Family medicine offers challenges, flexibility, and tremendous diversity. Family physicians provide comprehensive care for patients and their families within the community, with a focus on prevention, management of chronic disease, and coordination of care. Family physicians have the opportunity to provide care in a variety of settings, including medical clinics, emergency departments, acute care settings, and in patients’ homes. Some work internationally providing care to people in low-resource countries. With many physicians working in teams and with other health professionals such as nurses, occupational therapists, and nutritionists, the field is also becoming more collaborative.

Training for a career in family medicine
Family physicians are often the first line of care and care for patients when they present with illness through the management of chronic diseases.

Students should consider family medicine if they:
- Are interested in being generalists; family physicians specialize in breadth rather than depth of knowledge, amassing an equal but different knowledge base to specialists
- Enjoy diagnosing and managing the undifferentiated patient: family physicians have the opportunity to see patients from their first presentation, and to manage their care both independently and in partnership with other medical professionals in the community
- Are attracted to a number of different specialties and want their practices to encompass a wide range of disease presentations
- Want flexibility and control over their schedules
- Want to form long-term relationships with their patients

Diversity in patients, work settings, and schedules makes family medicine the most flexible career in medicine. A variety of practice models, the opportunity to job share, and the ability to shape their practices offer family physicians a great deal of choice. The high demand for family physicians in almost every region of Canada also opens many opportunities for locum positions and travel.

Some family physicians also choose to incorporate a focused area into their scope of practice. Nearly one-third of family medicine residents complete additional training to better prepare them for the patients they will encounter while serving their community’s specific needs.

Students may also pursue training through Enhanced Skills (R3) programs, ranging from a few months to one year. In 2008–2009, 196 R3 positions were available in Canada for family medicine residents. At some schools, prospective students can secure funding to support an R3 training program based on their unique career goals; availability and focus vary by school. Examples of Enhanced Skills programs include emergency medicine, sports medicine, geriatrics, women’s health (obstetrics, gynecology), adolescent medicine, mental health, research training, substance abuse treatment, international health, and HIV/AIDS.

Income for family physicians varies widely depending on hours, location, incentives, and type of practice. Within a group practice, family physicians should earn over $175,000 after overhead and before taxes.

Incentives for practicing in underserved areas range from higher salaries and higher fee-for-service payments to loan forgiveness, lump-sum payments, increased continuing medical education, and holiday support. Most rural physicians have lower overhead costs and the opportunity to earn higher income for performing procedures that would otherwise be carried out by other specialists.

In the midst of Canada-wide and global shortages of family physicians, the Canadian government is realizing that a robust primary care system is vital to the sustainability of our health care system. Will you be the future of family medicine?

For more information please see http://www.cfpc.ca/whyfamilymedicine

This is a condensed version of this document. For the complete pamphlet with more detailed information, please send an email to soms@cfpc.ca to receive a full version electronically.

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Special thanks to all of the medical students who have contributed their feedback.

This article has been made possible through a financial contribution from Health Canada. The views expressed herein do not necessarily represent the views of Health Canada.
EDITORIAL

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Penelina Lang

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The left half of the image shows what we as physicians can see. There are few other areas of the body where knowledge of anatomy is as crucial in understanding disease pathology. The airway, ear, and nose all require an optimal shape to function; the lungs need space to expand. Physiology allows us to understand the integration of structure with function. The right half of the image shows what we cannot see, and rather what we must think. It is essential to look beyond the obvious, considering the underlying anatomy and physiology, in order to understand.
All In the Head

Pencilla Lang (Meds 2011)

In the middle ages, a common treatment for foreign bodies in the throat was to call upon St. Blaise, the "defender of the throat":

"Piece of bone or thorn, whatever thou art, just as Jesus Christ caused Lazarus to come forth from the tomb and Jonah from the belly of the whale (here the patient should be seized by the throat) in the name of St. Blaise, martyr and servant of Christ, I order three to come up or go down" - Aetius of Amida (4th century AD).¹

Other early remedies included the use of the dung of lambs, the juices of a snail pierced with a needle, the ashes of burnt swallow mixed with hay, or centipedes mixed with pigeons' dung applied externally.²

In Grade 5 I wrote a poem in which I described the virtues and drawbacks of each medical specialty. In it, otolaryngology held the double distinction of being the most difficult specialty to pronounce and spell. Banished from my thoughts for these reasons, I gave diseases of the ears, nose and throat little thought until I was captivated by the complexity and mystery of the sphenoid bone in medical school. Over centuries, the study of anatomy and physiology have debunked many superstitions. We now know that poisons dropped into the ear do not have the same effect as poisons swallowed (as was believed during Shakespeare's time), and that tingling in the left ear is not caused by our peers speaking poorly of us. Equally many mysteries remain. What causes allergic rhinitis rates to rise and fall among populations? What is the pathophysiology of mitochondrial hearing loss? Are minimally invasive procedures an effective way to remove tumours with less damage to surrounding tissues?

The study of ENT covers a vast spectrum of diseases and crosses many medical specialties, from swimmer's ears and sore throats that frequent primary care offices, to problematic difficult airways in anesthesia, and tumours visualized only through imaging. This issue of the UWOMJ is an eclectic mix of topics. We bring you articles on the SoundBite hearing aid that allows a person to 'hear' with their teeth, free-flap oromandibular reconstruction techniques, a new transoral robotic surgery procedure, the debate surrounding funding of cochlear implants in Canada, and many more.

