ureter	1	
Neurological signs	5	
Diminished rectal tone	3	
Sensory changes	3	
Absent ankle jerk	1	
Other congenital malformations:		
Deformities of sacrum	39	41
Other spinal deformities	6	
Bicornuate uterus	5	
Duplication of vagina and uterus	3	
Other meningoceles	3	
Club foot	3	
Bilateral bifid renal pelvis	1	
Bilateral cong. Petit's hernia	1	

after the patient assumes the knee-chest position for a while. Steady pressure may elicit a headache (Cases 29 and 38) and sometimes local pain and tenderness. It is usually difficult to palpate the defect in the sacrum because of the position, fixity and tenderness of the tumour. The mass may assume a size varying from that of a small polyp to that of a child's head, and may at times be large enough to reach the umbilicus. In six cases the tumour was palpable through the abdominal wall.

The rectum is compressed and pushed by the tumour anteriorly or to one side. In women the vagina is stretched and the cervix can be felt with difficulty. The uterus is pushed anteriorly and superiorly above the symphysis pubis into the general abdominal cavity. The bladder is displaced anteriorly and superiorly. Although arising on the anterior surface of the sacrum, the tumour may pass through the sciatic notch and present in the gluteal region (Cases 2, 4, 15, 29 and 38) or below the coccyx and present in the intergluteal fold (Case 53).

Neurological signs are only exceptionally mentioned. The tone of the anal sphincter was mentioned only four times and was diminished in three cases. Sensory changes were found in three cases—in the distribution of the "lower sacral segments" in Case 24; in Case 42 there was hypæsthesia over S2 and S3 dermatomes on the side of the lesion; and in Case 38 "hypæsthesia over the feet and perineum". An ankle jerk was absent in Case 34 but on the side opposite the meningocele.

The association of other congenital malformations is striking but not surprising. The high incidence of double and bicornuate uterus must be noted (see Table II).

Diagnosis

A correct diagnosis is imperative because it is the only guarantee of correct management. A careful history and clinical examination should suggest the possibility of the condition. Radiography is a very important diagnostic aid. The presence on a plain film of the pelvis of what has been called "scimitar sacrum" because the deformed sacrum resembles a scimitar, or the presence of a cleft in the sacrum is strongly suggestive, while the passage of contrast medium into the meningocele on myelography is pathognomonic. However in some cases the stalk may be so narrow as to preclude the passage of oil, and a negative oil myelogram does not necessarily rule out the diagnosis. In such cases injection of a gas, usually oxygen, into the lumbar subarachnoid space with the patient in the head down position demonstrates the sac. Luth[25] advocates a cerebrospinal manometric investigation with manual pressure on the sac.

A barium enema examination reveals the displacement of the rectum, and a cystogram that of the bladder.

In the differential diagnosis one must consider a cyst of the ovary or of the broad ligament. These are not adherent to the sacrum and are not as a rule associated with other pelvic malformations. An echinococcus cyst may give a similar clinical picture, but here too there is no sacral deformity and usually a history of exposure can be elicited. Presacral tumour, a not too infrequent accompaniment of the meningocele (see Pathology), may simulate it so closely that it has been

included under this heading by reviewers. (Marwadel[26] described the case of a 13 day old girl operated on for a presacral mass. It was completely independent of the rectum and the dura, to which it was in close proximity, through a defect at the left sacrococcygeal joint. The tumour was covered on its internal surface by a mucous membrane similar to that of the rectum and containing Lieberkühn's glands, and had a muscular coat. It was removed surgically and the child recovered. We had the opportunity to treat a similar case. The mass, removed surgically, was in close relation to the anterior surface of the sacrum, and was a teratoma. The child, one year old, recovered completely.)

Pathology

The sac is formed of an out-pocketing of the sacral pachymeninges and leptomeninges through a defect in the sacrum or an enlarged intervertebral foramen. The connecting stalk is usually narrow in spite of the seemingly large bony defect. Part of the cauda equina, glial tissue or nervous tissue has been encountered within the sac (Cases 3, 5, 15, 17, 23, 28, 34, 35, 40, 42, and 53). Other tumours have been described in association with the sac (Table III); the presence of other congenital malformations has already been mentioned.

The sacrum is described in 41 cases. In 25 cases a lateral part of one or more sacral vertebræ was missing and replaced by a tough fibrous diaphragm. The edge of the remaining sacrum was concave towards the defect, smooth and with a form which to our knowledge is not duplicated by any other condition and therefore is pathognomonic of an anterior sacral meningocele when seen in a radiograph. The coccyx is tilted towards the defective side, which accentuates the concavity of the defect. It was absent in two cases. An enlarged intervertebral canal is described in four instances and a central slit in six.

TABLE III.—Tumours Associated with Anterior Sacral Meningocele

Tumour type	*Case number*
Lipoma	10, 11, 15
Teratoma	17, 20, 28, 53
Dermoid	19, 34, 42

In four cases a deformity is mentioned but not described. The remaining cases are the only reported ones where no sacral deformity was found in radiographs (Cases 47 and 53).

Treatment

The asymptomatic cases "are best handled with skilful neglect" except where spontaneous rupture may be feared because the wall is thin. This occurrence is best demonstrated in Cases 2, 4, 14, 36 and 44, the latter three patients dying in consequence of the rupture. We cannot therefore share the opinion of Weber[40] that no fatalities can result from conservative treatment.

Cases with symptoms are best managed by radical surgery. Aspiration of the sac has no place in treatment, firstly because the sac refills from the subarachnoid space and secondly because of the danger of infection. Should the cyst be discovered at the time of delivery, the safest course is to perform a Cæsarean section or probably a lumbar puncture with evacuation of enough cerebrospinal fluid to collapse the cyst, followed, after delivery, by elective extirpation of the meningocele.

For a radical operation different approaches are advocated by different surgeons. Weber[40] and Roux[32] recommend a laparotomy. This procedure is a difficult one, especially in the male where the pelvis is narrow. It has been tried with limited success by several surgeons, and some have had to abandon it after packing, draining or marsupializing the sac. Luth[25] who used this approach with a fatality believes it to be too risky because of the large pelvic vessels, and advocates a longitudinal incision extending from the rectum to the sacrum with resection of the coccyx, a method first successfully used by Pupovac[30] in 1903. The latter incision however is dangerous because of the possibility of infection due to the proximity of the anus. Demel[9] and Coqui[8] advocate a parasacral approach through the greater sciatic notch. This may be safest for meningoceles presenting in the gluteal region, otherwise an adequate exposure is difficult.

The method of choice which eliminates the dangers of infection and the hazards

TABLE IV.—Summary of Results According to Type of Treatment

Type of treatment	Number of cases	Condition unchanged	Cured without complications	Cured with complications	Died	Unknown
Puncture through vagina or rectum	10				8	2
Aseptic puncture	2	1			1	
Laparotomy	11		4	3	4	
Peritoneo-vaginal approach	1				1	
Ano-coccygeal approach	3		2	1		
Parasacral approach	5		3	1	1	
Trans-sacral approach	4		4			
Type not stated	1				1	
Totals	37	1	13	5	16	2

to sacral nerves and pelvic vessels, and which affords an easy and wide exposure for secure ligation of the stalk, is the one used by Adson[1] as modified by Cone. A transverse skin incision is made over the middle of the sacrum or the lumbo-sacral region. The bone is cleared and the sacral canal unroofed unilaterally. The sacral and coccygeal nerves, the filum terminale and the meningocele stalk are identified, and the latter is carefully isolated; if empty it is ligated and divided, otherwise it is opened, the nerve roots are freed and the fistula in the dura is closed. The meningocele wall may be removed piecemeal through the sacral defect or it may be left in place. Rectal examination at operation is helpful in establishing the presence of an accompanying tumour. The wound is closed without drainage and should heal within a week.

TABLE V.—Summary of Results

I. Untreated cases	15	
A. Condition unchanged	8	
B. Died	7	
Spontaneous rupture		3
Rupture of sac and peritonitis after delivery		2
Diarrhœa and malnutrition		1
Pneumonia		1
II. Treated cases	37	
A. Cured	18	
B. Unchanged (aseptic puncture)	1	
C. Died	16	
Meningitis		12
Septicæmia (aseptic puncture)		1
Tetanus (?) (marsupialization to vagina)		1
Cause not stated (laparotomy in one case and operation of unknown type in the other)		2
D. Results unknown	2	
III. No treatment mentioned	1	
Total	53	

Results and Prognosis (Tables IV and V)

The results up to date in treated as well as untreated cases have been disappointing. The prohibitively high global mortality rate of 43.4% in such a pathologically benign lesion is mainly due to misdiagnosis and inadequate management.

An analysis of the 16 reported deaths after treatment shows that in every case where the cause of death was mentioned it was due to infection. On the other hand in the 18 cures listed, any urinary symptoms, constipation, low backache and leg pain mentioned preoperatively disappeared in every instance. In Case 15 recovery followed an initial increase in the incontinence of urine and the appearance of incontinence of fæces, in Cases 22 and 34 a fistula developed but closed respectively five and six months later, and in Cases 26 and 45 a meningitis developed, followed by full recovery.

The case labelled "unchanged" in the treated group had been treated by an aseptic puncture through a parasacral incision. No further treatment was carried out.

In none of the reported cases did the patient develop any neurological signs and no patient developed hydrocephalus after extirpation of the sac.

Comment

The disparity of the incidence in females and males seems to be a genuine one and not related to the fact that the larger number of pelvic symptoms in women is liable to draw the attention of the examining physician to that region more fre-

quently in them than in men. Even after every case in a woman with any symptom referable to the genital system is discarded, the incidence remains four times greater in their favour. This finding coupled with the large incidence of duplication of the uterus and vagina may have some bearing on the pathogenesis of this condition.

Although congenital in origin, the condition tends to be overlooked in early life and only diagnosed in adult life, because the sac does not appear at the surface of the body and because the symptoms in this type of meningocele are insidious. That the condition is progressive and does at times become incapacitating is proven beyond doubt. The reason for this is not known with certainty; however, it is known that the sac increases in size (Cases 2, 4, 6, 29 and 53) and this enlargement may gradually compress the sacral nerves in the sacral canal or at their exit, thus aggravating the constipation and urinary symptoms and bringing out new symptoms such as pain in the back and lower extremities. It seems pertinent in this connection to point out that constipation and urinary symptoms are probably not due to simple mechanical interference of these viscera with evacuation but to pressure on their nerve supply as evidenced: (1) by the appearance of the symptoms with cysts not large enough to produce mechanical obstruction; (2) by the presence of a relaxed rectal sphincter; (3) by the disappearance of all such symptoms in our Case 1, although the cyst was replaced by a mass of gelfoam very nearly the size of the cyst itself.

The headache that some of the patients complained of is most probably due to increased intracranial pressure produced by compression of the meningocele (during defæcation in Cases 46 and 49, sitting in Case 29, enlargement of the cyst in Case 12, manual pressure in Case 38). The dysmenorrhœa was ascribed by Weber[40] to pelvic venous congestion due to mechanical compression of the pelvic veins. This does not seem to hold true in our Case 1, for the tumour was certainly too small to compress the pelvic veins. The surprisingly low incidence of dystocia may be due to the gradual emptying of the meningocele into the subarachnoid space because of its compression by the descending head.

The distribution of the numbness and pain, as well as the rapid postoperative disappearance of such symptoms, is an indication that they are the direct result of pressure of the meningocele sac or stalk on the sacral nerves. Whether this pressure is severe enough to produce weakness in the lower limbs is doubtful, because none of the patients who complained of pain or numbness had any weakness, and the latter symptom although described in four cases seems to be an accidental finding not related to the anterior sacral meningocele.

Summary of All Reported Cases of Anterior Sacral Meningocele

Case No.	*Author and reference*	*Age*	*Sex*	*Side*	*Symptoms*	*Signs*	*Therapy*	*Results*
1	Bryant[5] 1837	25	F.	?	Severe constipation; dystocia.	Very large rectum; retrorectal mass.	Extraction of fetus.	Died; peritonitis.
2	Virchow[39] 1863	23	F.	R.	Urinary incontinence; weakness of lower limbs.	Mass in buttock from birth increasing in size postpartum; right foot and leg œdematous.	Aspiration through vagina	Died; meningitis.
3	Emmet[14] 1871	36	F.	R.	Constipation; anuria; pain radiating to abdomen; dysmenorrhœa; pain in back radiating into the thighs.	Tumour at right iliac fossa adherent to sacrum.	Aspiration through rectum.	Died; uræmia and signs of meningitis.
4	Wegner[41] 1872	20	F.	R.	Bean-sized mass at birth, became head-size at 13 years; weakness of lower limbs; urinary incontinence after spontaneous rupture of sac.	Shrivelled; oozing; rest of sac in sacral region; decubitus ulcers.	None	Died; severe diarrhæa and pneumonia.
5	Hugenberger[21] 1879	25	F.	L.	In labour for 22 hours.	Dystocia, right leg weak and short; dorsal scoliosis.	Extraction of fetus.	Died; peritonitis.

SUMMARY OF ALL REPORTED CASES OF ANTERIOR SACRAL MENINGOCELE

Case No.	Author and reference	Age	Sex	Side	Symptoms	Signs	Therapy	Results
6	Kroner and Marchand[24] 1881	20	F.	R.	Gradual abdominal swelling; abdominal pain; headache; nausea and vomiting after fall off chair 4 months previously.	Right club foot; right leg short and thin; lumbar scoliosis; abdominal tumour.	Aspiration through vagina	Died; meningitis
7	Thomas[37] 1885	28	F.	?	Discomfort in pelvis; dysmenorrhœa; sterility.	Cyst filling cavity of sacrum; anteflexion of uterus.	None.	Unknown.
8	*Idem*	19	F.	?	Backache; dysmenorrhœa; sacral pain; fullness about pelvis.	Cyst adherent to hollow of sacrum.	Aspiration through vagina; 6 mos. later marsupialization to vaginal wall.	Died; meningitis.
9	Lohlein (Quoted by Coqui[8]) 1895	28	F.	?	Constipation; pain left leg; headache.	Cyst filling pelvis.	Delivery after three punctures through vagina; laparotomy unsuccessful; evacuation from rectum.	Cured.
10	Borst[3] 1898	3 mos.	?	R.	———	———	———	Died.
11	Pupovac[30] 1903	26	F.	mid-line	Right low abdominal pain.	Two pelvic cysts and mass near anus; bicornuate uterus.	Extirpation through anococcygeal incision.	Cured.
12	Nieberding[28] 1904	18	F.	L.	Abdominal pain.	Pelvic mass.	Laparotomy; aspiration through vagina	Lived; course unknown.
13	Willard*[42] 1904	4 mos.	F.	R.	Inability to move lower limbs.	Lumbar and abdominal tumours; paraplegia.	None.	Unchanged.
14	Neugebauer[27] 1905	22	F.	R.	Constipation; dysmenorrhœa	Pelvic mass; duplication of uterus and vagina.	Puncture under strictly aseptic conditions.	Died; spontaneous rupture 3 wks. later.
15	Grossman[18] 1906	6 mos.	M.	R.	Small frequent urinations.	Gluteal mass.	Parasacral excision.	Cured after initial increase in symptoms.
16	Fairbairn[15] 1911	18	F.	R.	Constipation; dysuria; irregular menses.	Pelvic mass; bicornuate uterus.	Peritoneo-vaginal resection.	Died; meningitis.
17	Tilp[38] 1912	38	F.	R.	Constipation.	Pelvic tumour.	Aspirated through rectum.	Died; meningitis.
18	Schultze (Quoted by Tilp[38]) 1912	?	F.	R.	None mentioned.	Abdominal cyst.	Abdominal (?) extirpation.	Died; meningitis.
19	Sawicki See Weber[40] and Frazier[17] 1914	25	F.	mid-line	Constipation; frequency.	Pelvic mass.	Laparotomy; marsupialization.	Cured.
20	Mayo† (Quoted by Flickinger[16]) 1915	22	F.	?	———	Pelvic tumour.	Laparotomy; drainage.	Cured.
21	Judd† (Quoted by Flickinger[16]) 1915	38	F.	?	———	———	Excision through Kraske approach.	Cured.
22	Coqui[8] 1916	20	F.	R.	Dysuria and retention.	Mass in hollow of sacrum.	Laparotomy; marsupialization.	Cured; fistula for 6 months.
23	Roux[32] 1918	8	M.	L.	Constipation; frequency and urinary incontinence.	Mass in hollow of sacrum.	Laparotomy; ligation of cyst neck.	Cured.
24	Frazier[17] 1918	52	F.	mid-line	Constipation; dysuria; incontinence; numbness of left pelvis and buttock.	Anæsthesia in lower sacral segments; mass in hollow of sacrum.	None.	Unknown.
25	Weibel (Quoted by Weber[40]) 1920	47	F.	L.	———	Cyst found during laparotomy for ovarian cyst.	Laparotomy; extirpation.	Died; meningitis.

SUMMARY OF ALL REPORTED CASES OF ANTERIOR SACRAL MENINGOCELE

Case No.	Author and reference	Age	Sex	Side	Symptoms	Signs	Therapy	Results
26	Weber[40] 1921	27	F.	mid-line	Dysmenorrhœa and sterility.	Mass in pelvis adherent to sacrum.	Laparotomy; ligation of cyst neck.	Cured; meningitis.
27	Kennedy[23] 1926	22 mos.	F.	mid-line	Constipation and painful defæcation.	Rectal polyp bleeding at times.	Excision of polyp.	Died; meningitis.
28	Sabatini[33] 1927	3 mos.	F.	L.	Anuria; constipation.	Low abdominal mass in hollow of sacrum.	Aspiration.	Died; meningitis.
29	Demel[9] 1928	20	F.	mid-line	Headache on pressure on mass; constipation.	Gluteal mass.	Parasacral excision.	Cured.
30	Eichler[13] 1928	15	F.	mid-line	Incontinence; constipation.	Tumour in hollow of sacrum.	None.	Unknown.
31	Drennan[10] 1929	21	F.	R.	Dysmenorrhœa 3 mos.; menorrhagia.	Tumour in hollow of sacrum.	Parasacral excision.	Died; meningitis.
32	Pick[29] 1929	32	M.	mid-line	Constipation; back pain radiating into the knees; headache.	Mass in hollow of sacrum.	Aspiration through rectum.	Died; meningitis.
33	Luth[25] 1937	15	F.	L.	Constipation; urinary incontinence; headache; abdominal pain (due to appendicitis).	Mass in hollow of sacrum found at laparotomy.	Marsupialization to abdomen.	Died; meningitis.
34	Santy[34] 1938	28	F.	L.	Constipation; pain in left hypochondrium radiating into left leg; frequency; pollakuria.	Mass in hollow of sacrum; hypotonic patellar reflexes; absent right ankle jerk.	Excision through anococcygeal incision.	Cured; fistula for 6 months.
35	Adson[1] 1938	22	F.	?	Constipation; backache radiating into left knee; paræsthesia left foot and leg.	Pelvic mass.	Trans-sacral excision.	Cured.
36	Holt and McIntosh[20] 1940	in-fant	?	?	Constipation.	Mass in hollow of sacrum.	None.	Died; accidental rupture during rectal examination.
37	Shidler and Richards[36] 1943	50	F.	L.	Pneumonia and septicæmia; shortness of breath; backache; occasional pain in both legs.	Mass in hollow of sacrum.	Aspiration through sacral defect.	Died; septicæmia.
38	*Idem*	29	M.	L.	Frequency; pressure sores on right foot.	Diminished anal sphincter tone; equino-varus right leg; calcaneo-cavus right foot; hypæsthesia over feet and perineum.	None.	Unchanged.
39	*Idem*	29	F.	L.	Lifelong constipation; dysmenorrhœa.	Mass in left pelvis.	Trans-sacral excision.	Cured.
40	Ingraham and Hamlin[22] 1943.	5 mos.	M.	?	Constipation; dysuria; oliguria.	Mass in hollow of sacrum.	Laparotomy; marsupialization.	Died.
41	Coller and Jackson[7] 1943	22	F.	R.	Constipation.	Tumour in hollow of sacrum.	Abdominal approach failed; parasacral excision.	Cured.
42	Brown and Powell[4] 1945	26	F.	L.	Pain in sacral region radiating into the left sciatic distribution; headache; nausea; vomiting; photophobia; incontinence.	Tender mass in hollow of sacrum; hypæsthesia over S2 and S3 segments; relaxation of anal sphincter.	Trans-sacral excision.	Cured.
43	Flickinger and Masson[16] 1946	41	F.	R.	Menorrhagia and leukorrhœa.	Pelvic tumour.	Laparotomy.	Cured.
44	*Idem*	31	F.	?	———	Spontaneous fistula into rectum.	None.	Died; meningitis.
45	Eder[14] 1949	27	F.	L.	Dysmenorrhœa; constipation.	Pelvic mass.	Laparotomy; excision.	Incontinence; meningitis; recovery.
46	Sherman, Caylor and Long[35] 1950	55	F.	L.	Backache; nocturia; stress incontinence.	Pelvic mass.	Parasacral aspiration.	Unchanged.

SUMMARY OF ALL REPORTED CASES OF ANTERIOR SACRAL MENINGOCELE

Case No.	Author and reference	Age	Sex	Side	Symptoms	Signs	Therapy	Results
47	*Idem**	32	F.	L.	Difficulty in swallowing.	Mass in hollow of sacrum.	None.	Unchanged.
48	*Idem*	40	F.	R.	Vaginal discharge; lifelong constipation.	Right retro-rectal mass.	None.	Unchanged.
49	Calihan[6] 1952	24	F.	R.	Headache associated with bowel movement.	Mass in hollow of sacrum.	None.	Unchanged.
50	*Idem*	7	M.	L.	Constipation.	Sacral defect.	None.	Unchanged.
51	*Idem*	8	F.	L.	Nausea and pain in one side.	———	None.	Unchanged.
52	Cone 1957	29	F.	L.	Low back pain radiating into left leg; constipation; frequency; dysmenorrhœa.	Mass in hollow of sacrum; diminished rectal sphincter tone.	Trans-sacral excision.	Cured.
53	Haddad 1957	3 mos.	F.	L.	Mass over the postperineum; constipation.	Mass just below tip of coccyx.	Excision.	Cured.

*Case not proven as meningocele.
†Not proven to be sacral.

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RÉSUMÉ

Le méningocèle sacré antérieur est une des quelques malformations congénitales du système nerveux central qui répondent au traitement chirurgical; malgré cela, cette affection souvent mal diagnostiquée est traitée inadéquatement, et dès lors devient quelquefois fatale.

Deux cas de méningocèle sacré antérieur, l'un chez une femme de 32 ans, l'autre chez un nourisson de trois mois, sont rapportés. La première patiente présenta une histoire de neuf mois de douleur dorsale basse intense, irradiant à la cuisse et au genou avec antécédents de constipation, de dysménorrhée, de symptômes urinaires et un accouchement gêné par une masse dans la concavité sacrée. On ne trouva guère de signes neurologiques, mais on put palper une masse fluctuante qui adhérait au sacrum en avant et du côté gauche. Une plaque simple montra une malformation sacrée et un myélogramme révéla une difformité de l'espace sous-arachnoïdien à sa limite inférieure. Le méningocèle fut enlevé par une approche trans-sacrée et l'espace qu'il occupait, comblé par du gelfoam; le spécimen était constitué de collagène et de tissu conjonctif fibreux mais ne contenait aucun tissu nerveux. Les symptômes disparurent après l'opération.

Dans le second cas, celui du nourrisson de trois mois, l'histoire a été celle d'un gonflement de l'extrémité inférieure de la colonne, qui augmentait de volume depuis la naissance. La masse pouvait être mobilisée en avant du coccyx jusqu'au sacrum. On ne constata aucune anomalie radiologique et cette masse kystique fut excisée en ligaturant son pédicule, qui naissait de la surface antérieure du sacrum. Une seconde masse fibreuse adhérente à la première fut enlevée du même coup. Un diagnostic de tératome avec méningocèle fut porté. L'opération apporta la guérison.

L'auteur passe en revue les 53 cas de méningocèles sacrés antérieurs publiés dans la littérature. De ceux-ci, 45 sont survenus chez des jeunes femmes; dans la majorité des cas, le diagnostic fut porté alors qu'elles étaient dans la vingtaine; le plus jeune sujet était âgé de trois mois et le plus vieux de 55 ans. La douleur au dos ou aux membres inférieurs, la constipation, la dysménorrhé et la dystocie, les troubles urinaires, la gêne causée par la masse fessière et les céphalées constituaient les principaux symptômes, alors, qu'occasionnellement on accusa de l'engourdissement ou de la faiblesse des jambes.

L'examen rectal révéla chez presque tous les malades une masse kystique adhérente à la concavité sacrée mais non à la muqueuse rectale, et variant en volume de celui d'un polype à celui d'une tête d'enfant. Le déplacement du rectum, de l'utérus et de la vessie fut observé. Si les signes neurologiques furent rares, on nota par contre une fréquence élevée de malformations congénitales, comme particulièrement l'utérus didelphe ou bicorne.

La radiographie est un auxiliaire diagnostique important: la présence, sur une plaque simple, d'un sacrum en cimeterre, ou d'une fissure sacrée, est fortement suggestive, alors que le passage du médium de contraste dans le méningocèle à la myélographie est pathognomonique. Le diagnostic différentiel est à faire avec un kyste de l'ovaire ou du ligament large, un kyste échinocoque ou une tumeur présacrée. Pathologiquement le sac est constitué par un prolongement des méninges sacrées à travers un orifice anormal dans le sacrum ou un foramen intervertébral aggrandi.

Les cas asymptomatiques ne requièrent aucun traitement à moins qu'on ne craigne une perforation. Les cas avec symptômes sont avantageusement traités par une chirurgie radicale. L'aspiration du sac est inutile. Si le kyste empêche l'accouchement, la césarienne est indiquée. Du point de vue technique, la voie d'abord transabdominale n'est pas recommandée. La méthode de choix est celle préconisée par Adson et modifiée par Cone, et qui consiste en l'incision transversale au milieu du sacrum ou à la région lombo-sacrée, suivie de la mise à nue unilatérale du canal sacré et l'ablation fragmentée de la coque à travers la fenêtre sacrée. Les résultats du traitement ont été jusqu'à maintenant décevants puisque le taux de mortalité des cas rapportés est de 43.4%. Les 16 morts post-opératoires ont toutes été causées par l'infection. Il y eut guérison complète chez 18 cas.

PYOGENIC OSTEOMYELITIS OF THE SPINE*

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PYOGENIC OSTEOMYELITIS of the spine is a not uncommon disease which may defy prompt and accurate diagnosis. This delay and difficulty in diagnosis results from the ameliorating effect of "shotgun" antibiotic therapy, the minimal early radiographic changes and the confusion with spinal tuberculosis or spinal disc disease. The patient may present with various clinical features which Guri (1946)[8] described as the hip joint, abdominal, meningeal and back pain syndromes.

My interest in this entity was prompted by the observation that genito-urinary infections or operations were apparently frequent before the onset of a spinal infection. This association has been noted by Deming and Zaff (1943),[5] Adlerman and Duff (1952),[1] Gariepy (1953)[7] and DeFeo (1954).[4] As a result of this interest, a review of the cases of pyogenic osteomyelitis available from the records of the Toronto General Hospital and the Hospital for Special Surgery in New York City was undertaken in 1954 and 1955.

CLINICAL RESULTS AND DISCUSSION

It was possible to collect 29 cases of blood-borne pyogenic osteomyelitis of the spine, 18 from Toronto and 11 from New York City. Postoperative spine infections have been excluded from consideration in this paper. Males were more commonly affected than females in the ratio of three to one and the patients varied in age from 12 to 76 years. The site and causative organisms are indicated in Table I. One infection occurred in the cervical region, 10 in the thoracic region and 18 in the lumbar region. The organism was *Staphylococcus aureus hæmolyticus* in 18 instances and *Bacillus coli* in one instance. In 10 patients a causative organism was not isolated from the spine lesion but culture from other infective foci, a positive blood culture or the clinical course allowed the diagnosis of pyogenic osteomyelitis.

TABLE I.—SITE AND MICRO-ORGANISM IN 29 SPINE INFECTIONS

Cervical	1	*Staph. aureus*	18
Thoracic	10	*B. coli*	1
Lumbar	18	Unknown	10

TABLE II.—ETIOLOGICAL FACTORS IN 29 SPINE INFECTIONS

Topical infection	4
Other osteomyelitis	7
Pneumonia, empyema	3
Postnatal uterine infection	1
Renal stone	1
Bladder infection	1
Prostate infection	3
Scrotal infection	1
Unknown factors	8

Etiological factors are indicated in Table II. Infection may reach the spine by direct extension after a spinal operation, or by the blood stream from a distant focus. Of the 29 cases, there was a distant focus of infection suggesting blood stream spread in 21 instances. Such a focus included topical infection in four, other bone infection in seven, pneumonia and empyema in three, postnatal uterine infection in one and renal, bladder, prostatic or scrotal infection in six instances. In eight cases no etiological factors were reported.

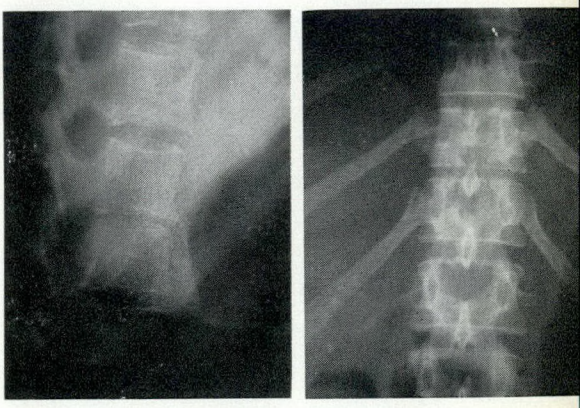

Fig. 1A and 1B.—Active staphylococcal osteomyelitis of 11th and 12th dorsal vertebræ a few weeks after postnatal uterine infection. Note the disc space narrowing and small areas of bone destruction in the vertebral bodies.

*Presented at the Annual Meeting of the Canadian Orthopædic Association, Murray Bay, Quebec, June 29, 1957.

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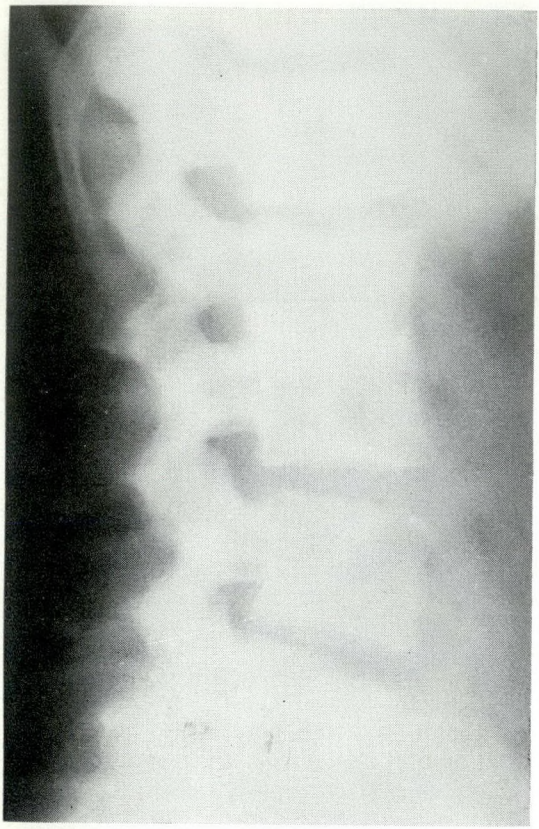

Fig. 2A

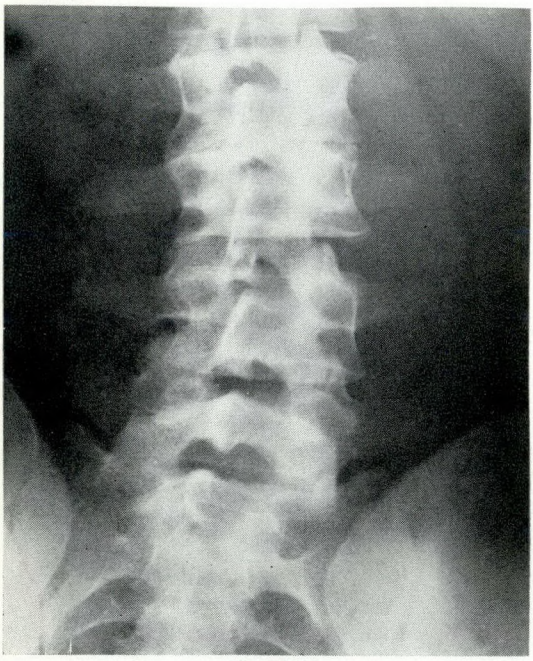

Fig. 2B

Figs. 2A and 2B.—Healed pyogenic osteomyelitis of second and third lumbar vertebræ. There is no apparent kyphotic deformity.

The onset of this disease may be sudden or insidious, with severe or slight back pain accompanied by fever, malaise and eventual loss of weight. The pain is usually aggravated by movement and coughing and is worse at night. Localized symptoms may result from abscess formation in the retropharyngeal, paravertebral, perinephric, psoas, pelvic or extradural regions.

The diagnosis of osteomyelitis of the spine is aided by appropriate radiographs (see Figs. 1 and 2). Pyogenic osteomyelitis is characterized by narrowing of an intervertebral disc with associated minimal destruction in adjacent vertebral bodies. Bone destruction and atrophy are rapidly followed by sclerosis and within a few months by new bone formation which tends to produce ankylosis of the affected vertebræ. There is little or no associated spinal deformity. In comparison, tuberculous osteomyelitis of the spine is characterized by a more slowly destructive process with minimal sclerotic reaction and tendency to ankylosis. A localized kyphosis is most often present and may be severe. Further aid in diagnosis may be gained by a search for other foci of infection, a sedimentation rate determination, a white blood cell count, a blood culture, a tuberculin test and agglutination tests to discern the rare typhoid and brucellar forms of osteomyelitis. Vertebral punch biopsy was used as a diagnostic aid in 10 of the Toronto series of 18 cases. Aspiration or incision and drainage of an associated abscess was done in 11 of the 29 cases.

Treatment was usually conservative, and operative interference other than vertebral body biopsy was rarely necessary in the deepseated vertebral body infection. Appropriate drainage of associated abscesses by aspiration or incision and drainage, antibiotic therapy, bed rest and sedation usually resulted in resolution of the presenting symptoms. The patient was then allowed up with spinal support applied until ankylosis of the affected area occurred. This therapy was used in almost all of the 29 cases reported, with aspiration of an abscess in six and incision with drainage of an abscess in five instances. Formal spinal fusion was done in three cases. Operations to remove dead or infected

bone were not necessary, though they might be required in osteomyelitis following a spine operation.

The prognosis depends to a great extent on the portion of the vertebra involved. With involvement of the vertebral bodies alone, satisfactory healing was usually obtained by conservative means in six to nine months. A notable exception was a young boy with staphylococcal osteomyelitis of dorsal vertebræ 8-9 and 10-11, who suffered repeated recurrences over seven years until treated by aspiration of an associated paravertebral abscess and many months of penicillin administration. Guri[8] established that when the neural arch of the vertebra is affected the patient is more commonly troubled with recurrences of infection and involvement of the spinal cord and nerve roots. One of the two deaths in this series occurred among the three patients with spinal arch involvement. Persistent infection or paraplegia developed in all of these patients. Complications included persistence of a draining sinus with residual infection in one patient, paraplegia in two patients, and amyloid disease in two patients aged 17 and 18 years who suffered from multiple foci of osteomyelitis.

TABLE III.—End Results of 29 Spine Infections

Healed and well	22
Draining sinus	1
Amyloid disease	1
Paraplegia	1
Death (1 paraplegia; 1 amyloid disease)	2
Unknown	2

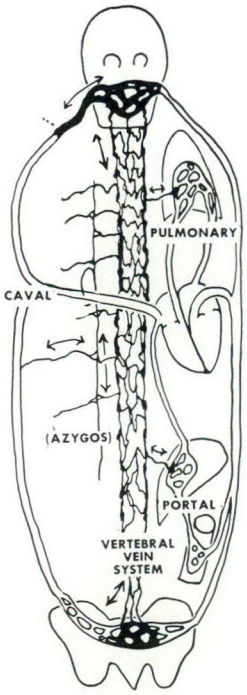

Fig. 3.—Diagram to demonstrate the rich vertebral plexus of veins and its connections. (Batson.[2] By kind permission of the J. B. Lippincott Company and *Annals of Surgery*.)