Since it's establishment in 1930, the UWOMJ has been continually changing and growing to meet the needs of our community. I first got involved with the UWOMJ as a junior departmental editor in 2007, and over the years I have had the privilege to witness extraordinary growth in this journal. Highlights have included the forging of a partnership with CU Advertising allowing the printing and distribution of the UWOMJ free of charge to readers, a beautiful new layout, a new online presence at http://www.uwomj.com/ (please do drop by and visit!), and the creation of feature article, departmental and artwork awards to recognize the contributions of UWO medical students. The editorial team expects the 2011-2012 year to bring even more change - keep your eyes peeled for an interactive online component to the journal!

Despite the changing landscape, the UWOMJ remains a publication of work written by and for UWO medical and dental students. Our objectives are twofold: to educate and enlighten by encouraging the sharing of information and ideas between students, teachers and our medical community, and to allow UWO medical students to experience the process of crafting their own research, review and case study articles. We invite you to join us this year as an author, supporter or reader.

REFERENCES
Microvascular free flap transfer for reconstruction of oromandibular defects

Brennan Ballantyne (Meds 2014), Sandeep Dahiwal (Meds 2013)
Faculty Reviewer: Dr. Anthony Nichols, Department of Otolaryngology – Head and Neck Surgery, UWO

Reconstruction of the mandible presents unique challenges to the head and neck surgeon. Although mandibular defects can result from trauma, infection, congenital deformities, or osteonecrosis, it most commonly occurs following ablative surgery for the treatment of benign or malignant neoplasms. Primary intrabony mandibular carcinoma is rare; therefore, the involvement of the lower jaw is usually secondary to neoplasm extension from the oral cavity or the oropharynx. Although tumour resection to ensure patient survival is a surgeon’s primary concern, not to be overlooked are aesthetic and quality of life parameters. The mandible serves to provide shape for the lower third of the face, a border between the face and neck, and positions the mentum and lower lip. Functionally, it supports masticatory forces and the mandibular dentition as well as the tongue in both position and function. On average, it must sustain a force of 726N with a maximal force occurring at the molar teeth of 4346 N.1

The use of nonvascularized techniques for repairing the mandible provides excellent results in certain patients. For example, alloplastic implants, such as those composed of titanium, provide rapid reconstruction options without the need for harvesting autogenous free flaps. However, the disadvantage of this method is the risk of plate fracture, plate extrusion, and exposure with subsequent infection. Alternatively, free tissue transfer provides superior results in repairing mandibular defects in most situations as an abundance of literature is available to suggest that such techniques improve patients’ quality of life.2,3 Figures 1-4 outline the basic principles of tumour resection and oromandibular reconstruction. Currently, there are several surgical options available for the repair of oromandibular defects using microvascular free flap methods.

FIBULAR OSTEOCUTANEOUS FREE FLAP

The fibular free flap has been deemed the “workhorse” donor site for reconstruction of oromandibular defects because of its versatility, frequent use, and success rates that approach upwards of 95%.4,6 The fibular flap is vascularized by the peroneal artery and its two associated venae comitantes. The entire fibula (~25cm) can be harvested except for small segments at the distal and proximal ends to preserve joint stability and can be used with the flexor hallucis longus muscle or a skin paddle for additional soft tissue repair.7 As such, it is the natural choice when longer lengths of bone are needed to repair a surgical resection and an excellent choice for reconstructions that require primarily bone or where the mandible is atrophic.8 The fibular flap provides enough bone for supporting dental implantation and is an ideal match for the contour of the natural jaw anatomy.

Criticisms of the fibular free flap have surrounded the height discrepancy compared to the native mandible, and the inability to reconstruct large-scale soft tissue defects (i.e., those resulting from total glossectomies). Notwithstanding, continued innovation has resulted in the development of a “double-barrel” technique that folds the fibula onto itself and thereby effectively doubles the height of the mandible available for osseointegrated implants.9 Large soft tissue defects can be repaired by using a second flap such as the radial forearm free flap or pectoralis myocutaneous flap.10 Finally, donor site morbidity is a particular concern. Although most patients will experience a hindrance in ankle plantar- and dorsiflexion range of motion and strength testing, studies have shown that this decrease is not enough to impact patients’ quality of life.11

SCAPULAR OSTEOCUTANEOUS FREE FLAP

The scapular osteocutaneous free flap (SOFF) is a versatile flap for mandibular reconstruction as it enables repair of many bone defects while simultaneously providing an abundance of soft tissue for repairing defects that involve facial skin and oral mucosa. The SOFF can provide up to 14 cm of scapular bone, and is based on the circumflex scapular artery and vein.12 The branching pattern of the vasculature permits harvesting a number of fasciocutaneous and osteocutaneous flaps. Often, part of the latissimus dorsi and/or serratus anterior vascularized by the thoracodorsal artery and vein can be incorporated to provide more soft tissue bulk. Nevertheless, the limited length, width and integrity of bone available makes the scapular flap unsuitable for dental implants. Decreased range of shoulder motion can occur if aggressive post-operative physical therapy is not carried out. However, near normal function can be obtained if proper rehabilitation is pursued. A drawback of the flap is the need to change the position of the patient during surgery from supine to lateral for harvesting. This prevents harvest of the flap at the same time as the tumor ablation, which may prolong the case.