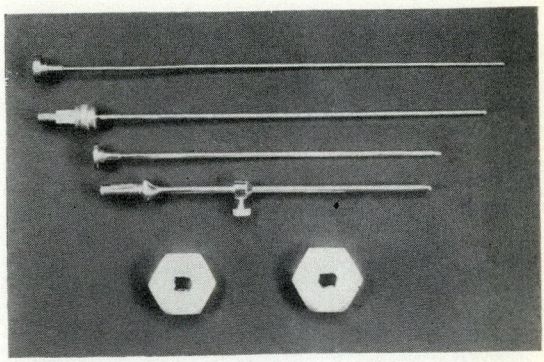

Fig. 4.—A satisfactory vertebral biopsy tool which includes an 11 gauge guide trocar and a 13 gauge, 125 mm. toothed biopsy needle with handles. (Turkel Trephine Instrument.)

The end result was satisfactory in 22 patients, with the lesions healed and good health re-established (see Table III). Three patients were troubled by residual complications—a draining sinus, paraplegia, and amyloid disease respectively. Death occurred in two instances. One of the deaths resulted from the complications of paraplegia, and the other was attributed to an associated acute hæmorrhagic colitis in a patient with amyloid disease. Two patients were lost to follow-up.

Comment

1. *The relation to genito-urinary infection.*—Since this investigation was primarily undertaken to assess the association of genito-urinary tract infection with pyogenic osteomyelitis, it is interesting to note that a uterine, renal, bladder, prostatic or scrotal infection preceded the onset of pyogenic osteomyelitis in seven of the 29 cases. It is accepted that other foci of osteomyelitis and topical infection give rise to spine infection by means of arterial bacteræmia. The occurrence of seven cases following

genito-urinary infection and three cases in association with pneumonia and empyema allows speculation on the role of the vertebral plexus of veins in the development of spinal infection.

Batson (1940)[2] reported that the injection of thin radio-opaque material into the dorsal vein of the penis of human cadavers and live monkeys was followed by a radiographic extension of the injection mass into the vertebral plexus of veins, the bones of the pelvis, spine and skull by direct extension through this rich valveless plexus of vertebral veins when it temporarily becomes a bypass for caval and azygos venous systems on coughing and straining (Fig. 3). It is reasonable to assume that the vertebral plexus could similarly serve as a route of spread for infection. The large venous connections from the lungs, kidneys, ureters, bladder, prostate and uterus to the vertebral plexus would allow any of these organs to serve as a primary focus for the development of pyogenic osteomyelitis of the spine.

2. *The diagnostic value of vertebral body biopsy.*—Punch or aspiration vertebral body biopsy has recently gained in popularity, as indicated by Frankel (1954),[6] Ottolenghie (1955)[9] and Craig (1956).[3] This procedure is a simple method which yields an accurate diagnosis by histological examination of tissue and culture of the infecting organism. The determination of the antibiotic sensitivity of the organism is a valuable aid to treatment. It is best performed with the patient under general anæsthesia, in a prone position. Accurate radiographic control of the biopsy tool in two planes is necessary. Possible complications include damage to important organs such as the kidney or lung, the spread of infection to the pleural space and the occurrence of troublesome hæmorrhage. No complications occurred in the 10 biopsies reported and the risk to the patient can be considered slight. A Turkel Trephine Instrument, which can be used in performing a vertebral biopsy, is shown in Fig. 4.

Summary

1. Pyogenic osteomyelitis of the spine is a not uncommon disease entity, usually occurring in the lumbar spine of males and due to infection by *Staphylococcus aureus hæmolyticus.*

2. Involvement of the neural arch of a vertebra as compared to the vertebral body is more commonly complicated by recurrence of infection and paraplegia.

3. Resolution of the lesion can usually be obtained with adequate, prolonged antibiotic therapy and immobilization of the spine. Operative therapy is seldom necessary as in the treatment of established postoperative spine infections.

4. The rich valveless vertebral plexus of veins and its large venous connections may be of importance in the spread of infection to the spine from adjacent organs in about one-fifth of the cases reviewed.

5. The diagnosis and treatment of this condition is aided by vertebral aspiration or punch biopsy under radiographic control.

Acknowledgment

The author is indebted to Dr. F. P. Dewar of Toronto for suggesting this work and for permission to use material from the Toronto General Hospital. Dr. T. Campbell Thompson has given permission for the use of material from The Hospital for Special Surgery, New York City.

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Résumé

Le diagnostic de l'ostéomyélite spinale pyogène peut facilement être méconnu du fait de l'amélioration clinique par thérapeutique antibiotique plurimédicamenteuse, des changements radiologiques minimes à son début et de sa ressemblance à la tuberculose de la colonne ou à la maladie discale. L'intérêt de l'auteur fut soulevé par l'observation de la fréquence des infections spinales survenant à la suite d'opérations ou d'infections génito-urinaires. L'analyse de 29 cas d'ostéomyélite d'origine sanguine fut l'objet de son travail; il étudie 18 dossiers de l'hôpital général de Toronto et 11 de l'hôpital de Chirurgie spécialisée de New-York. Les hommes sont affectés trois fois plus souvent que les femmes et l'âge des malades varie de 12 à 76 ans. L'auteur nous réfère aux Tableaux I et II pour ce qui est du site et des facteurs étiologiques.

La maladie peut se manifester de manière soudaine ou insidieuse avec une douleur dorsale intense ou minime, accompagnée de fièvre, de malaise et d'une perte de poids éventuelle. La douleur est souvent aggravée par le mouvement et la toux, et augmente le soir. Les radiographies facilitent le diagnostic; les clichés montrent dans ces cas un rétrécissement du disque intervertébral avec une atteinte minime des corps vertébraux adjacents. La destruction osseuse et l'atrophie font rapidement place à la sclérose, puis en quelques mois, à une néoformation osseuse qui tend à produire l'ankylose des vertèbres atteintes. Il y a peu ou pas de difformité spinale. La ponction biopsie vertébrale a servi au diagnostic pour 10 des 18 cas de Toronto.

Le traitement est habituellement conservateur et toute manœuvre opératoire autre que la ponction biopsie a rarement été nécessaire. Le drainage des abcès, l'usage des antibiotiques, le repos au lit et la sédation ont été suffisants dans la plupart des cas pour amener la disparition des symptômes. Le patient est alors autorisé à se lever; il doit porter un support vertébral qu'il gardera jusqu'à ce que l'ankylose soit installée.

Le pronostic dépend pour une large part du segment vertébral affecté. Une guérison satisfaisante est obtenue après six à neuf mois de ce traitement conservateur lorsqu'il n'y a que les corps vertébraux qui sont touchés. Cependant, lorsque les lames sont atteintes l'infection persiste et la paralysie s'installe. Les résultats sont soulignés au Tableau III.

Commentaires

1. *Relation à l'infection génito-urinaire.*—L'auteur note que dans 7 des 29 cas, une infection soit utérine, rénale, vésicale, prostatique ou scrotale, a précédé l'apparition de l'ostéomyélite pyogène. A cause de cette occurrence et de l'association de trois autres cas dont l'ostéomyélite a été précédée de pneumonie et d'empyème, il est permis de spéculer sur le rôle du plexus veineux vertébral dans le développement de l'infection spinale.

2. *La valeur diagnostique de la ponction biopsie vertébrale.*—Celle-ci a été popularisée par Frankel (1954), Ottolenghie (1955) et Craig (1956). De technique simple, elle permet l'examen histologique du tissu, la culture des agents pathogènes et l'antibiogramme. Elle est pratiquée sous anesthésie générale, le malade en pronation avec contrôle radiologique de l'instrument dans les deux plans. Les complications possibles, dont les malades examinés ont été exempts, comprennent la blessure du rein ou du poumon, l'étendue de l'infection à la plèvre et le déclenchement d'une hémorragie grave. L'instrument est illustré à la fig. 4.

CARCINOMA OF THE BREAST: THE STUDY AND TREATMENT OF THE PATIENT. (New England Journal of Medicine Medical Progress Series). Andrew G. Jessiman, Henry E. Warren Fellow and Assistant in Surgery, and Francis D. Moore, Moseley Professor of Surgery, Harvard Medical School. 135 pp. Illust. Little, Brown and Company, Boston and Toronto; J. B. Lippincott Company, Montreal, 1956. $4.00.

In their preface the authors of this monograph outline the purpose of this review. It is to integrate "the operative endocrine and metabolic aspects of surgical care of carcinoma of the breast". It is remarkable that such wide and controversial subjects could have been dealt with so clearly and adequately in this small book. The success is due as much to the clear, terse style of writing as to the methodical presentation.

Starting with the setting of the disease, the authors outline the role of the œstrogens as stimulators and suggest various sources of the abnormally high œstrogen levels found in many postmenopausal women with mammary carcinomas. Cortical stromal hyperplasia is discussed and Smith's theory of its causation is outlined. Mention is made of mammary carcinoma occurring when treated with œstrogens for carcinoma of the prostate.

Following this, the authors discuss methods of separating tumours that are œstrogen stimulated from those that are not so affected. A scheme for investigation is described and the method of calcium excretion estimation is given in detail. The stilbœstrol stimulation test is also described and explained. It is made clear that these tests are not complicated and do not require elaborate laboratory techniques.

The place of local as opposed to radical mastectomy is touched on and the indications for castration, adrenalectomy and hypophysectomy described. Finally, schemes for treatment are given. These depend on the clinical types of the disease which the authors have classified into eight groups varying from the "young and early" to the "late with visceral spread".

In conclusion, this book can be recommended to all as it gives a concise, practical and up-to-the-minute picture of diagnosis and treatment of mammary carcinoma, not only in the early, localized type of case but also in those cases where spread has occurred.

TANTALUM GAUZE AS A SUPPORTING AGENT IN AORTIC LESIONS: PRELIMINARY REPORT*

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THE TREATMENT of aortic aneurysms has aroused much interest and experimental work in the past 10 years. Originally efforts were directed towards supporting the wall of the aneurysm in order to prevent further progression with eventual rupture. Wrapping the vessel with reactive cellophane,[1-3] perivascular injection of dicetyl phosphate,[4] and surrounding the sac with fascia lata[5] or a layer of nylon net[6] have all been employed experimentally and clinically.

Resection of the aneurysm and replacement by an aortic homograft or plastic prosthesis have come to be considered the best methods of dealing with this lesion. However, not all aneurysms are amenable to these methods of treatment, and it is impossible to resect some of them.

The authors consider that the use of a supporting medium should not be neglected (a) in non-resectable lesions, (b) as a support to a homograft or plastic prosthesis in resectable lesions, (c) in thromboendarterectomy and (d) as a support to venous grafts.

Tantalum gauze as supplied for use in surgery was suggested as a suitable medium because: (1) It is strong and capable of resisting strain for a considerable period. (2) It is pliable and easy to mould, manipulate, cut and sew, without the use of special instruments or appliances. (3) It is not injurious to tissue and does not produce undesirable chemical or physical reaction in surrounding tissue. (4) It is sufficiently porous to allow the growth of vessels through the mesh to supply the wall of the vessel. (5) It acts as the skeleton for the development of a fibrous tissue sheath which is dense and strong.

EXPERIMENTAL WORK

The following experiments were devised:

A. *Technique.*—Under intravenous thiopentone (Pentothal) and inhalation ether anæsthesia, the abdominal aorta of a series of mongrel dogs of varying sizes was isolated by reflecting the descending colon and peritoneum, and the aorta was mobilized from the renal vessels to the trifurcation, the lumbar vessels being doubly ligated and divided. The aorta thus exposed was wrapped in a single layer of tantalum gauze after stripping the adventitia. The gauze was sutured in place with 000 silk. The peritoneum was sutured over the gauze (Figs. 1 and 2). Of the 14 animals operated upon, seven survived sufficiently long to be of value. The animals were destroyed at intervals, survival time varying from six days to 180 days. Actual survival times were six, 12, 17, 30, 49, 118 and 180 days. Specimens were examined, photographed and preserved in formalin. The aorta and supporting gauze were split longitudinally

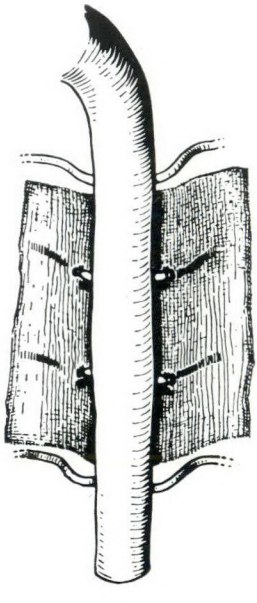

Fig. 1.

Fig. 2.

Figs. 1 and 2.—Artist's drawings illustrate method of wrapping aorta with tantalum mesh, with overlap of edges and interrupted sutures.

*From the Department of Surgery, University of Manitoba, and the Abbott Clinic, Winnipeg.

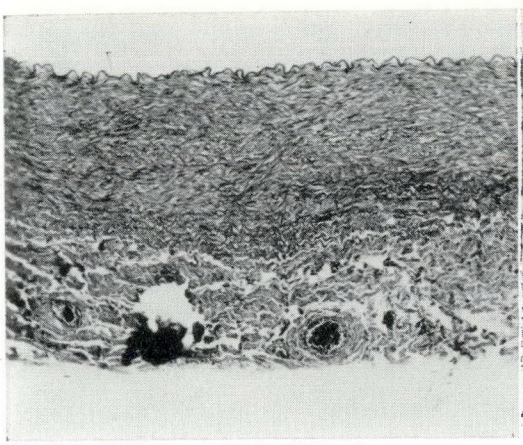

Fig. 3.

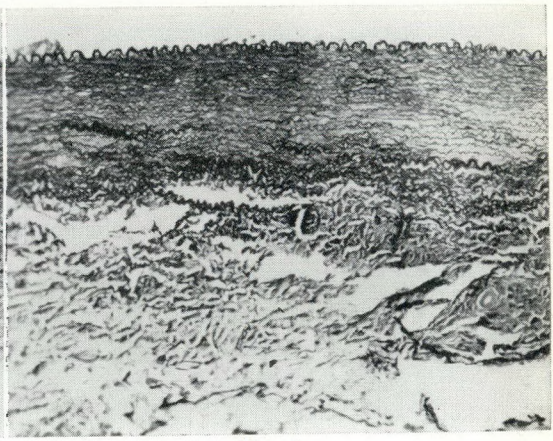

Fig. 4.

Fig. 3.—Abdominal aorta x 75 (H.&E.). Aortic wall and intimal surface are intact. No inflammatory reaction around tantalum wire (118 days' survival). **Fig. 4.**—Abdominal aorta x 75, elastic tissue stain. Elastic tissue normal in amount and fibres intact (118 days' survival).

and the intima was examined grossly. The gauze was stripped from the aortic wall and sections were cut of the aortic wall and the tissue surrounding the gauze. Sections were stained for elastic tissue and for muscle.

Results. – The peritoneum over the wrapped vessel was intact in each instance. There were no visceral adhesions to the line of peritoneal incision. Specimens of six, 12, and 17 days' survival were easily removed from the abdomen. The gauze stripped from the aorta without difficulty.

In the four remaining specimens of 30, 49, 118, and 180 days' survival, the aorta was surrounded by a mass of firm scar tissue, fixing it to the posterior abdominal wall. The fibrous mass was adherent to the inferior vena cava but did not obstruct it. In the 118 day specimen, one ureter was involved in the fibrous mass but was not obstructed. It was necessary to remove these specimens by sharp dissection from the posterior abdominal wall. The gauze was stripped with difficulty and a firm smooth sheath of fibrous tissue surrounded the aorta.

On opening the vessel, the intima was found to be smooth, shiny and intact. The intima in the wrapped area appeared to be depressed in relation to the intima in the unwrapped area.

Microscopically the intima was intact in all specimens (Fig. 3). The amount of elastic tissue appeared to be normal and the fibres intact (Fig. 4). The media in some specimens showed evidence of slight degeneration in the outer third.

At 12 days' survival, considerable fibrous tissue with small blood vessels was seen between the gauze and the arterial wall. At 49 days, fibrous tissue had grown through the mesh and filled the interstices. Approximately 1 mm. of fibrous tissue was found between the gauze and the wall. At 118 days the intima and muscular coat were intact and showed no evidence of degeneration, and there was 1-2 mm. of fibrous tissue between the gauze and the arterial wall. Findings were similar at 180 days.

No inflammatory reaction was seen around the wire mesh in any specimen (Fig. 3).

B. *Technique.*—The left thoracic cavity was opened and the descending thoracic aorta mobilized, just above the diaphragm, two pairs of intercostal arteries being divided and ligated with 000 silk. The procedure described in "A" was then carried out and the chest closed without drainage. The anæsthetic was intratracheal oxygen-ether with intravenous thiopentone (Pentothal). A total of 13 dogs was operated upon. Twelve specimens were obtained, the survival times ranging from four days to 355 days. Actual survival times were five, five, 35, 48, 72, 173, 180, 195, 202, 235, 235, 235, and 355 days. The specimens were examined as in "A". Direct

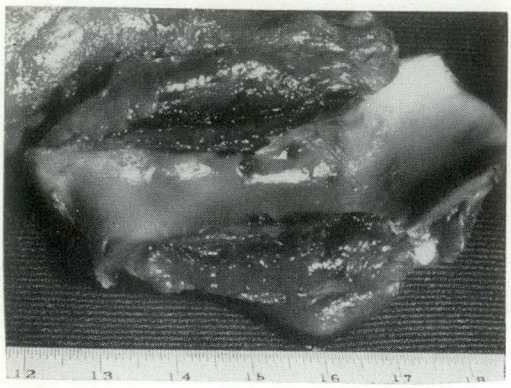

Fig. 5.—Thoracic aorta with adherent viscera (180 days' survival). Note the relative depression of intima of wrapped portion; smooth intimal lining and fibrous tissue between gauze and aortic wall.

blood pressure readings with a mercury manometer were taken above and below the wrapped area at the time of sacrifice.

Results.—Blood pressure readings taken above and below the wrapped area showed no significant variation in any dog of this series.

All specimens were adherent to the thoracic wall, but the two five-day survival specimens were easily mobilized. The remainder were firmly fixed and required sharp dissection for removal. The wrapped area was surrounded by a dense fibrous scar in the ten older specimens, to which the left lung and œsophagus were adherent in varying degree. Aeration of the left lung did not appear to be interfered with. The lumen of the œsophagus was not diminished.

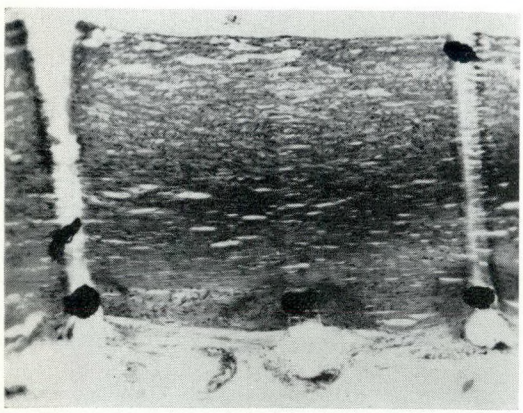

Fig. 6.—Thoracic aorta x 75, H.&E. No inflammatory reaction was seen around tantalum mesh (180 days' survival).

Specimens with adherent viscera were removed and split longitudinally. The intima in all instances was smooth and appeared somewhat depressed below the intima of the aorta above and below the wrapped area (Fig. 5). It appeared to be intact in each specimen. In the 48 day survival specimen the intima appeared almost translucent in the wrapped area, and the gauze mesh could be seen through the intima in two small areas. It was found possible to include the tantalum gauze in the microscopic sections. No inflammatory reaction was seen around the tantalum wire (Fig. 6). The intima was intact in all specimens. Elastic tissue stains showed no damage to the elastic tissue of the aortic wall.

Two specimens with survival times of five days and 173 days showed aortic medial necrosis of the type seen in human specimens. Specimens at 195 and 202 days showed some thinning of the media with patchy degeneration of the media in its outer one-half. The remainder (eight specimens) showed no medial degeneration. At 355 days' survival, the aortic wall appeared to be intact.

Discussion

Tantalum gauze proved easy to work with, and no technical difficulties were encountered in its use in these experiments. The absence of inflammation around the tantalum wire was obvious in all sections.

The dogs used in this experiment were of all age groups, and the two instances of marked medial necrosis were in elderly dogs in which there were gross arteriosclerotic changes in the aorta.

Grossly, each specimen was surrounded by a firm fibrous mass which required sharp dissection for its removal in all specimens with over 17 days' survival time.

Suturing the peritoneum over the gauze in the abdominal series was apparently effective in preventing visceral adhesions. Inability to close the parietal pleura in the chest resulted in visceral adhesion of varying degree, which did not apparently interfere with pulmonary aeration or œsophageal lumen.

The appearance in the specimens of depression of the intima of the wrapped

aorta below that of the unwrapped vessel was considered to be due to fixation of the aortic wall by fibrosis, and the prevention of normal retraction on removal of the specimen.

The gauze wrapping did not interfere with circulation distal to the wrapped area, as far as could be ascertained, for blood pressures above and below the area were identical. No definite evidence of growth of blood vessels into the aortic wall was seen. The presence of some degree of medial necrosis in the outer one-third of the media was considered to be due possibly to fixation of the wrapped area, and to the pressure exerted on nutrient blood vessels by the intermittent aortic pulsations here in contrast to the unsupported area which permitted expansion and contraction of the aortic lumen. This degree of necrosis was not considered to be of great significance by the pathologist.

Conclusions

1. Tantalum gauze is considered to be a suitable medium for support of the aortic wall.
2. Its use causes no significant nutrient changes in the aortic wall.
3. It causes no significant circulatory disturbance below the point of wrapping.
4. It produces no inflammatory reaction.
5. A dense fibrous sheath is formed with the gauze as a skeleton, fixing the vessel to the parietes.
6. Covering the gauze with a serous membrane prevents visceral adhesions in the abdomen.
7. No fragmentation of the gauze is observed up to a period of 355 days.

It is hoped to continue these studies by inserting a heterologous graft in the thoracic aorta of a series of dogs and supporting each alternate one with tantalum gauze, thus determining its efficacy in preventing aneurysm formation in the graft.

Acknowledgment

This work was made possible by a grant from the Banting Institute. Our thanks are due to Professor J. M. Lederman, Professor of Pathology, University of Manitoba, for his interpretation of the microscopic sections, and to his staff for cutting the sections and taking the photomicrographs. Our thanks are also due to Johnson & Johnson for supplying the tantalum gauze, to the Associated Anæsthetists for providing anæsthesia, and to Miss Nancy Jay for Figs. 1 and 2.

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Résumé

Bien que le meilleur traitement de l'anévrisme aortique soit la résection et le remplacement par une homogreffe ou une prothèse synthétique, les auteurs considèrent tout de même qu'il ne faut pas négliger l'usage des manchons protecteurs (a) dans les cas de lésions non réséquables (b) pour renforcer une homogreffe (c) après une thromboendartérectomie, ou (d) pour supporter les greffes veineuses. La maille de tantale est la prothèse que les auteurs préfèrent à cause de sa solidité, de sa malléabilité, et de son inertie chimique.

Les auteurs rapportent deux séries d'expériences pratiquées sur l'aorte abdominale ou sur l'aorte thoracique de chiens de tailles variées. Dans les deux séries, un segment d'aorte fut mobilisé, libéré de son adventice, puis recouvert d'un treillis de tantale, fixé par de la soie 000. Les animaux furent sacrifiés à des intervalles variant de 5 à 355 jours et les spécimens furent examinés, photographiés et conservés dans la formaline. On nota que le treillis de tantale était de maniement facile n'ayant soulevé aucune difficulté technique et n'avait produit aucun signe d'inflammation.

Les spécimens prélevés un mois et plus après l'opération furent découverts enfouis dans une trame de tissu conjonctif si dense que leur extirpation exigea une dissection minutieuse dans chaque cas. On ne trouva pas d'adhérence dans l'abdomen lorsque le treillis fut recouvert de péritoine; par contre dans le thorax la plèvre pariétale ne se prêtant pas à une manœuvre semblable, on observa des adhérences viscérales d'étendue variable ne nuisant cependant pas à la ventilation ou au transit œsophagien.

La circulation n'a guère semblé être modifiée si on se fie aux pressions artérielles qui furent trouvées identiques en amont et en aval du segment entouré. Le léger degré de nécrose au niveau du tiers superficiel de la média semble avoir résulté de la fixité du segment entouré et de la pression exercée sur les vaisseaux nourriciers par les pulsations aortiques intermittentes alors que normalement la lumière aortique est capable d'expansion et de contraction.

En conclusion, les auteurs considèrent le treillis de tantale adéquat pour consolider la paroi aortique. Son usage ne produit aucune altération importante de la paroi, aucune perturbation circulatoire, ni aucune réaction inflammatoire. Le treillis sert de squelette à une couche fibreuse dense, qui immobilise le vaisseau. Il ne s'est produit aucune fragmentation du treillis ou cours d'une observation s'étendant jusqu'à 355 jours.

Les auteurs projettent de poursuivre des études sur la mise en place chez des chiens de greffons hétérologues dans l'aorte thoracique, recouverts d'un manchon de tantale, afin de déterminer l'efficacité d'une telle précaution dans la prévention des anévrismes qui résultent souvent de ces greffes.

FATE OF ORLON AORTIC IMPLANT IN MAN

In discussing their findings in a patient who died two and a quarter years after the insertion of an abdominal aortic graft of orlon cloth, Eastcott and Wilson of London, England, (*Lancet*, 1: 353, 1958) point out that there is a scarcity of observations on the manner in which such material is finally accommodated in the human aorta.

In the present case, the authors had operated upon a man aged 63 with an aortic aneurysm, and resected the latter which involved the aorta from 3-4 cm. below the renal arteries to the first part of the common iliac arteries. They restored the gap by a graft of orlon cloth previously prepared in the form of a bifurcation. The patient recovered well and experienced no further pain, but died two and a quarter years later of tuberculosis.

At autopsy, the following features were found: (1) Fibrin had been deposited on the internal aspect of the orlon only in patches; large areas of the orlon were completely bare. (2) The outer surface of the orlon was not attached to surrounding tissues, except at the anastomoses and down the sides where there were seams joining the anterior and posterior halves of the graft. (3) There were transverse wrinkles in the orlon at some places. (4) At one point a free edge of the graft had been inadvertently turned in and protruded into the lumen, but here there was no increase in fibrin formation. (5) Tissue around the graft was dense, pale grey, connective tissue, less than 1.5 mm. in thickness.

Microscopy showed that the tissue covering the orlon on the outer side was dense collagenous fibrous tissue and almost avascular. There was no sign that the orlon had any irritative or productive effect on tissues. The orlon was not infiltrated by fibroblasts or histiocytes, and there was very little foreign body giant cell reaction. There was no sign of endothelialization.

This inert behaviour of the body towards the orlon reflects that of an arterial homograft with negligible foreign body reaction, even at wrinkles and other faults in the preparation and insertion of the graft. The authors consider that the findings in this case are so surprising that some peculiarity of the patient or his treatment may be suspected. Study of further long-term grafts is indicated.

LUMBAR SYMPATHECTOMY: A LONG TERM FOLLOW-UP ON 124 OPERATIONS DONE FOR ARTERIOSCLEROSIS AND BUERGER'S DISEASE OF THE LOWER LIMBS*

H. F. ROBERTSON, M.B., B.Sc.,(Med.), F.R.C.S.[C], *Toronto*

THIS PAPER PRESENTS the results of a long term follow-up on 124 sympathectomies done by various surgeons at the Toronto General Hospital from 1932 to 1950 for arteriosclerosis and Buerger's disease of the lower limbs.

This survey was begun to discover how many good results were obtained from sympathectomy, how many remained good and for how long, which symptoms and signs were most benefited, and whether digital plethysmography, added to the usual tests, would be a useful objective control method.

The majority of the patients were seen personally; a few were assessed from history, follow-up notes and questionnaires. The cases studied were unselected except for discarding those without sufficient reliable data.

A small number of patients with occlusive arterial disease, not operated on, have been followed up as controls to represent in some degree the natural course of this disease. One remembers that in arteriosclerosis and Buerger's disease the lesions are quite variable in extent and distribution, and the natural course varies greatly. In both, the natural response to occlusion is a collateral circulation so variable that it may completely counterbalance the lesion, or may be quite inadequate.

Throughout this investigation it was kept in mind that clinical assessment of the response of circulatory disease to therapy is notoriously fallacious, particularly the subjective responses. Therefore every effort was made towards objectivity and strict assessment.

The choice of patients for sympathectomy varied somewhat because a number of surgeons were responsible for these patients. Generally a conservative attitude predominated. Poor risk patients such as those quite senile, those with widespread arteriosclerotic changes, and those with advanced cerebral, cardiac, pulmonary or urinary tract disease were not offered sympathectomy. Patients with gangrene or ulceration extending from the toes on to the foot or leg, or those with extensive early gangrene of the foot or leg, or those with an acutely fulminating lesion were not submitted to sympathectomy. Patients with marked trophic changes or marked rest pain were not accepted as a rule, particularly if the popliteal and distal pulses were absent. In Buerger's disease sympathectomy was usually not done while the disease was rapidly progressing and acute, though an early sympathectomy was felt at times to protect the patient from skin necrosis and infection and also to limit the extent of amputation, especially when vasospasm was a marked feature. In cases of arteriosclerosis early sympathectomy was often done for the same reasons. Over the years a variety of skin temperature tests, or other tests to assess the blood flow in the extremity, were carried out. Usually the clinical assessment of cases was relied on; as has been found in other similar studies, patients responding poorly to laboratory tests might respond well to sympathectomy. In short, the patients selected for sympathectomy were those most likely to do well, and to show, as a series, low morbidity, amputation, and mortality rates.

Whenever possible pathological material was re-examined. This procedure helped in the correct classification of cases of arteriosclerosis and Buerger's disease.

RESULTS

This follow-up study presents cases of arteriosclerosis and of Buerger's disease so that the two may be compared.

The age and sex of the patients followed the usual pattern, as shown in Table I. The majority of patients with arteriosclerosis were in the 50-70 year age group, those with Buerger's disease in the 30-50 group. There was one arteriosclerotic in

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TABLE I.—Age and Sex of Patients with Occlusive Vascular Disease

Age	*54 arteriosclerotics* *50 male*	*4 female*	*40 Buerger's* *40 male*
20-29	1	—	6
30-39	1	—	13
40-49	6	—	17
50-59	18	2	4
60-69	16	2	—
70-79	7	—	—
80	1	—	—

his twenties. This is not surprising on recalling various studies of juvenile arteriosclerosis.[1-4] One notes under sex distribution only four female arteriosclerotics, and no cases of Buerger's disease in females. The only diabetic was a Chinese male aged 65, an arteriosclerotic.

Only three of the 54 patients with arteriosclerosis had both limbs affected when first seen; 16 of the remaining 51 cases in which only one limb was involved when first seen eventually had the other limb affected. Nineteen of the 40 cases of Buerger's disease had both limbs affected when first seen; seven of the 21 remaining patients who had only one limb involved when first seen eventually had the other limb affected.

Table II shows the follow-up period by various monthly groups. Limbs that survive the first few months after sympathectomy are usually good for many years in both arteriosclerosis and Buerger's disease. Twelve out of 62 arteriosclerotic limbs were amputated after sympathectomy because of continuing pain or necrosis; this is not a high incidence of amputation. The loss of six out of 62 limbs after sympathectomy for Buerger's disease, because of continuing pain or necrosis, is also a low incidence. The largest number of patients was in the group followed up for over six years, with only three late leg amputations in cases of arteriosclerosis and one late amputation in the group with Buerger's disease. The majority of the arteriosclerotic patients lived for many years. Seven of the 13 late deaths, unrelated to sympathectomy, were cardiovascular in nature, four being due to coronary thrombosis. This is not an unusually high rate of cardiovascular deaths considering the age grouping.

The response of limbs to sympathectomy has been assessed under main indications such as claudication with or without necrosis (Table III). There is of necessity overlapping to some extent. Good results were those in which the patient was completely relieved of symptoms and signs for some years. Fair results were those in which the patient was relieved of major complaints but retained some minor disability such as mild claudication after a long walk. Poor results were those with no relief. The results of sympathectomy in arteriosclerotic disease will be presented first.

Arteriosclerosis

The group of patients suffering from *claudication without necrosis* was the largest. After 23 sympathectomies there was a good result in eight limbs and fair improvement in eight. In seven there was no improvement, three of the limbs coming to amputation, which in one case resulted in postoperative death. These results lie between the optimistic figures of De Bakey, Creech and Woodhall[5] with 85% a good result, and Mavor's[6] with only 17% improved.

In the group associated with *claudication with necrosis* there were 14 sympathectomies, six giving a good result. Eight

TABLE II.—Period of Follow-up after Sympathectomy or Interval before Post-Sympathectomy Amputation or Postoperative Death*

Follow-up period: months	*62 sympathectomies for arteriosclerosis* *No.*	*Postoperative amputation*	*Postoperative death*	*62 sympathectomies for Buerger's* *No.*	*Postoperative amputation*	*Postoperative death*
Less than 1	8	5	5	2	2	
1 - 3	12	7	2	5	4	
3-12	2			1	1	
12-24	6			4		
24-48	12			7		
48-72	6			14		
6 years to 20 and up	16			29		

*Amputations of toes, part feet, not shown here.

TABLE III.—Indications for Sympathectomy and Response of Presenting Signs and Symptoms to Sympathectomy

Indications for sympathectomy	62 sympathectomies for arteriosclerosis				62 sympathectomies for Buerger's			
		Response to sympathectomy				Response to sympathectomy		
	No.	Good	Fair	Poor	No.	Good	Fair	Poor
Claudication								
Without necrosis	23	8	8	7	25	8	10	7
With necrosis	14	6	–	8	9	2	–	7
Constant pain								
With necrosis	11	5	2	4	6	3	–	3
Without necrosis	1	–	–	1	2	–	–	2
Impending gangrene	5	–	–	5	2	2	–	–
Superficial necrosis	5	2	1	2	6	–	2	4
Gangrene toes	2	–	1	1	–	–	–	–
Cold extremity	—				2	2	–	–
Phlebitis								
With claudication	1	–	–	1	7	1	4	2
Without claudication	1	1	–	–	7	–	2	5

sympathectomies gave a poor result, three ending in amputation, with one postoperative death. The report of Coller *et al.*[7] in 1949 was more optimistic than this but a more recent paper reported a lower recovery rate with more amputations.

Of the 12 limbs with *constant pain*, including night or rest pain, 11 showed necrosis. Constant pain with necrosis is generally regarded as an evil omen. But in this series, after 11 sympathectomies, five had a good result and two a fair result. There were four poor results, each ending in amputation with one post-amputation death. It was noted frequently that pain persisted until an ulcer healed or until a toe was removed and the stump healed. Thus sympathectomy by itself does not stop ischæmic pain in the presence of unhealed ulcers and necrosis, but undoubtedly expedites and actively aids the healing of many small lesions, with or without the aid of gentle surgery such as the careful removal of necrotic tissue.

Patients with *definite impending gangrene* of limbs did not do well after sympathectomy. Of five sympathectomies in this group, three limbs were lost, one patient died after sympathectomy and one died after amputation following sympathectomy. These patients had usually many other symptoms and signs and were truly in desperate condition as far as limb viability was concerned.

Superficial necrosis is not of necessity of grave import. Sympathectomy gave a good result in two out of five limbs so affected, and a fair result in one. Two patients died, one after an amputation following sympathectomy. An increased blood supply, along with increased care of the limb and the patient in hospital, apparently turned the balance in favour of healing in some cases.

Gangrene of toes has been listed separately in two cases but was seen in other cases along with other symptoms and signs. Removal of toes may relieve pain completely and along with sympathectomy end in a good result. In some centres more local amputations and debridements are being done with some success.[9, 10]

Phlebitis was seen in two cases of arteriosclerosis, incidental to other main conditions. These were not cases of Buerger's disease.

Buerger's Disease

In Buerger's disease we again find *claudication without necrosis* the largest group. Of 25 sympathectomies eight gave a good result; 10 gave a fair result. Only seven sympathectomies gave a poor result, three ending in amputation.

Of nine sympathectomies for *claudication with necrosis* two gave good results with cessation of pain and healing of necrosis. Of seven poor results two ended in amputation.

Constant pain, including night or rest pain, with necrosis occurred in six limbs, and in three was completely relieved by sympathectomy. Three were unrelieved, two ending in amputation. The two limbs

TABLE IV.—Postoperative Complications of Sympathectomy

Complications	No. cases	In 62 sympathectomies for arteriosclerosis: Deaths related to sympathectomy	In 62 sympathectomies for Buerger's: No. cases	In 62 sympathectomies for Buerger's: Deaths related to sympathectomy
General				
Hemiplegia	1	1 Age 57; postoperative stroke; hypertension.		
Pneumonia	1	1 Barrett, age 83, post. symp., post. amp.; cystitis and pyelitis.	1	
Pulmonary embolism	0		1	
Intestinal distension	0		2	
Thrombo-phlebitis	0		4	
Sympathectomy wound				
Hæmatoma and infection	1	1 Age 74.		
Deteriorating vascular state				No postoperative deaths
General	2	2 Ages 75 and 76.		
P.O. increased pain and/or spread gangrene with loss toes or forefoot	7		6	
P.O. increased pain and/or spread gangrene with loss foot	1		1	
P.O. increased pain and/or spread gangrene with loss leg	12	3 Barrett, age 83; Smith, age 58; Wood, age 74.	6	
Amputation stump				
Infection	1	1 Wood, post. symp., post amp.; *B. welchii.*		
Non-healing	1	1 Smith post. symp.; post. amp.; ?cor. ?pul. emb.		

grouped under constant pain without necrosis did badly after sympathectomy, one being amputated. This is too small a number from which to draw conclusions but one recalls that many patients in the claudication without necrosis group who did well also had rest pain which was relieved by sympathectomy.