SCAPULAR TIP OSSEOUS FREE FLAP

Preferred by the head and neck team at the University of Western Ontario, one increasingly popular alternative to the traditional scapular flap is the scapular tip osseous free flap based on the angular branch of the thoracodorsal artery. This modified flap enables the use of up to 20 cm of bone, is often harvested with the latissimus dorsi and/or serratus anterior muscles, and provides the option of increasing the skin and muscle pedicle length by also extending the dissection to the subscapular artery and vein. This allows the pedicle length to reach upwards of 17 cm compared to 6 cm from the SOFF.13 Furthermore, the triangular nature of the inferior angle of the scapula allows for harvesting a greater variety of 3-dimensional shapes. These reconstruction advantages – increased bone availability, increased pedicle length, and bone geometry – offered by the scapular tip free flap have been shown to be associated with highly successful surgical outcomes.14
ILIAC CREST OSTEOCUTANEOUS FREE FLAP

The iliac crest osteocutaneous free flap (ICOFF) offers unique advantages over the fibular flap with respect to quality and quantity of bone available. The natural shape of the iliac crest resembles the mandible anatomically, and therefore minimal osteotomy is required to form the neomandible. For example, the hemimandible can be recreated from the ipsilateral ilium using the anterior superior iliac spine to restore the mandibular angle. The available bone has a height comparable to the native dentate mandible, and is therefore an optimal substrate for dental implantation. However, the surgery is very complex compared to newer options, and has been largely supplanted by the fibular free flap as the primary choice. The ICOFF blood supply is based upon deep circumflex iliac artery and vein. The internal oblique muscle is thin and pliable, and can be manoeuvred independently of the bone easily and reliably. A significant drawback to the use of the ICOFF is that harvest involves the release of the abdominal muscles to access the peritoneal space leading to morbidity at the donor site, including issues of hernia prevention at the abdominal wall, gait alteration, sensory disturbances, and acute pain. Therefore, significant rehabilitation is often required to regain normal ambulation.

RADIAL FOREARM FREE FLAP

The radial forearm free flap (RFFF) has some of the best blood supply compared to other tissue options, is well innervated for good recovery of sensory function, and additional bulk can be added by incorporating the brachioradialis muscle. The arterial supply to the RFFF is based on the radial artery. Therefore, an Allen test must be performed before harvesting this flap to ensure the ulnar artery can adequately supply the hand. Venous drainage occurs through the venae comitantes of the radial artery or via the cephalic vein.

The RFFF offers a large area, thin and pliable skin segment which is ideal for intra-oral reconstruction thus making it the most widely used microvascular free flap in all head and neck surgery. It is used more for defects of the oral cavity, oropharynx, nasopharynx, and tongue as a fasciocutaneous flap, but the option of using it as an osteocutaneous flap by including bone is available. Approximately 10 cm of bone can be taken. Although it is strong cortical bone, it tends not to be very thick as only 1/3 of the cross-sectional area of the radial bone can be taken without increasing the risk of stress fracture to the arm. As such, RFFF is best suited for lateral or ramus mandibular defects that require minimal amounts of bone but an abundance of soft tissue. Known limitations include the lack of available bone for osteotomy, and morbidity at the donor site due to the bulk of remaining bone. Fracture rates following RFFF approaches 18% of cases, but prophylactic internal fixation of the radius has been shown to reduce this fracture rate to as low as 4.5%. 18 Tapering edges of graft in a “boat tail” can also reduce the risk of postoperative fractures as can a prolonged period of immobilization (3 weeks). For these reasons, only small bony defects of the mandible are repaired using radial forearm flap, or it is combined with other donor sites (i.e. iliac, fibular or scapular). 19

POST-OP / OUTCOMES / COMPLICATIONS

Success rates for free tissue transfer at most high volume centers is high, exceeding 95% or higher. 10 However, close postoperative monitoring can detect complications that may affect tissue viability, allowing for early intervention to minimize recipient site morbidity. The most common complications that threaten the viability of the free flap results from vessel thrombosis, predominantly in the veins. 20 Hematomas as a result of the surgery or the failure to place an adequate suction drain are also well-known complications. Other problems that have been cited in the literature as causes of morbidity include pulmonary problems, prolonged ventilatory support, and acute alcohol withdrawal. 19

Postoperatively, most patients are transferred to the intensive care unit for an average of 2.44 days, and an average hospital stay of 2-4 weeks. 21 The most common methods of monitoring the graft includes assessment of flap colour, pin prick and bleeding rate, capillary refill, skin surface temperature, and Doppler signal investigations. Other methods less commonly used are electrical impedance plethysmography, laser Doppler, photoplethysmography, transcutaneous pulse oximetry, and scintigraphy. 20 Patients are followed long term to ensure that the flap remains viable, the aesthetic goals of the patient have been reached, and that the patient is achieving functional rehabilitation. A 10 year follow up of these patients has revealed that aesthetic outcomes are achieved in 90% of patients, 70% have regular diets and the remainder have soft diets, 85% have easily intelligible speech, and greater than 90% have preserved bone height, indicating that there is minimal bone resorption. 22 These results highlight the notion that microvascular free flap reconstruction has achieved excellent outcomes that are celebrated by health care teams and their patients.