Impending gangrene was the main indication for sympathectomy in two cases, both of which had a good result. This might be explained by the relief of vasoconstriction which is often very pronounced in Buerger's disease as opposed to arteriosclerosis.

In the group of six limbs with *superficial necrosis* only two had a fair result from sympathectomy; four results were poor, one limb being amputated.

In two patients *coldness of the extremity* was the major complaint; it was relieved by sympathectomy.

Superficial, migrating phlebitis was noted in only 14 of the limbs with Buerger's disease, though it had always been diligently sought for and recorded. The fact that superficial or deep, and large or small vessels may be affected to quite a variable extent may account for this. Phlebitis with or without claudication seems to have been an unfavourable sign, limbs without claudication faring worse. It was however the accompanying necrosis, pain, or claudication that determined the poor result here.

The results in Buerger's disease in this series are not as favourable as in some reported series; though criteria are so variable that comparison is not really fair.[11-13]

Postoperative Complications

Postoperative complications were uncommon (Table IV). A few postoperative deaths are to be expected in any series of operations on the elderly and in this series seven deaths related to sympathectomy were confined to the arteriosclerotic group. These patients were all over 70 except one aged 57, a hypertensive who suffered a fatal stroke, and another aged 58 who died either of a coronary thrombosis or of a pulmonary embolus. There were two deaths due to wound infection and these were avoidable although each patient was aged 74. Only two cases of intestinal distension were noted, a low figure for this sometimes troublesome postoperative condition. The

four instances of thrombophlebitis in the Buerger's group did not unduly retard the progress of any patient or interfere with a good result later. There were several examples of genito-femoral or other neuralgia but they were of minor and transient nature.

Discussion

A study of the lengths of sympathetic chain and/or the number of ganglia the various surgeons thought they had removed showed that a more detailed description of the operation should be made and would help subsequent research (Table V). There have been many recent articles emphasizing the extreme anatomical variability of the lumbar sympathetic system.[14, 15] Atlas[16] and others have related the various lengths of lumbar chain removed with the physiological effects in foot, leg and thigh and the clinical result. Many of the good immediate and long-lasting results in this follow-up occurred when comparatively short lengths of chain had been removed. Probably this was so because most lesions were distal, and usually it was the mid and caudad lumbar chain that was removed; that is the portion of the lumbar sympathetic chain that controls the vasomotor fibres to the toes, foot and leg. Nevertheless, it is highly desirable to perform as definitive an operation as possible, and more complete removal of the lumbar sympathetic chain seems to be the present trend, though too high resection may shunt blood away from distal parts to the thigh and thus endanger toes or the foot.[17, 18]

Apropos the physiological effect of sympathectomy a word should be said in favour of reverting, sometimes, to spinal anæsthesia if reliable preoperative skin temperature, plethysmographic or other tests are to be obtained. Limb or body warming, nerve block and paravertebral lumbar sympathetic block are often not dependable. However a fall in blood pressure or a psychomotor upset after spinal anæsthesia may also render tests unreliable.[8, 19, 20] Fig. 1 demonstrates the point well. Body or limb heating, paravertebral sympathetic block, drugs, etc., gave an entirely negative and false picture of the true vasodilator capacity (Fig. 1a). Only after spinal anæsthesia did the capacity for dilatation of this patient's vessels become evident (Fig. 1b). Sympathectomy gave an excellent vasodilator response and a spectacularly successful clinical result (Fig. 1c). Of interest also were several excellent examples of paradoxical skin temperature reactions, in which the skin temperature fell in response to sympathetic

TABLE V.—Relation of Length of Lumbar Chain Removed to Result of Sympathectomy

O.R. note re amount of chain taken	*Physiological effect of sympathectomy*			*Clinical result of sympathectomy*		
	No. sympathectomies	*Good*	*Nil*	*Improved*	*Not improved*	*Length chain taken (path.)*
Arteriosclerosis						
One ganglion	3	2	1	3	—	
Two ganglia	4	1	–	2	2	1-5cm.—4
Three ganglia	14	3	2	6	8	5-10cm.—18
Four ganglia	3	–	1	1	2	10-15cm.—9
Crus to pelvis 2 to iliac etc.	15	5	1	7	8	
Bilateral simult.	0					First ganglion said to have been taken in 2 cases.
0 chain	0					
Indefinite	22	5	2	7	15	
Buerger's disease						
One ganglion						
Two ganglia	12	3	1	9	3	1- 5cm.—8
Three ganglia	13	6	1	6	7	5-10cm.—14
Four ganglia	1	1	–	1	—	10-15cm.—0
Crus to pelvis 2 to iliac etc.	21	8	–	11	10	O symp. found—1
Bilateral simult.	8					
0 chain	1	1	–	1	—	
Indefinite	14	4	–	7	7	

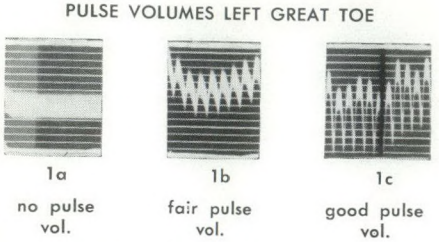

Fig. 1.—Excerpts from plethysmograms showing effect of various vasodilatory methods on blood flow.

block, and in these cases loss of tissue did result after sympathectomy.[12, 21]

Sympathectomy had no adverse effect on male potency in this series. However only two of the sympathectomies included the first lumbar ganglion. Neither of these patients complained of impotence. The question of the adverse effects of removal of the first lumbar ganglia on male potency, ejaculation and sterility still seems unsettled.[22-24] In this series only three patients complained of erectile loss. Sympathectomy was not the cause of impotence in these. No patient could be shown to be sterile or to have ejaculatory disability. On the other hand aged athletes were encountered with amazing stamina or imagination.

Smoking is generally banned in occlusive vascular disease. Smoking frequently elevates blood pressure and pulse rate, and causes peripheral vasoconstriction.[25-29] However Fig. 2 is an example of a vasodilator response to smoking recorded plethysmographically; similar responses have been noted on several occasions during plethysmography. Statistically smoking did not seem a serious hazard in this series (Table VI). Reliable data were hard to get but many patients were seen after sympathectomy for both arteriosclerosis and Buerger's disease who had continued smoking steadily for many years and still showed good results. Of 12 arteriosclerotics suffering from claudication, who continued to smoke, six had a good result, four a fair and two a poor result. Of 15 patients with Buerger's disease suffering from claudication and continuing to smoke eight had a good result, three a fair result and only four a poor result, one losing toes, one a foot and two losing a leg. Possibly some of the cases of Buerger's disease we have all seen, that seemed suddenly to do badly when smoking was recommenced, were about to have a recrudescence of their recurrent type of disease.

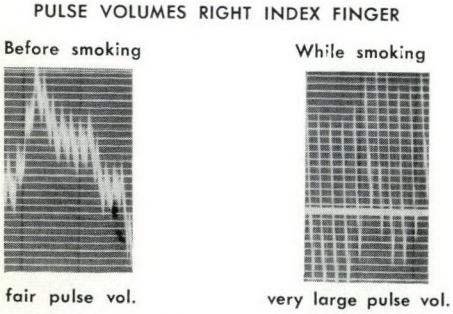

Fig. 2.—Excerpts from plethysmograms showing vasodilation rather than vasoconstriction while smoking.

TABLE VI.—Relation of Smoking to Result of Sympathectomy

Indication for sympathectomy	*No.*	*Good*	*Fair*	*Poor*
Arteriosclerosis				
Claudication				
still smokes	12	6	4	2
stopped smoking	1	1	–	–
Buerger's disease				
Claudication				
still smokes	15	8	3	4
stopped smoking	5	-	3	2

TABLE VII.—Cases of Arterial Thrombosis in Arteriosclerosis

Age	*Nine cases of thrombosis*		
50-60	0	+*	0
60-70	0	0	0
70-80	0	0	0

One case arterial embolism in arteriosclerosis

58 years; aur. fib.; saddle emb.; below-knee amp. 3 and 8 years; later sympathectomy to save stumps but Gritti-Stokes and mid-thigh amp. necessary.

*+ = clinical diagnosis; 0 = path. diagnosis.

Arterial thrombosis was diagnosed clinically only once in the 54 arteriosclerotics in this series (Table VII). Perhaps it should have been found more commonly clinically. Eight of 11 amputated limbs thoroughly examined showed arterial thrombosis. Other authors report it to be the greatest single factor influencing the circulation and viability of the limb.[30-32]

Six patients who refused operation were used as controls and followed up for four to 10 years. One arteriosclerotic died at 65 of a coronary occlusion, but his claudication had been lessening, allowing normal walking. Another who had claudication for a time, then 10 years ago a femoral artery thrombosis now has had no symptoms for six years and has a better circulation in the affected leg clinically and by plethysmography. Another patient has had one definite coronary occlusion and has angina pectoris, but claudication is usually absent. The other two arteriosclerotics show marked improvement, one at 73 doing a full day's heavy labour (Fig. 3). The one patient with suspected Buerger's disease had claudication and a big toe ulcer which healed with simple dressings. This man has been symptom free, working a full day, for five years. But these cases on the whole were milder and were obviously less rapidly progressive than those operated on in our series. They remind one of the ability of the collateral circulation to counterbalance occlusive arterial disease and the natural variations in the course of occlusive arterial disease.

Indeed there seems to be no practical and certain way of telling in a long term follow-up which cases benefited from sympathectomy mainly, and which benefited also from naturally enlarging collateral channels, the ordinary and natural but quite variable response to occlusive arterial disease. This may be so, even though many patients had an immediate favourable response to sympathectomy and retained a warm, dry foot and leg for years afterwards. Atlas,[33] for example, followed up sympathectomies done for occlusive arterial disease using oscillometric readings for a check. He found that over many years increased oscillometric readings corresponded to clinical improvement. But there is no way of proving how much improvement was due to the response to sympathectomy and how much due to natural enlargement of the collateral blood supply.

Plethysmography has proven a very sensitive method of recording changes in the volume of circulation in the digits. It has been most useful in demonstrating the vasodilator response to sympathectomy, the length of time the response remained elevated, and how soon it varied. It was equally useful in demonstrating the vasomotor response to the various drugs used, to body and limb heating, to pain, fear and other psychic and emotional stimuli. As a control, plethysmography is so sensitive that the tests are themselves hard to control because the varying vasomotor reactions of

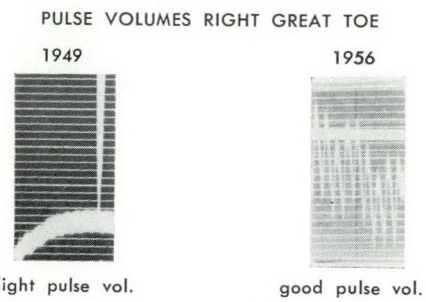

Fig. 3.—Excerpts from plethysmograms showing spontaneous improvement in blood flow 1949-56.

the patient, even under the best regulated conditions, may give a false value to any single test.[34]

Generally sympathectomy can be counted on to increase the blood supply of the skin, thus offsetting necrosis and infection or even allowing healing of open lesions in many cases. Many patients in this series had a warm dry leg 10 to 20 years after sympathectomy. Barcroft and others have shown that sympathectomy may also improve the blood flow to muscle.[35,36] This finding may account for the frequent relief of claudication in this series.

There is a variable but definite tendency for a limb suffering from deficient blood supply and relative anoxia to build up a collateral circulation. In considering the effect of sympathectomy on the vessels of a limb one must balance the extent and progression of the occluding lesions against the natural tendency towards an enlarging collateral circulation. Such collateral vessels may be small and non-pulsatile, but they may be very numerous and carry an adequate blood supply unless trauma, infection, or thrombosis intervene to swing the balance toward necrosis. Sympathectomy allows an increased blood flow by eliminating vasoconstriction, so that large and small vessels not stenosed by organic disease may become fully dilated, arterioles opening

fully to sweep blood through the previously static capillary beds. This mechanism has been demonstrated frequently by plethysmography, nail bed capillary microscopy, and skin temperature tests.[37-40]

Summary

In this series of 124 sympathectomies for occlusive arterial disease of the lower limbs, 62 were done for arteriosclerotic disease. Improvement was shown in half to two-thirds of these when claudication, constant pain or superficial necrosis was the main indication for operation. Impending gangrene was not averted. Of 62 sympathectomies done for Buerger's disease improvement was seen in about half when claudication or constant pain was the main indication for operation; only one-third were improved when superficial necrosis was the indication, while in two cases of impending gangrene complete recovery took place.

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Résumé

Cette étude concerne 124 sympathectomies lombaires; dans 62 cas il s'agissait de troubles des membres inférieurs causés par l'artériosclérose; la claudication, la douleur constante ou la nécrose superficielle étaient les indications opératoires et les résultats furent favorables dans 66% des cas. La gangrène, lorsqu'elle semblait imminente n'a pu être empêchée. Soixante-deux interventions sur le sympathique lombaire furent faites pour maladie de Buerger; il y eut 50% de bons résultats en ce qui concerne la claudication ou la douleur constante; dans un tiers des cas de nécrose superficielle il y eut amélioration; deux cas en instance de gangrène furent sauvés. L'auteur nous avertit que seuls les cas qui semblaient les plus favorables furent soumis à l'intervention; ceux qui présentaient de la gangrène ou des troubles importants de l'état général ne furent pas opérés.

En général, la sympathectomie améliore la circulation cutanée, ce qui permet l'amélioration des lésions de la peau; elle améliore aussi la circulation dans les artères des muscles, ce qui explique le soulagement fréquent de la claudication. Le membre qui souffre d'une irrigation insuffisante a une tendance variable mais nette à établir une circulation collatérale compensatrice. Les vaisseaux collatéraux peuvent être petits et impalpables, mais leur nombre peut permettre une irrigation suffisante à moins que l'infection ou la thrombose ne viennent contrecarrer le processus réparateur. La sympathectomie, en éliminant la vasoconstriction, augmente l'apport sanguin dans les lits capillaires.

L'auteur croit que la pléthysmographie est une technique d'investigation qui donne des renseignements précieux concernant l'irrigation sanguine dans le membre affecté et qu'elle permet une évaluation anticipée des résultats de l'opération.

SYMPATHECTOMY FOR RAYNAUD'S PHENOMENON

A follow-up study of the results of sympathectomy performed at the Mayo Clinic on 70 women with Raynaud's disease and another 54 with secondary Raynaud's phenomenon has recently been published by Gifford and his colleagues (*Circulation*, 17: 5, 1958).

The criteria for diagnosis of *Raynaud's disease* included episodes of bilateral Raynaud's phenomenon caused by cold or emotion; at the most, minimal grades of skin gangrene; absence of other primary causal disease; symptoms for at least two years. Follow-up was by questionnaire, re-examination or both. Most patients were under 40 at operation.

Two-thirds had preoperative trophic changes or sclerodactylia. The 70 with Raynaud's disease had a total of 89 sympathectomies (cervicothoracic ganglionectomy (Adson); resection of thoracic trunk (Smithwick); lumbar sympathectomy) and were followed up for from one to 28 years (mean 12 years).

The effects of sympathectomy on the upper limbs were rated as excellent in seven, good in 30, fair in six, poor in 25 cases. On the lower limbs the effects were excellent in 15, good in two and poor in one. Thus, as in other reported series, results of sympathectomy for Raynaud's disease proved much better and more predictable in the legs than in the arms. There was a high incidence of relapse after sympathectomy of the upper limbs. The data do not permit conclusions about the advantages of postganglionic over preganglionic sympathectomy. The incidence of long term good results of surgical treatment is not much greater than that of conservative treatment, but probably patients with more severe disease were selected for surgery.

Sympathectomy carried out for *Raynaud's phenomenon secondary to other diseases* in women before 1946 gave poor results as regards the arms in 33 out of 46, and as regards the legs in nine out of 18 cases.

The authors conclude that sympathectomy should be reserved for the more severe and progressive Raynaud's disease.

SURGICAL TECHNIQUE

A CONCEPT OF AUTOMATION IN VASCULAR SURGERY: A PRELIMINARY REPORT ON A MECHANICAL INSTRUMENT FOR ARTERIAL ANASTOMOSIS*

I. J. VOGELFANGER, M.D. and W. G. BEATTIE, M.D., *Ottawa, Ont.*

SURGICAL TECHNIQUE since antiquity has been based essentially on manual skill. Even our dynamic century of unprecedented technological progress left almost untouched the mechanically dormant art of surgery.

In the past, there have been occasional attempts to introduce mechanical ideas into surgical practice. Few of these were accepted, possibly because they were too complicated, but probably because they lacked an integrating theme of mechanization. This has tended to create an atmosphere almost predicting oblivion for any automatic instrument.

About two years ago, a program of automation in surgery was begun in association with the National Research Council. Precedence was given to problems in vascular surgery because of current interest.

The publication of the Russian achievement[1] in this field added impetus to this work. The result of two years' work is the instrument described below.

DESCRIPTION OF THE INSTRUMENT

The instrument is a modified stapler, performing an everting interrupted metallic suture (Fig. 1). The instrument consists of two universal handles for grasping interchangeable split bushings, of varying diameters (Fig. 2). One driving bushing carries the fine U-shaped tantalum staples. The other with its moulding surfaces acts as the anvil. The staples are designed to clinch at a predetermined thickness to ensure viability of the vessel walls (Fig. 3).

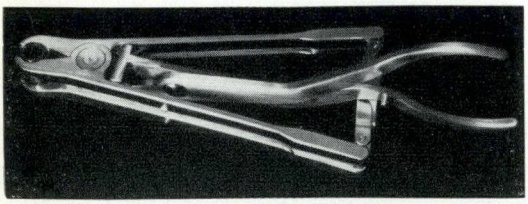

Fig. 1.—Instrument assembled.