FUTURE DIRECTIONS / CONCLUSION

Head and neck reconstructive surgery has seen monumental advances in the past few decades. State-of-the-art microvascular equipment, along with the development of numerous free flap tissue options has resulted in vascularized osseous free flap transfer becoming the preferred method for reconstruction leading to a dramatic rise in repair success rate. 23 Currently, in the field of oromandibular repair, exciting new advances are continually being made to improve surgical outcomes. For example, the concept of distraction osteogenesis, originally developed for orthopedic application to lengthen bone, is beginning to be used by head and neck surgeons. Distraction osteogenesis involves an external mechanical device that separates two bony surfaces. The length of the distraction is then progressively lengthened over several days to allow a gap for new bone to form during the consolidation phase. It is used for patients with poor functional outcomes following reconstruction due to scar formation or inadequate bone length. 4, 24 Moreover, the field of tissue engineering also holds promise for the future of head and neck repair. The use of recombinant bone morphogenic protein (rhBMP-2) has been shown to stimulate bone regeneration without the use of autologous grafts in an in vitro setting. 24 Additionally, in vivo animal and cadaveric studies have demonstrated the utility of tissue engineering in developing bone grafts for the use of reconstructing mandibular defects. 25, 26 In this manner, the development of techniques that allow for the transfer of cultured cell substrate to regenerate portions of the mandible will likely offer the next step in the evolution of mandibular reconstruction.

REFERENCES


Malignant airway obstruction: treating central airway obstruction in the oncologic setting

Esther Chan (Meds 2013), Niran Argintaru (Meds 2014)
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Obstruction of the central airways, the trachea and main stem bronchi, may result from many disease processes including malignant growths. It is estimated that in the United States, malignant neoplasms will cause central airway obstruction (CAO) in 80,000 cancer patients a year. It is estimated that 20% of these patients will experience significant morbidity due to persistent cough, dyspnea, and obstructive pneumonia, and as many as 35-40% of lung cancer patients die due to complications resulting from loco-regional disease. While most treatments for malignant CAO are not curative, they have been shown to improve respiratory function, avoid mortality, and improve quality of life. Many different strategies for managing malignant airways exist. Choosing the best one depends on patient factors such as presence of co-morbidities, medical stability, the nature of the underlying tumour, and overall prognosis. Non-patient related factors such as expertise of medical staff and availability of technology also greatly impact the mode of treatment chosen. This article presents current treatment options for malignant CAO, specifically, therapeutic bronchoscopy, radiotherapy, and surgical resection.

CAUSES OF MALIGNANT CENTRAL AIRWAY OBSTRUCTION

The most common malignant causes of central airway obstructions are direct extension into the airway lumen by extrinsic tumours (fig. 1b). Of these tumours the most common types are bronchogenic carcinomas (i.e. small cell lung cancer and non-small cell lung cancer), followed by esophageal and thyroid carcinomas. Primary tumours of the trachea and bronchi, or intrinsic central airway tumours (fig. 1a) are relatively rare. Seventy to eighty percent of these tumours are of squamous cell or adenoid cystic carcinoma type. Squamous cell carcinomas typically occur later in life and more frequently in men and smokers, while adenoid cystic carcinomas are found in younger patients and are not related to exposure to smoking or to the sex of the patient. Occasionally, but less frequently, metastases from carcinomas of the breasts, kidneys, colon, thyroid and esophagus may spread to the respiratory system and cause CAO.

CLINICAL MANIFESTATIONS AND DIAGNOSIS

Clinical manifestations of malignant CAO depend on size, location, and the rate of progression of airway obstruction. Moreover, the patient’s underlying health status and ability to compensate for decreased airflow will influence the extent to which symptoms appear. If encroachment into the airway is minor, then there will be little impact on airflow and patients will likely be asymptomatic and never brought to clinical attention. The majority of patients that experience symptoms of CAO have advanced disease and a history of underlying malignancy. Thus, symptoms of CAO are late findings and include dyspnea, cough, wheezing, stridor and frequently, pneumonia. Because these symptoms overlap with those found in asthma and COPD, patients with malignant CAO are commonly misdiagnosed. However, a strong indication that symptoms are due to CAO is that they are unresponsive to inhaled steroids and bronchodilators. Other advanced CAO symptoms are related to signs of decreased ventilation such as tachycardia, diaphoresis and increased work of breathing. Symptoms of bradycardia, cyanosis and obtundation suggest that the airway lumen is severely compromised and in need of immediate intervention in order to avoid imminent respiratory failure.

Evaluation and diagnosis of malignant airways is often based on clinical examinations as well as a tissue biopsy and radiological studies to confirm the diagnosis. While chest radiographs have little diagnostic value, they may be used to quickly rule out other causes of breathing difficulty such as tracheal deviations or a pneumothorax. Chest and neck computed tomography (CT) scans make it possible to estimate tumour size, depth of invasion, and the ability to see if the airway distal to obstruction is still patent, providing important information for treatment planning. CT scans are typically always performed in conjunction with bronchoscopy, the gold standard for evaluating CAO. Bronchoscopy allows for direct visualization of the tumour, evaluation of tumour length and location, differentiation between an intrinsic endobronchial and extrinsic tumours, and most importantly, is equipped to provide a tissue diagnosis. Moreover, if needed, diagnostic bronchoscopy may be quickly converted to therapeutic bronchoscopy for CAO management.