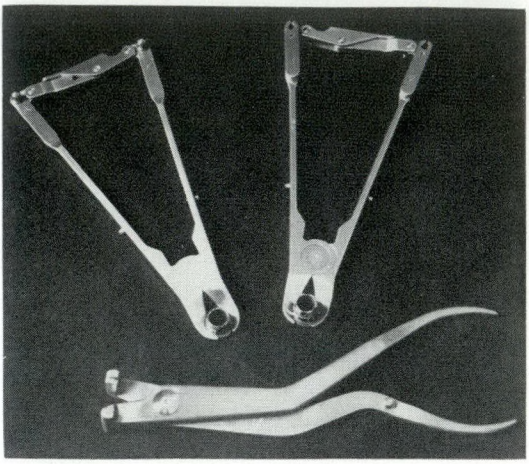

Fig. 2.—Instrument disassembled with 8 mm. bushings in handles.

USE OF THE INSTRUMENT

After exposure, the appropriate bushing is chosen and placed in the handle. The severed host vessel is everted over the anvil bushing (Fig. 4). One end of the graft is everted over the staple-driving bushing. The handles are locked together by spring connectors, which guide the vessel-covered bushings into accurate apposition of intima to intima. At this moment the staples are driven through both walls

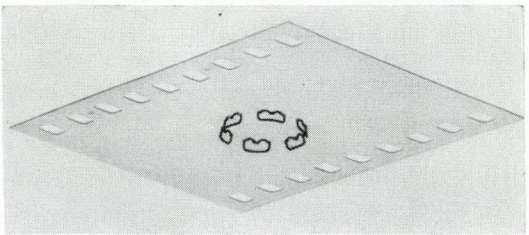

Fig. 3.—Staples clinched on transparent film.

*From the Department of Surgery, Ottawa Civic Hospital, Ottawa; the National Research Council, Department of Mechanical Engineering, Ottawa; and the Animal Diseases Research Institute, Hull, Que.

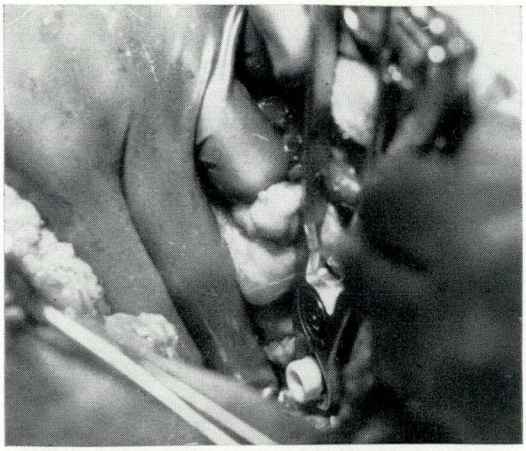

Fig. 4.—Host aorta everted over anvil bushing.

Fig. 5.—Proximal anastomosis completed with bushings in place after removal of handles.

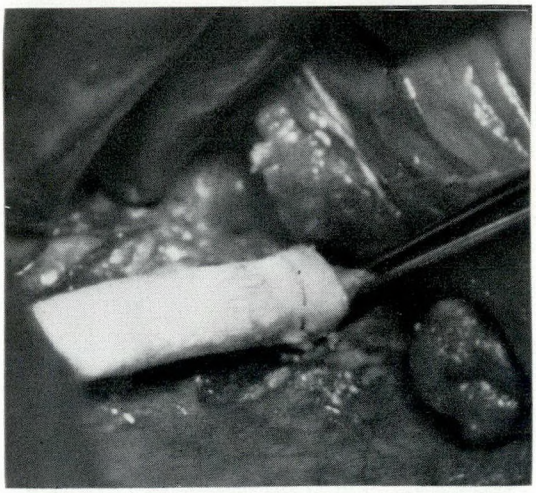

Fig. 6.—Proximal anastomosis completed, bushings removed, staples visible.

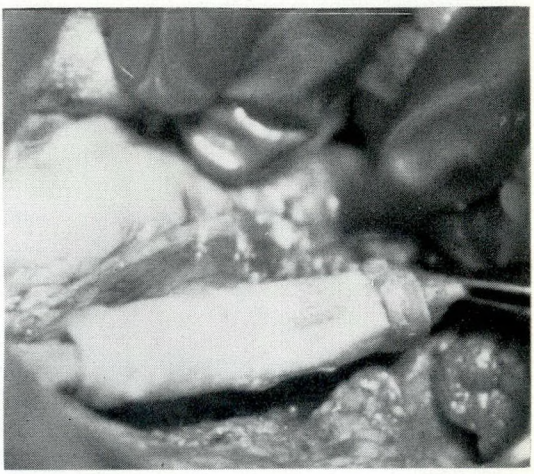

Fig. 7.—Proximal and distal anastomosis completed; no blood flow.

Fig. 8.—Clamps removed. Blood flow re-established. Anastomosis leakproof.

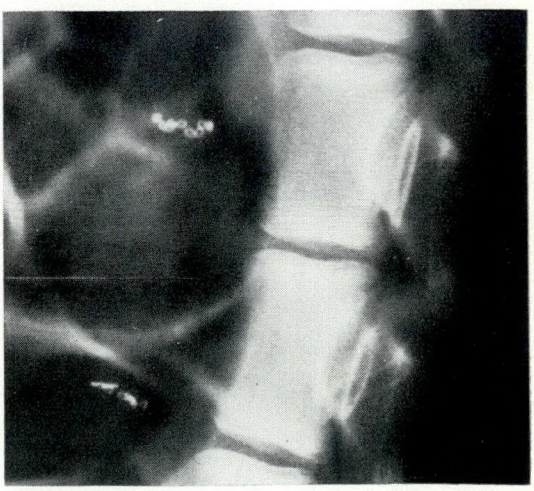

Fig. 9.—Lateral radiograph of pig abdomen (eight weeks postoperative). Graft outlined by staples.

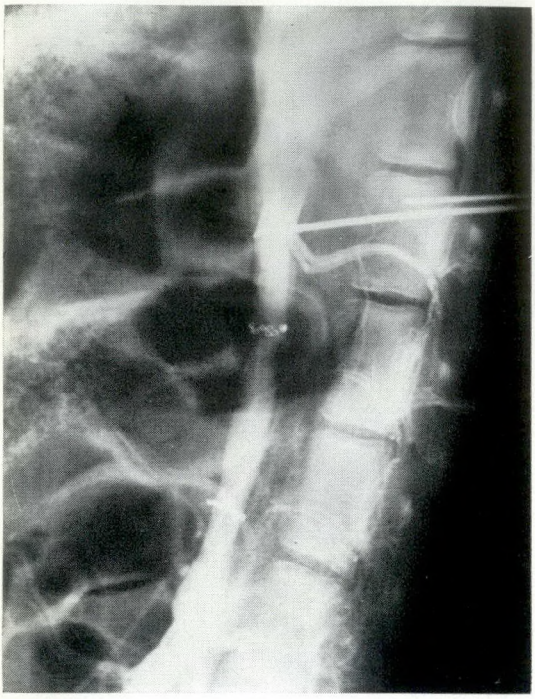

Fig. 10.—Lateral radiograph of pig abdomen (eight weeks postoperative). Aortogram to show graft patency.

and clinched. A special mechanism releases both handles at once, allowing the split bushings to fall away from the completed blood-proof anastomosis.

Animal Experiments

Ten pigs were operated upon with insertion of aortic homografts using the stapling instrument. The time elapsing from exposure of the vessel until re-establishment of blood flow through the graft was on an average between five and 10 minutes. This procedure is illustrated in Figs. 5, 6, 7 and 8. The patency of each graft was established by an aortogram prior to sacrificing the animal (Figs. 9 and 10).

The gross specimens and microphotographs are presented in Figs. 11 and 12.

Discussion

Dependence on manual skill, which is limited, and failure to supplement it by a mechanical device prevents surgery from implementing progressive ideas in medical research. The introduction of the principle of automation into surgical technique can make the difficult easy and the impossible an achievable reality. The instrument described above serves as an initial step in the application of this principle and promises advances in scientific, clinical and defence problems.

Mechanization exceeds the realm of human skill and opens new horizons in physiological research through experimental surgery.

In the unexplored field of small vessel anastomosis, the mechanical device combines the advantages of speed and high precision, with the elimination of the unavoidable trauma associated with prolonged manual effort. This introduces the possibility of transplanting organs by creating new blood supply from distant sources. In operations requiring interruption of blood supply to vital organs, the saving of time accomplished by such an instrument may decrease the necessity for by-pass procedures and hypothermia.

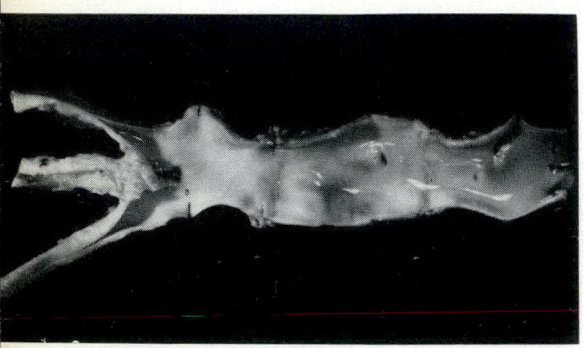

Fig. 11.—Smooth intimal union at both suture lines (six weeks postoperative).

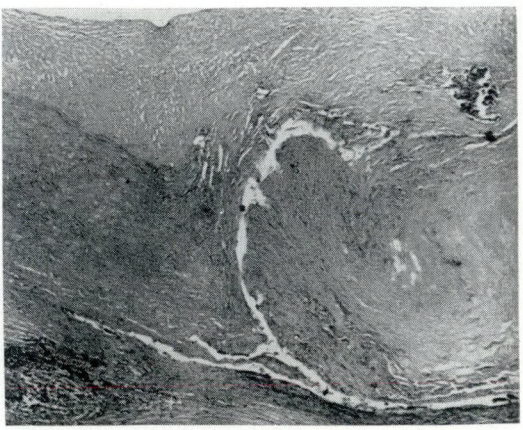

Fig. 12.—Microphotograph (magnification x 20) of anastomosis. Host aorta—to right. Graft—to left.

In days of peace, procedures requiring highly specialized surgical technique may be within the grasp of the average surgeon, while in days of war, when mass casualties present overwhelming demand for specialized skill under pressure of time, automation may answer the problem.

Summary

An instrument for anastomosis of blood vessels is presented; its mechanical principle has been tested successfully on animals. The principle of automation in surgery is illustrated by this preliminary report.

The instrument is described and animal tests are documented. Its potential application is discussed.

Acknowledgments

The authors wish to thank Mr. G. Klein, Mr. A. Smialowski, and Mr. C. Fischer, of the Department of Mechanical Engineering, National Research Council, without whose co-operation this project would not have been accomplished. Thanks are due to Dr. P. J. G. Plummer and his staff of the Animal Diseases Research Institute, including Dr. D. Mitchell, Dr. J. Howell, Mr. D. Heyland and Mr. W. Conroy, for their generosity in time and facilities. The assistance of Dr. D. Cockburn, Dept. of Radiology, Dr. J. Patton, Dept. of Pathology and Mr. M. Smith, Dept. of Photography, Ottawa Civic Hospital, is greatly appreciated. The authors are specially grateful to Dr. Charles Mitchell of the Defence Research Board for his enthusiastic support of the project.

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ATLAS OF EYE SURGERY. R. Townley Paton, Clinical Professor of Ophthalmology, New York University School of Medicine, and Herbert M. Katzin, Manhattan Eye, Ear and Throat Hospital; illustrated by Daisy Stilwell. 248 pp. Illust. McGraw-Hill Company of Canada Ltd., Toronto, 1957. $15.75.

This is a disappointing book by authors whose surgical skills are highly regarded and who have previously made well-written and important contributions to the ophthalmological literature. Its scope is intentionally limited to selected operations for the following eight groups of conditions: cataract, glaucoma, retinal detachment, corneal transplantation, enucleation and evisceration, strabismus, and pterygium; 464 line drawings form the major part of the work, and the accompanying text is purposely brief. The drawings are adequate but in no way superior to illustrations in other texts in clarifying the steps of the various operations.

The chief weakness of the work lies in the sketchiness and inadequacy of the text. Too many essential details are omitted from the description of each operation to make it of major value. One also has the impression that the text was thrown together hurriedly, since the style is poor and grammatical errors recur.

A few examples may be cited to illustrate the book's weaknesses. The section on anæsthesia limits itself to Van Lint akinesia, retrobulbar injection and injection of the superior rectus muscle. A 4 cm. needle is recommended for the retrobulbar block, but the needle gauge, the concentration and amount of procaine, etc., are not mentioned. The recommended site of needle puncture is described no more specifically than "the inferior temporal cul-de-sac", while the accompanying illustration suggests that the puncture is being made at about the midpupillary line. The procedure of peripheral iridectomy in angle-closure glaucoma is not illustrated and is covered in the text by one brief sentence. In the section on loop extraction of the dislocated lens, a faulty technique is suggested, since there is no implication in either the drawing or the text that the initial direction of the loop must usually be upward, so as to clear the superior pole of the lens.

In spite of its weaknesses, most ophthalmologists will be able to find some points of interest, and will enjoy noting the authors' preferred techniques. Resident surgeons, for whom the work is mainly intended, may also derive some benefit from its perusal, but even for the beginner too much has been omitted to make it a truly profitable guide. The authors have attempted a new method of supplementing the teaching of eye surgery, which this reviewer feels is based on faulty principles, since success in eye surgery can be attained only by meticulous attention to many small details. A more complete and carefully written text in a subsequent edition could greatly enhance the value of this atlas.

CASE REPORTS

ADENOMA OF THE COMMON BILE DUCT CAUSING OBSTRUCTIVE JAUNDICE

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EVERY FEW YEARS isolated reports of obstructive jaundice caused by benign tumours of the extrahepatic biliary ducts appear in the medical literature. Comprehensive reviews of the subject have been published by Moore, McElwee and Ramiti[1] and by Chu.[2] It is our intention to present a brief study of the problem and to report a case of adenoma of the common bile duct which was successfully excised.

The usual clinical picture is that of the gradual onset of a relatively persistent and severe obstructive jaundice. There may be mild or moderate associated pain, nausea and vomiting but these findings are by no means constant. Choledocholithiasis or cholelithiasis if present may influence symptoms considerably. Insufficient cases have been reported in the literature to establish any consistent syndrome.

Pathologically a great variety of benign tumours have been described. Epithelial tumours such as adenoma, papilloma or polyp were the most common. Fibroma, lipoma, neuroma, melanoma, myxoma, xanthoma and mixed tumours comprised the remainder. The total number of cases reported by Moore and his colleagues was 52 and the authors remark that there were at least 13 reports of successful removal of benign biliary tract tumours. Chu found 54 reported cases in the literature, of which he considered 29 acceptable; 11 patients underwent successful excision of the tumour.

CASE REPORT

S.D., a 39 year old white Canadian, was admitted to St. Joseph's Hospital, Toronto, on February 28, 1955. The chief complaint was of the sudden onset of painless jaundice on February 21, 1955. This had been preceded for three days by anorexia and a sense of heaviness in the right upper quadrant but no severe pain and no nausea or vomiting. At about this time he also noticed the presence of dark urine and clay-coloured stools. There was never any intolerance of fried or fatty foods, but for six months there had been gradually increasing constipation of a mild variety. There was no history of excessive intake of alcohol, recent injections, blood donations or transfusions.

The patient was well developed and nourished. The liver was questionably palpable but definitely tender. There was deep jaundice but otherwise there were no significant abnormalities on physical examination.

Laboratory investigations revealed the following: van den Bergh test values elevated, both direct and indirect, with a total of 19.1 units; serum alkaline phosphatase markedly elevated—37.7 units; cephalin cholesterol flocculation—negative; thymol turbidity—control 1.1 units, test 2.8 units; serum proteins 7.55 g. % with albumin/globulin ratio 4.1/3.45; urine—bile 4 plus, urobilin negative.

It was thought that he was suffering from an obstructive jaundice most likely caused by a silent biliary calculus.

At operation on March 3, 1955, the gall-bladder was normal. It was thin-walled and contained no calculi. The common and hepatic ducts were dilated but there was no thickening of the walls. There were large, soft, discrete and vascular lymph nodes about the cystic and common bile ducts.

Choledochotomy was performed and a small firm nodule 0.5 cm. in diameter was palpable at the lower end of the common bile duct. However a sound was considered to enter the duodenum and the nodule was thought to represent a lymph node. A T-tube was placed in the common duct and cholangiography carried out with Diodrast on the operating-room table. This showed a persistent obstruction at the lower end of the common bile duct in radiographs taken at two, five and 15 minutes. There was excellent filling of the hepatic radicles, the hepatic ducts, the cystic duct, and the gall-bladder. The common bile duct was partially filled and the dye within it ended abruptly, suggesting that the duct was blocked. No dye was seen within the duodenum. After 15 minutes the hepatic radicles had almost completely drained, and

*From the Department of Surgery and Pathology, St. Joseph's Hospital, Toronto.

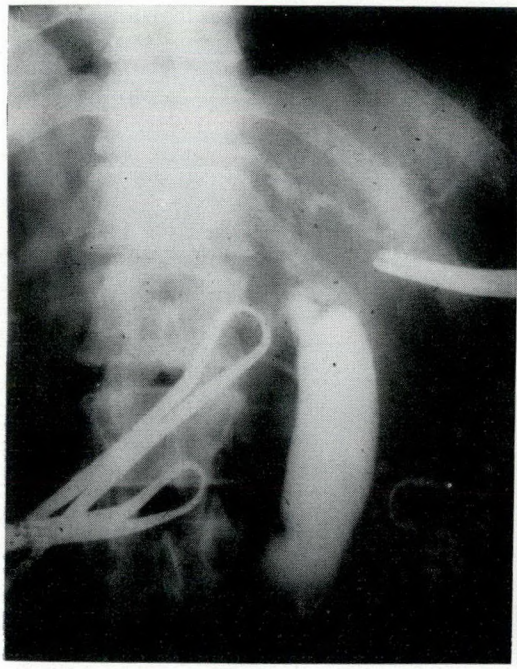

Fig. 1

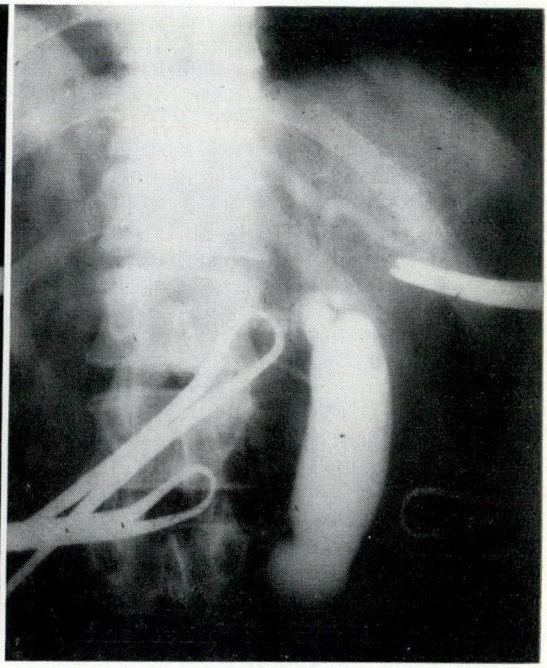

Fig. 2

Fig. 1.—Operative cholangiogram—two minutes. **Fig. 2.**—Operative cholangiogram—15 minutes.

all the opaque material had apparently passed into the gall-bladder, as none was seen in the common bile duct or the duodenum.