Figure 1: Schematic diagram of intrinsic (a) and extrinsic (b) tumour obstruction of the central airways. Each demonstrates 50% occlusion. Adapted from Bollinger et al. Therapeutic bronchoscopy with immediate effect: laser, electrocautery, argon plasma coagulation and stents (2006).
TREATMENT MODALITIES

1) Therapeutic bronchoscopy:
Therapeutic bronchoscopy utilizes the rigid stainless steel bronchoscope to visualize, treat and debulk tumours. Its wider diameter facilitates ventilation allowing for a variety of procedures to be performed, including tumour debulking, laser resection, argon-plasma electrocautery, balloon bronchoscopy, and stent insertion to re-canalise the airway.2,7,8

i) Tumour debulking:
The sharp bevelled tip of the rigid bronchoscope is used to core out the tumour and apply pressure to airway walls promoting clot formation. However, inadvertent damage to surrounding airways during treatment is a risk and complications may include cutting the lips, gums, larynx or airway mucosa or cartilage during intubation. Perforation of the mediastinum may also occur if the scope is not in line with the airway lumen.8

ii) Laser Resection:
Laser energy delivered by optical fibres is used to resect obstructing tumours. The main type of laser used during bronchoscopic resection is the Neodymium:yttrium aluminium garnet (Nd:YAG) laser which transmits light energy at 1,064 nm wavelength to the target tissues.2,7 The thermal energy from the Nd:YAG laser is absorbed into the core of tissue where temperatures may reach up to 100°C.2 The heat is then transmitted and scattered around into surrounding tissues so that total tissue effects may extend up to 10mm below the surface of laser administration.2,7,8 Darker pigments, such as those found in blood maximally absorb energy from Nd:YAG lasers. As a result, tissues exposed to the laser energy are devascularised-a process otherwise known as electrocautery.7 Additional administration of the Nd:YAG laser causes charring and eventual vaporization, which is removed by ventilation from the bronchoscope.2,8 If tissue is not completely vaporised, it may be mechanically debulked. Because total tissue effects are not immediately visible during treatment and may extend well past the depth of the tumour, complications include late devascularisation of adjacent healthy tissues well after the treatment is completed.2,8

iii) Argon-Plasma Electrocautery:
Argon-Plasma Electrocautery (APE), as opposed to laser electrocautery, is a form of non-contact electrocautery. Using a 5,000-6,000 volt spark at the tip of the probe, argon gas, also released at the tip, becomes an ionized plasma that finds the nearest grounded tissues producing coagulative necrosis.1 Advantages of APC are that it may treat tumours lateral to or around a corner from the tip of the probe that would not otherwise be accessible for laser therapy.1,9 The electron energy utilized by APC, however, does not penetrate tissues as deeply as laser energy resulting only in superficial necrosis opposed to the deep tissue necrosis created by Nd:YAG lasers.9 This may be desirable for treating superficial squamous cell carcinomas or if major blood vessels are close to the tumour bed.9

iv) Balloon Bronchoplasty:
Balloon bronchoplasty uses a balloon to evenly dilate the airway with minimal trauma and subsequent granulation tissue formation in mucusal tissues. While most rigid bronchoscope techniques require general anaesthetic, balloon bronchoplasty may be performed with a flexible bronchoscope under conscious sedation.1 Dilution is immediately effective and may be used for both intrinsic and extrinsic airway obstructions. The results of balloon bronchoplasty are not typically sustained and dilatation is usually followed by stenting or laser resection. Complications include airway rupture resulting in pneumothorax, mediastinitis and bleeding.1

v) Airway stent insertion:
Airway stents are made of silicone, metal or a combination of both and are used to mechanically prop open obstructed airways. Stents restore airway patency, improve ventilation, and allow for the clearance of airway secretions.2,7,8 They can be used as standalone treatment or in conjunction with debulking and they do not interfere with subsequent radiation treatments, brachytherapy, or chemotherapy if any are needed.8 Moreover, if the patient’s ventilation status improves following treatment, silicon stents can be removed.2 However, metal stents are very difficult to extract and are essentially permanent.2,8 One of the greatest advantages to using stents is that they may counteract compression by tumours extrinsic to the airway. Complications include stent migration, more commonly seen with silicon stents, and stent obstruction by recurrent tumour growth or granulation tissue formation (typically seen with metal stents).2,8 Newer metal stents used for malignant airway obstruction have silicon coverings and are made of Nitinol, a flexible elastic biomaterial, to help avoid stent obstruction.2 Additionally, newer silicone stents are meshed for flexibility and shaped or studded to prevent stent migration.2

Indications for therapeutic bronchoscopy are the presence of symptoms of advanced CAO.3 Necrosis, bleeding and cartilaginous destruction are not contraindications for treatment.8 In emergency settings, therapeutic bronchoscopy may provide more immediate improvement of the patient’s ventilator status and stabilize them enough for further treatment with radiation or chemotherapy.8

2) Radiation Treatment:
Radiation has long been used to decrease tumour size and improve symptoms that result from a large tumour burden, especially in palliative settings. For malignant CAO, radiation may be delivered in one of two methods; intrinsic radiation treatment (i.e. brachytherapy) or external beam radiotherapy (EBRT).

i) Brachytherapy:
Brachytherapy refers to the placement of a radiation source within or adjacent to the tissues being treated. This is achieved by placing radiation seeds directly into the tumour (interstitial brachytherapy) or inserting catheters into the lumen of the organ being treated such as an airway.3 For the treatment of malignant CAO, an empty catheter is inserted into lumen of the airway approximately two centimetres beyond the estimated distal end of a target area that includes the tumour.2 The catheter is then secured at the nostril and a radiation source, most commonly iridium-192, is then loaded into the catheter.2,8 The area targeted by radiation can be several centimetres long depending on whether high-dose radiation (HDR) or low-dose radiation (LDR) is used.2 However, LDR has fallen out of favour and HDR is most commonly used as it utilizes the greatest advantage of the brachytherapy technique, that is, the radiation delivered directly at the site of target tissues minimizes radiation exposure to nearby healthy organs otherwise exposed during external beam radiotherapy. In this way HDR brachytherapy exposes vital structures near the airway—such as the esophagus, thyroid, mediastinum and aorta—to minimal amounts of radiation while enabling larger radiation doses to be delivered to the target tissue sites. A typical HDR regimen delivers a fraction dose of 7,000-8,000 cGy administered once a week for three weeks; however, the exact dose and number of fractions (radiation treatments) will depend on the size of the tumour and its location.2,8 Each fraction lasts between 3 to 30 minutes allowing brachytherapy to be delivered as
an outpatient procedure. Brachytherapy is contraindicated for tumours that invade major arteries or other structures within the mediastinum. Complications include early and late radiation effects such as radiation bronchitis, hemoptysis, bronchial stenosis, and bronchial fistulas.