For this reason an anterior, longitudinal duodenotomy was performed and a large metallic sound inserted into the common bile duct from above. This caused prolapse of a small, firm, pinkish tumour 0.5 cm. in diameter through the ampulla of Vater. The growth was excised at its base with a scalpel and a long-armed T-tube was inserted into the common bile duct and duodenum. The latter was closed transversely in three layers.

It was considered at operation that the patient was suffering from obstruction of the common bile duct due to an adenoma of its

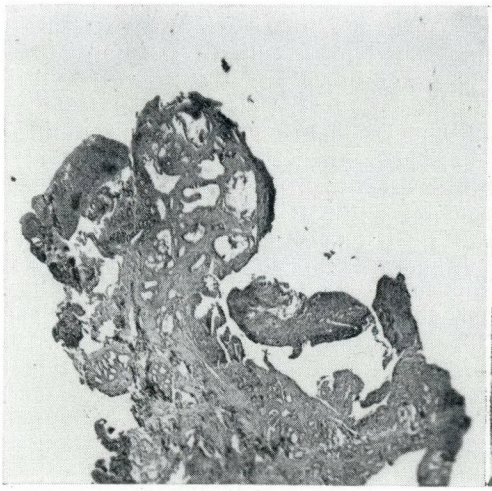

Fig. 3

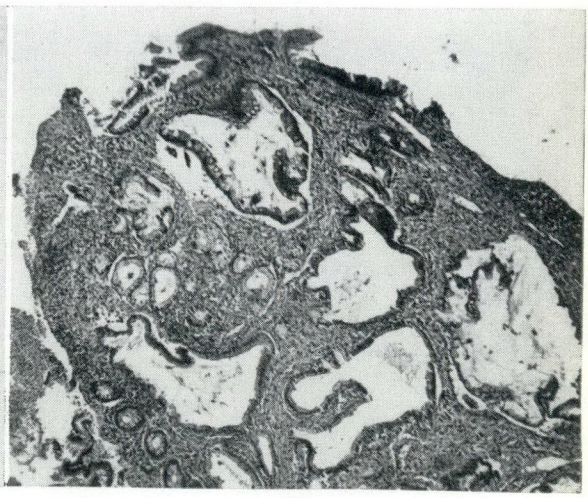

Fig. 4

Fig. 3.—Benign adenoma of common bile duct x 8. **Fig. 4.**—Benign adenoma of common bile duct x 80.

lower end. Pathological sections showed such an adenoma situated in the common bile duct just proximal to the junction of the duct and the duodenum. The adenoma consisted of dilated glands forming cystic spaces. It was covered with a single layer of columnar epithelium and there was no evidence of malignancy. A liver biopsy was taken and showed biliary obstruction with pericholangitis.

The patient made an uneventful recovery with no complications. His urine gradually cleared of bile and his van den Bergh value was 0.1 direct and 0.1 total on May 19, 1955, one month after removal of the T-tube.

It is now three years since the operation was performed, and the patient had no symptoms and no abnormalities on physical examination.

Summary

It does not appear likely that the clinical preoperative diagnosis of obstruction to the common bile duct by benign neoplasm will be made very frequently. However, the survival rate after local excision of these lesions should be satisfactory in view of their benign nature. A case is reported of an adenoma of the common bile duct causing obstructive jaundice. The tumour was successfully excised and there has been no evidence of recurrence on follow-up of three years' duration.

References

1. Moore, S. W., McElwee, R. S. and Romiti, C.: Benign tumors of the biliary tract, *J. A. M. A.*, **150:** 999, 1952.
2. Chu, P. T.: Benign neoplasms of the extrahepatic biliary ducts; review of literature and report of cases of fibroma, *Arch Path.*, **50:** 84, 1950.

Résumé

Les tumeurs bénignes des canaux biliaires extrahépatiques se retrouvent occasionnellement—Moore et coll. en ont rapporté 52 cas; Chu en a trouvé 54 cas dans la littérature. Il s'agit le plus souvent de tumeurs épithéliales telles qu'adénome, papillome ou polype; on a aussi identifié des fibromes, lipomes, neuromes, mélanomes, myxomes, xanthomes et des tumeurs mixtes. Le tableau clinique est le plus souvent celui d'un ictère par obstruction progressif et grave; il n'y a pas en somme de syndrome particulier.

Dans le cas rapporté ici, il s'agit d'un homme de 39 ans, avec ictère progressif indolore sans histoire d'intolérance aux lipides. Le diagnostic d'ictère par obstruction fut fait; des examens de laboratoire ont montré des épreuves de van den Bergh à taux élevé, une phosphatase alcaline à 37.7 unités, un thymol à 2.8 unités; une forte quantité de bile dans les urines, sans urobiline. L'opération révéla une obstruction du cholédoque à son extrémité inférieure—une cholangiographie fut faite durant l'opération et montra l'obstruction à l'extrémité vatérienne du cholédoque. Une duodénotomie permit de réséquer une petite tumeur de 0.5 centimètre, qu'une sonde métallique passée par le haut avait fait hernier à travers l'ampoule de Vater; on laissa un tube en T et la plaie duodénale fut refermée en trois plans. L'examen pathologique révéla un adénome simple sans malignité, la biopsie du foie montra une image d'obstruction biliaire avec péri-cholangite. Les suites post-opératoires furent normales et trois ans après l'intervention, le patient se porte parfaitement bien.

THE HEALING OF WOUNDS. Edited by Martin B. Williamson, Loyola University, Chicago. 202 pp. Illust. McGraw-Hill Company of Canada Limited, Toronto, 1957. $7.35.

This small book is in effect a symposium on the healing of wounds which was held at the Stritch School of Medicine, Loyala University, Chicago. As noted in the preface, the symposium did not cover all the research that had been or was being carried out on the problem of wound healing, but did delineate the more recent significant work and attempt to point the direction for future study.

Several of the contributors to the symposium, and the editor himself, are biochemists, and one feels that this symposium will be of little value, except to the biochemist or the research worker in clinical fields who is primarily interested in the metabolism of wound healing. Some of the chapters are filled with biochemical data, the nature of which would be completely foreign to the average reader of this journal.

However, the chapter on the "Clinical Approaches to the Concepts of Wound Healing" is well written and re-affirms the fundamental principles, particularly in surgical wounds of adequate exposure, meticulous hæmostasis, elimination of dead space, minimizing the tension in a closed wound, etc.

The bibliography which accompanies the papers submitted by the individual contributors is extensive.

CONGENITAL ANOMALIES IN A CENTENARIAN

BURNS PLEWES, M.A., M.D., M.S., F.R.C.S.(Edin. C.), *Toronto*

THE TREATMENT of diseases related to Meckel's diverticulum most often falls in the province of the pædiatric surgeon. In a review of this subject, Wansbrough, Thomson and Leckey[1] point out that intestinal obstruction caused by this congenital anomaly has no definite age incidence at the Hospital for Sick Children, Toronto. Inspired by their article, the following case is reported.

A woman of 101 years was admitted to the Toronto East General Hospital on December 8, 1956, after three days of abdominal pain and vomiting. Though deaf, she was lively and co-operative. The pain was not constant; she was somewhat dehydrated, but thin with wrinkled shiny skin. The abdomen was scaphoid except for a rounded prominence in the midline below the umbilicus, over which there was a wide vertical scar from an operation for a pelvic tumour many years previously. Apparently there had been an incisional hernia for many years. Loops of small bowel could be easily felt beneath the skin and, while most of the mass could be returned to the abdomen, the hernia was never completely reduced and returned as soon as pressure was removed. No tenderness or other hernia could be demonstrated. Bowel sounds were increased. Vomiting was occasional and consisted of dark brown fæcal-appearing fluid. Roentgen examination showed mildly dilated loops of small bowel. Laboratory examinations showed hæmoglobin value 13.6 g. per 100 ml., non-protein nitrogen (NPN) 85 mg. %, serum chloride 316 mg. %, sodium 129 mEq./l., potassium 4.4 mEq./l.

A Levine tube was passed into the stomach, removing a quantity of brown foul fluid, and shortly afterward the patient passed gas by rectum. Intravenous fluids were administered. Enemas gave poor results.

The following day she appeared to be no better, and surgical intervention for acute small bowel obstruction, thought to be due to incarceration in an incisional hernia, was decided upon.

At operation via an incision through the old scar over the hernia there was no evidence of strangulation of the bowel in the wide-mouthed hernial sac, though some loops were adherent to the wall. The site of the obstruction was a kink of the lower ileum due to the pull of a Meckel's diverticulum, the tip of which was adherent to omentum which plugged the sac of a right indirect inguinal hernia. On releasing the diverticulum from the incarcerated omentum, the kinking was released. Distended proximal ileum contracted. Collapsed intestine distally became filled. Active peristaltic waves were seen passing over the whole area. The base of the diverticulum was wide, as was the lumen of the intestine. No further procedure was carried out, except that the incisional hernia was repaired in closing the abdomen.

The patient got out of bed the next day and convalescence was rapid. When she went home on December 22, 1956, laboratory tests showed Hb. 11.0 g. %, NPN 28 mg. %, serum chloride 460 mg. %, sodium 135 mEq./l., potassium 4.7 mEq./l.

Nine months after this episode, the patient, a widow, remains well and is keeping house for her 80 year old daughter who goes out to work.

If complications of Meckel's diverticulum are going to occur, symptoms usually appear in the first two years of life. Symptoms of indirect inguinal hernia are often longer delayed. In this case it took both congenital anomalies a hundred years to cause symptoms.

REFERENCE

1. WANSBROUGH, R. M., THOMSON, S. AND LECKEY, R. G.: Meckel's diverticulum: a 42-year review of 273 cases at the Hospital for Sick Children, Toronto, *Canad. J. Surg.*, **1**: 15, 1957.

Medical Arts Bldg.,
170 St. George St.,
Toronto 5.

RÉSUMÉ

L'auteur rapporte le cas d'une femme de 101 ans qui s'est présentée à l'Hôpital général de l'est, Toronto, souffrant depuis trois jours de douleurs abdominales intermittentes accompagnées de vomissements fécaloïdes. A part une légère déshydratation, l'état général semblait par ailleurs satisfaisant. L'abdomen était scaphoïde à l'exception d'une voussure sous-ombilicale où il existait une éventration partiellement irréductible produite à la suite d'une opération remontant à plusieurs années, pour une tumeur pelvienne. Il y avait de l'hyperpéristaltisme; une plaque simple montra une distension modérée d'anses grêles.

Le lendemain de l'admission, avec un diagnostic pré-opératoire d'obstruction du grêle par hernie post-opératoire incarcérée, l'abdomen fut exploré par cette voie. On ne trouva que quelques anses adhérentes à un sac sans collet. L'obstruction était causée par un coude idéal résultant de la trac-

tion par un diverticule de Meckel dont l'extrémité était adhérente à de l'épiploon qui obturait le sac d'une hernie inguinale indirecte droite. La libération du diverticule leva l'obstruction. L'abdomen fut refermé sans plus, tout en réparant la vieille éventration. La malade, qui est veuve, se porte bien après neuf mois et tient maison pour sa fille de 80 ans, qui travaille en dehors.

BOOK REVIEWS

See also pages 247, 265 and 268

THE CENTURY OF THE SURGEON. Jürgen Thorwald. 432 pp. Illust. Pantheon Books Inc., New York; McClelland & Stewart Limited, Toronto, 1957. $6.50.

This is a book about both the highways and the byways of surgery written in an unusually interesting way, the developments in the last hundred years being described as though they had all been witnessed or inquired into by the biographer, Dr. Hartmann. This has had the effect, so to speak, of bringing the reader almost into the operating-rooms of Billroth, Warren, Syme, Liston, and Lord Lister. The appalling conditions of the hospital at Scutari are vividly described and the immense influence which Miss Nightingale wielded both in the Army and among the important personalities in England and is made clear.

Not only is this a book which should be read by all medical students, but it is one which should bring home to the general public how extraordinarily fortunate they are to live in an era in which asepsis and antiseptics, antibiotics and anæsthesia, to say nothing of many other advances, have removed the fear of surgery and the appalling consequences of disease.

This book is thoroughly recommended for its accuracy and for its great interest.

THE FOREQUARTER AMPUTATION. H. F. Moseley, Hunterian Professor, Royal College of Surgeons of England; Assistant Professor of Surgery, McGill University, Montreal. 79 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1957. $7.15.

This 80-page monograph is most useful for the clear and detailed description of the anatomical relationships of structures encountered in the procedure. The illustrations by Miss Helen MacArthur are mostly in colour and are of excellent quality. In the chapter on anatomical considerations, the third plane is impressed on the reader by beginning with the deepest structures and adding the more superficial in succeeding drawings. In the description of the operative procedure, the successive drawings reverse this order and show the steps of the operation clearly and accurately.

There are separate and complete descriptions of the operation performed by beginning anteriorly, and by starting posteriorly. As well there is a good description of scapulectomy and another of excision of scapula, clavicle and head of humerus.

The first chapter, on historical aspects, is brief but full of interest, as is that giving summaries of published cases in which the operation was performed because of trauma. These latter, 68 in number, are in chronological order from 1737 to 1956.

The paper, printing and construction of the book are of high grade.

As forequarter amputation will undoubtedly continue to be necessary occasionally, this book will be a helpful addition to the hospital library.

GENERAL UROLOGY. Donald R. Smith, Clinical Professor of Urology and Chairman of the Department of Urology, University of California School of Medicine, San Francisco. 328 pp. Illust. Lange Medical Publications, Los Altos, California, 1957. $4.50.

This is an up-to-date review in which the subject matter is well organized and the fundamentals of urology are presented in a manner easy to read and understand. Many of the recent advances scattered widely in medical literature are brought together and the various phases of urologic disease briefly outlined. The book is abundantly illustrated with well selected radiographs and excellent drawings.

Each chapter is concerned with the essentials of one aspect of the subject. That on "Symptoms of disorders of the genito-urinary tract" contains a fund of information which should be very useful to the medical student. The short review of urinalysis included under "Urologic laboratory examination" is a refreshing exposé of certain fallacies, and describes the examination as it should be carried out. "Roentgenographic examination of the urinary tract" clearly outlines the routine procedures and in addition refers to those more recently introduced. The inclusion under "Non-specific infections of the urinary tract" of acute necrotizing papillitis—a much omitted but very im-

portant clinical entity—and a review of chemotherapeutic and antibiotic treatment of the urinary tract, serves to indicate how brevity may be combined with thoroughness. "The neurogenic bladder" is particularly well described; a subject very confusing to the average reader is simplified by methodical arrangement of material and proper illustration. The sequence of events following injury to the spinal cord is clearly described and the subject of cystometry taken up in some detail. Chapters on "Intersexuality", "Renal hypertension", "Infertility" and "Psychosomatic urologic syndromes", while very brief, contain information which should stimulate further study.

On the debit side, it is felt that an obvious omission from an otherwise satisfactory outline of urology is a chapter dealing with diseases of the adrenal gland.

Because of its brevity and clarity this book should be a useful guide to the medical student, surgical resident and general practitioner.

LES HYDROCEPHALIES DU NOURRISSON (Hydrocephalus of the Newborn Infant). C. Pheline and N. Boineau, Medical Infants' Clinic, University of Algiers. 98 pp. Illust. Expansion Scientifique Française, Paris, 1957. Fr. 950.

Ce texte forme la sommation des cours consacrés à l'hydrocéphalie en vue de la préparation au Certificat d'Etudes Spéciales de Pédiatrie et Puériculture de l'école de médecine de l'université d'Alger. Les auteurs commencent d'abord par poser le problème et après une revue des définitions de l'hydrocéphalie proposées par plusieurs autorités en la matière, s'arrêtent sur celle de Matson qui veut que l'hydrocéphalie soit "toute condition pathologique caractérisée par *l'augmentation de taille des ventricules* et, accessoirement, des espaces sous-arachnoïdiens en rapport avec une *hyperpression du L.C.R. actuelle ou ancienne.*" Différents rappels suivent: anatomique, clinique, physiologique et physiopathologique. La clarté de ces exposés mérite d'être signalée. Le corps du sujet comprend une étude clinique, biologique et radiologique. On y commente les signes attirant l'attention et ceux à rechercher. Les examens complémentaires à pratiquer sont énumérés. L'exploration radiologique, y compris la pneumographie cérébrale, est illustrée de plusieurs schémas.

Le diagnostic différentiel comprend la grosse tête congénitale, les grosses têtes des enfants en avance pondéro-staturale, la grosse tête de certaines ostéopathies et l'hématome sous-dural. Les auteurs insistent sur l'importance du diagnostic topographique puisque les interventions thérapeutiques dépendent de la localisation du niveau du blocage. Non moins important est le diagnostic étiologique car il détermine l'étendue de l'acte chirurgical. En dehors des malformations congénitales causant une anomalie du système nerveux, des malfaçons méningées ou osseuses, des traumatismes, des inflammations et des tumeurs, "il faut cependant savoir que, dans certains cas, même à l'autopsie, on ne trouve aucune raison anatomique suffisante pour expliquer l'hydrocéphalie".

La section consacrée au traitement s'ouvre sur les indications opératoires. Si le processus n'est pas trop avancé, et qu'il ne montre pas de signe de s'être stabilisé, "il faut intervenir sans retard, sans demi-mesures, si l'état de l'enfant permet d'espérer qu'il sera récupérable socialement." Suivent les différents procédés avec leurs dérivations ingénieuses et leurs abords variés. Sans s'illusionner, les auteurs admettent qu' "il n'y a pas de chapitre de neuro-chirurgie plus passionnant. Hélas, il est rare aussi de trouver voie plus riche en déboires et en désillusions." La conclusion pratique de cet exposé enseigne que "le diagnostic précoce, voire le dépistage au cours des affections neuro-méningées du jeune enfant" revêt autant d'importance dans le traitement de l'hydrocéphalie que le choix judicieux de l'intervention.