ii) External beam radiotherapy:

External beam radiotherapy (EBRT) has variable efficacy for treating CAO and the therapeutic effects may be quite delayed. However, EBRT continues to be a mainstay of treatment for CAO especially in patients with highly advanced disease or comorbidities that preclude them from undergoing general anaesthetic. Palliative doses of EBRT for the treatment of CAO are typically 3,000 cGy in 10 consecutive fractions. Side-effects also include early and late radiation effects. Early effects are radiation dermatitis to the overlying skin and fatigue. Long-term effects mainly involve thoracic structures close to the airway (such as the lungs), which may undergo fibrosis as a result of inadvertent radiation exposure. However, current techniques in EBRT such as intensity-modulated radiation therapy in conjunction with shielding or stereotactic body radiotherapy effectively minimize radiation exposure to surrounding tissues.

3) Surgical resection:

Surgical resection is usually reserved for tracheal tumours that have not yet metastasized to other areas of the body. If surgical resection is successful in removing the entire tumour and achieving negative margins, it may be a curative treatment for cancer. The procedure involves removal of the tumour and the involved tracheal segment followed by re-anastomosis or reconstruction of the tracheal tube. Tumours that involve the carina or subglottic larynx can be successfully resected while preserving ventilation and vocal function. In addition, it is possible to remove up to 50% of the cervical or intrathoracic tracheal length without compromising anastomotic healing. While its advantage is that it is a potentially curative treatment for cancer, surgical resection cannot be performed if complete tumour removal threatens the healing of the anastomosis, if the tumour length exceeds 50% of the trachea or if vital structures such as the aorta or heart are involved. Moreover, the presence of CAO symptoms that alert clinicians to the need for treatment typically appear at advanced stages of disease when metastatic spread has likely to have already occurred. Although surgical resection cannot be performed after the mediastinum has received a high-dose of radiation (due to impaired tissue healing), it may be followed by adjuvant radiation therapy to decrease the likelihood of loco-regional disease reoccurrence.

DISCUSSION

Interventions for malignant CAO are highly technical and require a large amount of medical resources and teams of well-trained medical personnel. Often the widespread availability of these treatments is limited to patients within a reasonable distance of specialized centers. However, many studies have shown that these treatments are effective, improve patient quality of life, and may be life-saving in emergent situations. In a prospective cohort study of 20 patients with symptomatic CAO, all patients demonstrated improvements in airway diameter and 16 patients achieved greater than 80% patency using therapeutic bronchoscope techniques. Moreover, the study demonstrated that Nd:YAG laser therapy alone, airway stenting alone, and a combination of stenting, laser, and/or cryotherapy were each individually effective at re-establishing airway patency and improving symptoms. Similar positive results were demonstrated for the treatment of CAO using stent insertion and radiotherapy. Authors of a multicenter trial found that silicone mesh, stented stents re-established patency, and improved functional capacity, dyspnea, and global functioning at 1 month and 3 months after stent placement. HDR brachytherapy has also been found to be successful in prospective cohort studies at improving symptoms of CAO by more than 90%. Lastly, for patients eligible for surgery, brachytherapy offers a high rate of curative success. While most of these trials compared intervention to no treatment and were not randomized control trials, they have demonstrated that interventions may improve symptoms and quality of life. However, to date there are no best practice guidelines available on which interventions should be used. It has been frequently observed that the best approach includes a combination of treatment interventions, and although many centers are already utilizing these interventions to manage malignant CAO, choice of treatment is heterogeneous and centre-specific.

As incidences of cancer and specifically bronchogenic tumours continue to rise, it can only be expected that a growing number of patients will need to be managed for malignant CAO. Signs and symptoms of malignant CAO occur at advanced stages of disease and patients suffering from CAO almost always have a positive history for underlying malignancy. Symptoms of CAO may be treated with a number of techniques including therapeutic bronchoscopy, radiotherapy, or surgical resection. Each modality has been shown to improve symptomology, decrease morbidity, and improve quality of life. These are surgery alone, airway stenting alone, and a combination of stent insertion and radiotherapy. Authors of a multicenter trial found that silicone mesh, stented stents re-established patency, and improved functional capacity, dyspnea, and global functioning at 1 month and 3 months after stent placement.
Listening with our teeth! The SoundBite Hearing Aid: a new technology for single-sided deafness

Melissa J. MacPherson (Meds 2014), Mayoorendra Ravichandiran (Meds 2013)
Faculty Reviewer: Dr. Lorne Parnes, MD (Department of Otolaryngology)

Hearing loss is a significant and common disability that affects approximately 9% of the Canadian population. This disability is more prevalent in older populations and if uncorrected can lead to social isolation and communication difficulties. There are two distinct types of hearing loss; each with a characteristic pathophysiology. Sensorineural hearing loss (SNHL) arises from conditions affecting the inner ear or the cochlear nerve, whereas conductive hearing loss develops from conditions affecting the outer ear, the middle ear and the tympanic membrane. These distinctions are important since hearing aid technologies address the different types of hearing loss using different strategies. Patients with a conductive hearing loss require the amplification of all sound wave frequencies. In contrast, patients affected by sensorineural hearing loss present a much more complicated technological problem since these patients may have decreased audibility of certain sound frequencies as opposed to an overall decrease in the audibility of all sound frequencies. Most patients with sensorineural hearing loss have decreased audibility of high frequencies; however, in the case of Meniere's disease there is a decreased audibility of low frequencies. This results in the ability to hear sound but the inability to understand speech since speech amplitude (loudness) is caused by low frequency sound waves which the patient can detect but speech comprehension is poor due to the loss in detection of the high frequency sound wave components. Speech comprehension is more difficult in the presence of background noise and consequently hearing aid technologies address this issue by increasing the signal-to-noise ratio to bring out speech from noise.

HEARING AID TECHNOLOGIES FOR UNILATERAL SENSORINEURAL HEARING LOSS

Patients with unilateral sensorineural hearing loss (single-sided deafness) also face difficulties localizing the direction of unseen sounds and detecting sounds localizing from the direction of the affected ear, in addition to the difficulties previously mentioned. The head shadow effect causes a particular difficulty for these patients since sound waves originating from the affected side are attenuated by the head before reaching the functional ear. Several technological strategies used to address some of these problems include the routing of sound from the disabled ear to the fully functional ear using air conduction contralateral routing of sound (CROS) devices or bone-anchored hearing aids (BAHA).

While CROS devices do not allow for sound localization, they do aid a patient to overcome the head shadow effect. CROS devices consist of essentially two hearing aids. One hearing aid acts as a microphone in the affected ear and transmits the auditory signal to a second hearing aid that acts as a receiver in the functional ear. The CROS hearing aids in current use are wireless devices that use FM or Bluetooth technology to transmit the auditory signal to the external receiver.

BAHA devices take advantage of the physical property of bone to conduct sound. The first BAHA device was developed by a Swedish anatomist, Per-Ingvar Branemark, and implanted in three patients in 1977. The device has achieved international recognition as a solution to conductive hearing loss with more than 80,000 devices currently in use worldwide. The device also has a second application for the treatment of unilateral sensorineural hearing loss. The BAHA system consists of three components: a titanium post implant, an external abutment and an electronic sound processor. It is important to note that the BAHA system requires surgical implantation of the titanium post followed by the implantation of the titanium implant into the bony architecture. The device works by transmitting sound through bone to the inner ear thus, skipping both the external auditory canal and the middle ear. In the case of unilateral sensorineural hearing loss the sound is transmitted transcranially and stimulates the cochlear fluid of the unaffected inner ear. The titanium screw is implanted directly into the mastoid bone in order to overcome the loss of energy during the transcutaneous transmission of sound. The electronic sound processor is responsible for the transmission of sound vibrations via the external abutment to the titanium implant. Despite its value and popularity, there are a number of complications associated with the BAHA device. The most common complication is skin irritation at the site of the implant. In most cases, this can be managed using topical therapy. A more serious complication is the failure of the titanium post to osseointegrate. This complication can lead to poor function or failure of the implant. In addition, several less common but potentially dangerous complications such as skin flap necrosis, wound dehiscence, bleeding and pain have been reported. The sound conduction property of bone exploited in the BAHA technology has also been applied in the most recent technological advancement for the treatment of unilateral sensorineural hearing loss; the SoundBite Hearing Aid.

THE SOUNDBITE HEARING AID

A unique technological approach for the treatment of unilateral sensorineural hearing loss is the use of a removable oral device called the SoundBite hearing system developed by Sonitus Medical. The SoundBite hearing system also makes use of the sound conduction properties of bone; yet, unlike the BAHA system, does not require the use of surgery. The SoundBite hearing system uses a microphone unit housing a receiver and wireless transmitter to receive sound. The microphone portion of the unit sits in the affected ear canal to take advantage of the ability of the ear's pinna and external ear canal to capture and direct sound into the microphone, while the receiver and the transmitter sit in a unit behind the affected ear. The unit then transmits the captured sound wirelessly to a...
removable oral device similar to a retainer that sits over the maxillary molars in the mouth. The oral device touches several structures in the mouth including the gingiva, teeth and the inner cheek. The electrical signal from the behind the ear transmitter is captured by the oral device and is transduced into vibrational energy using a piezoelectric transducer.9 The vibrations are conducted by way of the teeth to the bone and transcranially to the cochlea of the ear. One of the advantages of the piezoelectric transducer is that it allows a much wider frequency range to be conducted through the teeth than the traditional electrodynamic transducers used in the BAHA systems.9

The oral device does not require the modification of the maxillary molars and is custom fitted for each patient by taking a dental imprint of the maxillary arch.3 Since the device vibrates the maxillary molars to transmit vibrations to the bone, the force of the oral device was tested to determine if it wears the teeth. Interestingly, the force of the oral device is four orders of magnitude lower than the forces exerted on the teeth by normal mastication and is within the force range of normal orthodontic devices and does not damage the surface of the maxillary molars.9 Moreover, the oral device is comfortable, well tolerated in most patients, does not affect the speech and can even be worn while eating.3 There are several advantages of the SoundBite hearing system which are outlined in Box 1. The most striking advantage of the SoundBite hearing system when compared to bone anchored hearing aids (BAHA) is the avoidance of surgery.9 A patient can be fitted quickly for the oral device and begin using the hearing aid immediately. With BAHA, surgery is required to implant a titanium post. The surgery is followed by 3 months of healing to ensure osseointegration of the implant before the patient can begin to use the device.2 The SoundBite hearing system avoids this delay and avoids potential surgical complications seen with the BAHA procedure. The SoundBite hearing system is a truly unique and novel technological approach to address unilateral sensorineural hearing loss. The next time you see a patient with unilateral sensorineural hearing loss, take a look in their mouth and chew on this possibility; they might be listening through their teeth!