THE PROXIMAL END OF THE FEMUR: Investigations with Special Reference to the Etiology of Femoral Neck Fractures. Anatomical studies; Roentgen projections; Theoretical stress calculations; Experimental production of fractures. (**Acta Radiologica** Suppl. 146) Stig Backman, Department of Diagnostic Roentgenology, Karolinska Sjukhuset, Stockholm. Translated by Stanley H. Vernon. 166 pp. Illust. Acta Radiologica, Stockholm, 1957. Sw.Kr. 35.00.

The custom of preparing theses for the degree M.D. leads to painstakingly detailed monographs on isolated medical topics. This volume is no exception. The author has studied the strength of the femoral head and neck by mechanical and mathematical studies which are quite beyond the capacity of the reviewer to assess. About the only practical conclusion that can be drawn from all this is that there is a theoretical advantage in placing internal fixation for femoral neck fractures almost vertically—i.e., along a line joining the centre of the femoral head and the inferior cortex of the neck.

AN INTRODUCTION TO CHEST SURGERY. Geoffrey Flavell, Thoracic Surgeon, The London Hospital, England. 354 pp. Illust. Oxford University Press, London and Toronto, 1957. $4.50

In his introduction to this book the author claims that he has attempted to right two wrongs he always found in medical books. The first is that they cost too much, and the second is that they are too difficult to read. The reviewer believes that he has accomplished this purpose. He has produced a book which is small and compact, is quite obvi-

(Continued on page 274)

CANADIAN JOURNAL OF SURGERY

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BOOK REVIEWS

(Continued from page 271)

ously directed towards reading by medical students, but is also quite complete in its coverage of thoracic surgery.

The author has divided the subject into surgery of the lungs, pleura and thoracic confines; surgery of the œsophagus; and surgery of the heart and great vessels. The first part is of course much longer than the other two, and he covers the subject very satisfactorily. The language is simple, the illustrations are adequate, and the author remains a traditionalist in all his remarks on diagnosis and treatment. The second and third parts are adequate, but of course, he makes no serious attempt to cover the vast amount of modern work done in surgery of the heart.

This book can be recommended very highly to medical students and general practitioners who want to refresh their memory on fundamentals of chest surgery.

BIOCHEMICAL DISORDERS IN HUMAN DISEASE. Edited by R. H. S. Thompson, Professor of Chemical Pathology, University of London (Guy's Hospital Medical School), and E. J. King, Professor of Chemical Pathology, University of London (Postgraduate Medical School), England. 843 pp. Illust. Academic Press Inc., New York; J. & A. Churchill Ltd., London, 1957. $12.60.

Rapid developments have taken place in recent years in the application of the theory and methods of biochemistry to disease. There is now a wide range of diseases in which deviations from normal of the electrolyte balance of the body cells or intercellular fluids or abnormalities of enzyme action, congenital or acquired, have been demonstrated. Relatively few diseases could until recently be interpreted in terms of a disorder of known biochemical reactions. The authors of this book have assembled, related and interpreted the known facts concerning the biochemical disorders that underlie or are associated with human disease. This not only contributes to a better understanding of pathogenesis, but is also of practical importance in the diagnosis of disease and in treatment of medical and surgical patients.

The twenty chapters of the book review the various diseases of given organ-systems and were written by experts in their respective fields. The editors have very ably fused the variety of styles and writing of the various authors into a readable and authoritative account of the important aspects of the scientific background of present-day medicine. As certain diseases lend themselves more readily than others to analysis in terms of biochemical entities, this volume necessarily treats some diseases more fully than it does others. In reading the book, the interdependency of the fields of biochemistry and of medicine becomes increasingly apparent. Biochemists and physicians alike will find much of interest and of use in this book.

SURGERY OF HEAD AND NECK TUMORS. Hayes Martin, Attending Surgeon, Memorial Hospital, and Associate Professor of Clinical Surgery, Cornell University Medical College, New York. 430 pp. Illust. Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, 1957. $18.50.

For those who have a reasonably advanced knowledge of the surgery of the head and neck, this book has much to offer, as one author's opinion of the management of the controversial subject of tumours in this region. One can read it with pleasure. One can criticize many portions with facility. One can admire the author's philosophy of the management of malignancy. One cannot help but realize that this is another book on "cancer", rather than on "tumours", into which has crept inevitable personal prejudice as the opponent to objective teaching.

What does it contain? What does it lack?

It contains a surgical approach, only, to tumours of the head and neck with emphasis on techniques. It lacks the comprehensive discussion of forms of treatment other than operative; particularly is this noted in its malignancy content. It contains, in its entirety, a multitude of fine pen sketches, the advantage of which is to accentuate the points of technique. It lacks the photographs which might more truly reveal an end result; for artists cannot bring themselves to depict all bits of final morbidity in many plastic manœuvres. It contains a comprehensive application of the principles of surgical care, including preoperative and postoperative care. It lacks the detailed individuality of application for specific tumours, which is inevitable in a book in which tumours are not so much as classified. But above all, if you are interested in the surgery of the head and neck to any practical degree—read it!

SHOCK AND CIRCULATORY HOMEOSTASIS. Transactions of the Fifth Conference, November 30-December 2, 1955. Edited by Harold D. Green, Bowman Gray School of Medicine, Wake Forest College, Winston-Salem, N.C. 337 pp. Illust. The Josiah Macy, Jr. Foundation, New York, 1957. $4.75.

This monograph is the fifth in a series of Josiah Macy Foundation publications in the field of shock and circulatory homœostasis. It follows the informal question and answer format which is interesting but often confusing to the reader. Although this method of communication conveys to one an air of being present at the discussions, it tends also to leave the reader at a loss to decide what the exact conclusions of the discussants are. This could easily be remedied by including a summary of the presentation and the conclusions of the discussants at the end of each section. It is unfortunate, too, that there has been such a lapse of time between the conference and the publication. The monograph, however, contains a

wealth of information on the subject of shock and its consequences for those who want to delve for it. The book can be recommended to workers in the field, but will probably not be read by the busy clinician and is of little value to the undergraduate student.

SURGERY IN WORLD WAR II. GENERAL SURGERY, VOL. II. Edited by Colonel John Boyd Coates Jr. 417 pp. Illust. Office of the Surgeon General, Department of the Army, Washington, D.C., 1956.

Too often in the past, official government documentation of medical experiences in wartime has consisted essentially of the collections of huge masses of statistics, difficult to read and even harder to comprehend. This volume, published as part of a series by the Medical Department of the United States Army, definitely escapes from the pattern noted above, and is a real contribution to the surgical literature.

It is chiefly based on a total of 3154 abdominal injuries, all the result of the violence of war. That the analysis could be of such high quality is in large part due to the fact that, despite the pressures of the emergency situation, it was planned in advance.

The book is the combined work of a collection of experts, most of whom were already widely experienced authorities in practice. It is divided into three parts. Part I deals with resuscitation, control of pain and anæsthesia, Part II with abdominal injuries and the initial surgery of abdominal wounds. Part III is devoted entirely to the subject of colostomy. This procedure was widely employed in World War II and was responsible for saving many lives. It illustrates particularly well the efforts to evaluate the practices that were being used —in order to determine most accurately and quickly which methods were meeting the most success in the situations that were being encountered.

The writing is clear and interesting—and surprisingly easy to read. The evaluations of subjects such as antibacterial therapy and wound dehiscences which are of everyday interest in surgical practice, are particularly good. The results and the lessons of a tremendous mass of material are concisely presented in a few short chapters.

Every physician should find this book interesting. Few abdominal surgeons should overlook the opportunity to learn from it.

(Continued overleaf)

CONGENITAL ANOMALIES OF THE VISCERA: Their Embryological Basis. J. L. Bremer, Harvard University. 202 pp. Illust. Harvard University Press, Cambridge, Mass.; S. J. Reginald Saunders and Company Limited, Toronto, 1957. $5.50.

Professor Bremer gives a clear and concise description of the congenital anomalies of the viscera, discussing the etiological factors involved in their production. The book represents the results of 50 years of embryological research and bridges the gap between the basic embryological course given for medical students and the needs of the young doctor wishing to specialize.

The chapters devoted to the heart and great vessels, covering nearly one-third of the text, contain much of Professor Bremer's original work and should be especially noted by those working in the field of cardiovascular surgery.

This book will be especially valuable to those proceeding to certification or fellowship in surgery who will find the simplified line drawings and illustrations easy to follow.

THE STORY OF THE PEPTIC ULCER. Conceived by Richard D. Tonkin, Westminster Hospital, London, England; characterised by Raymond Keith Hellier, F.R.S.A. 71 pp. Illust. W. B. Saunders Company, Philadelphia and London, 1957.

"Dawn for depressed and disappointed dyspeptics" dedicated to "All the little villain's victims with confident hope."

This is what the doctor ordered. That sound explanation and advice could be charmingly and easily stated in a little book for the ulcer victim might be imagined. But that, in addition, hilariously apt cartoons can be made to illustrate it!

This prescription for duodenal ulcer patients is likely to lead to a slump in the antacid market. Doctors have, traditionally, done their best to decrease their practices, so it would not be surprising if they recommended this charming publication to their patients. Before doing so, they should think of what is to become of the poor gastrectomist.

But there is a ray of hope left for the starving surgeon. It is also traditional that patients disregard the advice of their physicians. Some may not go right out and buy "The Story of the Peptic Ulcer".

The author is a F.R.C.P., the cartoonist is a F.R.S.A., and the recipient is lucky.

PIONEER SURGEONS OF THE WOMAN'S HOSPITAL. James Pratt Marr. 148 pp. Illust. F. A. Davis Company, Philadelphia, Pa.; The Ryerson Press, Toronto, 1957. $6.00.

The Woman's Hospital in New York City is just over one hundred years old, and Dr. Marr tells the story of its early years in terms of the lives of the first four members of the surgical staff. The earliest to appear on the scene is the great American gynæcologist, James Marion Sims, who was the main driving force behind the foundation of the hospital. The other three members of the staff whose biographies appear here are Thomas Addis Emmet, Edmund R. Peaslee and Theodore Gaillard Thomas. Dr. Marr notes their different backgrounds. Sims was the son of an uneducated tavern keeper, while Emmet grew up in an atmosphere of poverty but culture; Peaslee lost his father at the age of seven and was therefore brought up in straitened circumstances, while Thomas was the son of a scholarly clergyman. It is curious to note that Sims even during the first ten years after his entry into the medical profession regarded his calling as only a means of livelihood and had no sense of vocation, while Peaslee was early fired with the ambition to be a doctor. Despite this difference, they both became men dedicated to the practice of their specialty.

In sketching the lives of these four great men, Dr. Marr contributes a brief survey of the formative years of American gynæcology. His book will therefore be of particular interest to students of the history of that specialty.

SURGICAL PATHOLOGY. Henry A. Teloh, Assistant Professor of Pathology, Northwestern University Medical School, Chicago, Ill. 127 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1957. $5.25.

This is a handbook of procedures in surgical pathology for residents and interns assigned to the cutting board and unfamiliar with the disciplines of this special branch of morbid anatomy. The introductory chapters set down general principles and methods and include the submission of specimens from the operating-room, frozen section, records, the culture of tissue specimens for bacteria and fungi and the significance of the adequate pathological examination. There follow a number of short chapters which detail the steps to be followed in delineating and describing the lesions likely to be encountered in each type of specimen. Appended are examples to illustrate the prerequisites of surgical pathology reports. Thus, the author has undertaken to provide a guide to the thorough examination of the surgical specimen and the improvement of pathology reports.

The extent to which this intention has been realized will be a matter of opinion among pathologists. The methods advocated certainly ensure accurate and comprehensive reports, but the text offers few hints on lucid description. The author has probably been wise in avoiding some subjects which approach the controversial side of resident training, but on the other hand, little instructional information has been provided on the use of diagrams or the preparation of specimens for photography. The omission of a bibliography of the im-

portant contributions to the study of surgical specimens is a distinct shortcoming. Residents should be stimulated to read these, and thereby persuade themselves of the merits of the procedures, lest they become prone to develop shortcuts which jeopardize the validity of their examination of tissues. Nevertheless, this book should fulfil its purposes.

On the whole, the procedures described are essentially sound and conform to accepted practice and, if the book effectively encourages the resident to carry out faithfully the dissection it prescribes, the patients will be the ultimate beneficiaries. Because of its particular value as an aid to initiating residents in the methodology of surgical pathology, this book will probably find its way into a great many laboratories. At the same time, the question remains whether it will gain acceptance by pathologists as an authoritative text on the subject.

HALSTED OF JOHNS HOPKINS: The Man and His Men. Samuel James Crowe, Professor Emeritus of Laryngology and Otology, The Johns Hopkins University, Baltimore, Md. 247 pp. Illust. Charles C Thomas, Springfield, Ill.; The Ryerson Press, Toronto, 1957. $5.50.

Johns Hopkins University, marking as it does a decisive point in the development of American medicine, has the same fascination for American medical historians as that other decisive point, the Civil War, has for their lay historians. The present book deals with the founder of Johns Hopkins surgery, Halsted, and some of the men he inspired.

Halsted was a man of great courage and resource. As a young man he saved his sister's life by transfusing her directly with his blood (the first successful transfusion in the U.S.A.), and soon afterwards saved his mother's life by removing her gallstones during an episode of cholecystitis (his first gallbladder operation). But even more remarkable was his completely successful battle against cocaine addiction, contracted in the cause of science, for Halsted was a pioneer in local anæsthesia. His many contributions to surgery are recounted in this book by Dr. Crowe, who was one of his keenest disciples and who died of a coronary thrombosis just after completing the work.

Crowe owed his dedication to medicine to a chance encounter with Halsted, when Crowe's horse went lame near the Halsted farm; Halsted even persuaded him to change his specialty from neurosurgery to otolaryngology, in which he subsequently rose to fame. Among the other biographical sketches in the book are those of Cushing and Dandy the neurosurgeons, and Young, the father of American urology. The book is a definite and firsthand contribution to Johns Hopkins lore, and therefore to American medical history.

Books Received

Books are acknowledged as received, but in some cases reviews will also be made in later issues.

No and Yes: On the Genesis of Human Communication. René A. Spitz, Denver, Colorado. 170 pp. International Universities Press, Inc., New York, 1957. $4.00.

Shock and Circulatory Homeostasis. Transactions of the Fifth Conference, November 30-December 2, 1955. Edited by Harold D. Green, Bowman Gray School of Medicine, Wake Forest College, Winston-Salem, N.C. 337 pp. Illust. The Josiah Macy, Jr. Foundation, New York, 1957. $4.75. (Reviewed in this issue.)

Chirurgie der Leber: Klinik und Technik (Surgery of the Liver: Clinical Features and Techniques). M. Reifferscheid, Bonn. 168 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1957. DM 36.

Nierenkrankheiten: Physiologie, Pathophysiologie, Klinik und Therapie (Diseases of the Kidneys: Physiology, Pathology, Clinical Features and Therapy). H. Sarre, Freiburg. 540 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1957. $14.05.

Lehrbuch der Kinderchirurgie (Textbook of Pædiatric Surgery). M. Grob, Zurich. 775 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1957. DM 157.

Chirurgische Indikationen (Indications for Surgical Intervention). 60 authors. 299 pp. Illust. Georg Thieme Verlag, Stuttgart, W. Germany; Intercontinental Medical Book Corporation, New York, 1957. DM 42.

Les Kystes Epidermoides Cranio-Encéphaliques (Intracranial Epidermoid Cysts). J. Lepoire and B. Pertuiset. 106 pp. Illust. Masson et Cie, Paris, 1957. Fr. fr. 1,400.

Traitement chirurgical des anevrysmes intracraniens du systeme carotidien (Surgical Treatment of Intracranial Aneurysms of the Carotid System). G. Allegre and R. Vigouroux. 122 pp. Illust. Masson et Cie, Paris, 1957. Fr. fr. 1,400.

Aortography: Its Application in Urological and Some Other Conditions. W. Barr Stirling, Senior Assistant, Urological Department, Glasgow Royal Infirmary, Scotland. 292 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada Limited, Toronto, 1957. $8.50.

Tumor Surgery of the Head and Neck. Robert S. Pollack, Clinical Instructor in Surgery, Stanford University School of Medicine, San Francisco, California. 101 pp. Illust. Lea & Febiger, Philadelphia; The Macmillan Company of Canada Limited, Toronto, 1957. $5.00.

The Forequarter Amputation. H. F. Moseley, Hunterian Professor, Royal College of Surgeons of England; Assistant Professor of Surgery, McGill University, Montreal. 79 pp. Illust. E. & S. Livingstone Ltd., Edinburgh and London; The Macmillan Company of Canada, 1957. $7.15. Macmillan Company of Canada Limited, Toronto, 1957. $7.15. (Reviewed in this issue.)

An Introduction to Chest Surgery. Geoffrey Flavell, Thoracic Surgeon, The London Hospital, England. 354 pp. Illust. Oxford University Press, London and Toronto, 1957, $4.50. (Reviewed in this issue.)

Anæsthesia. British Medical Bulletin Volume 14, No. 1, January 1958. 72 pp. Illust. The Medical Department, The British Council, London, 1958. $3.25.

Tumors of the Soft Somatic Tissues. George T. Pack, Attending Surgeon, Memorial Center for Cancer and Allied Diseases, New York; Irving M. Ariel, Associate Clinical Professor of Surgery, New York Medical College; and others. 820 pp. Illust. Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, 1958. $30.00.

Traitement chirurgical de la recto-colite ulcéro-hémorragique (Surgical Treatment of Ulcerative Colitis). E. Delannoy and M. Martinot, University of Lille, France. 120 pp. Illust. Masson et Cie, Paris, 1957. 1,400 Fr fr.

Duodenum et pancreas. Actualités Hépato-gastro-entérologiques de l'Hôtel-Dieu, 1956 (Duodenum and Pancreas. Hepato-Gastroenterological Conference of the Hotel-Dieu, 1956). Edited by Guy Albot, Hôtel-Dieu, Paris, and F. Poilleau, Corentin-Celton Hospital. 296 pp. Illust. Masson et Cie, Paris, 1957. 3,500 Fr. fr.

Technique chirurgicale infantile (Pædiatric Surgical Technique). Bernard Duhamel, with the collaboration of Simone Segaux. 354 pp. Illust. Masson et Cie, Paris, 1957. Fr. fr. 3,500.

Pathologie et Chirurgie des Carotides (Carotid Pathology and Surgery). Georges Arnulf. 544 pp. Illust. Masson et Cie, Paris, 1957. Fr. fr. 6,800.

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