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Falling on deaf ears: overview of cochlear implantation issues in Canada and locally

Niran Argintaru (Medicine 2014), Moska Hamidi (Medicine 2013) and Laura Allen (Medicine 2013)
Faculty Reviewer: Dr. Sumit K Agrawal MD

Is deafness a disease? Is it even a disability? Can or should it be “cured”? Such questions have been the root of many debates over the nature of deaf culture since the advent of cochlear implantation in the late 1950s. As implants become more reliable and provide increasing quality of hearing to profoundly deaf children and adults, many in the deaf community have grown to view implantation as a threat to both their way of life and the integrity of the community. As a result, factions of deaf society have waged a war against cochlear implants. “I would be remiss not to equate cochlear implants with genocide,” stated a 1992 deaf position article.

While such quotations represent an extremist view in the community, widespread concerns that cochlear implantation would diminish the deaf community’s size and cohesiveness, and that cochlear implantation represents a desire by the hearing population to “cure” deafness existed well into the 1990s. Many in the deaf community fear that cochlear implants would result in decreased resource availability and accommodations for the deaf, and hence pose a threat to deaf culture.

For the purpose of this article, deaf culture can be characterized as a community largely composed of profoundly deaf individuals that views deafness as a difference rather than a disability. They characterize lack of hearing as “deafhood” rather than “deafness”, with some in the community going as far as calling deafness a “birthright of silence”. This community provides resources, education and training to its deaf members, allowing them to function within the deaf community (i.e. through sign language) and in the hearing world (i.e. through lip reading). If one were to consider implantation to be a treatment for profound deafness, most of those implanted at a young age are likely to not partake in the deaf community as they would now be integrated into mainstream education.

As evidence mounts in favour of cochlear implantation, a shift has been seen to a point where the vast majority of eligible children are implanted, particularly if born to hearing parents. In response to the growing prevalence of implantation, in 2007, the Canadian Association of the Deaf (CAD) released a position paper on cochlear implantation. They asserted that while the CAD has little concern about autonomous adult implantation, they do not believe empirical research has provided sufficient evidence for the efficacy of cochlear implants in supporting first-language acquisition in deaf children, who are unable to make the choice for themselves. As the body of scientific literature in the field overwhelmingly supports early childhood implantation, the CAD’s position appears to focus on the right of every deaf child to learn sign language, regardless of whether they received an implant, allowing them to grow up “bilingual and bicultural”. It is difficult however to assert whether this position reflects an effort by the CAD to mitigate the loss of deaf culture by trying to increase the involvement of implanted children in the deaf community.

THE RIGHT TO CHOOSE: WHEN TO IMPLANT?

With newborn hearing screening programs offered in eight provinces and three territories as of 2008, children with significant hearing deficiencies are identified earlier than ever. Therefore, armed with an early diagnosis, parents are driven to make a decision regarding cochlear implantation in eligible children earlier in the child’s life, with an increasing body of evidence indicating significant advantages to early implantation. Notably, implantation in children under two years old has been extensively shown to provide significant improvement in language perception and vocabulary, often allowing recipients to enter first grade with language skills comparable to children with normal hearing. Recent evidence indicating that implantation as early as six months old leads to better long-term improvements in language, social skill development and significant advantages in parent-child bonding, has resulted in some centres implanting infants even earlier. While the current guidelines advise implantation at around two years old, studies have shown little additional risk of implanting patients at a significantly younger age, hence further shifting the trend towards earlier implantation.

Is this trend towards early implantation significant in terms of informed consent? The main decision to implant has shifted away from the patient when early childhood implantation started becoming common. This has left parents with the full responsibility of choosing implantation as well as the degree of deaf education the child will receive if implanted. However, with children implanted earlier, parents are faced with shorter timelines during which to educate themselves about the procedure. Therefore, while implanting at six months versus two years does not significantly alter the child’s ability to contribute to the decision, it may decrease the amount of time the parents have to consider the choice and could arguably pressure parents into rash decisions.

FUNDING OF COCHLEAR IMPLANTS IN ADULTS AND PEDIATRIC POPULATIONS

Currently, three centers (Toronto, London and Ottawa) provide the over 190 cochlear implant surgeries performed annually in Ontario. With wait times for implantation surgery far above the recommended three months for pediatric populations and six months for adults, the Ontario government released an additional $5.9 million in funding in March 2011 to cut wait times in half. Unfortunately, it is unlikely this one-time funding package will address waitlist issues in the long-run, particularly in the time-sensitive implantation of children as discussed above.

Specifically in London, a single annual budget is provided for
both pediatric and adult implantations. There are several problems that arise from this funding model. Firstly, as implant costs are covered under provincial health funding, patients cannot purchase their own implants in accordance with the Canada Health Act. Secondly, since a lump sum is allocated to the funding of implants per hospital, implantation can be undertaken only until the sum is exhausted in a given fiscal year. Lastly, due to the evidence presented above for early pediatric implantation, infants must be implanted within a certain window of time after the diagnosis. Therefore, as more pediatric implants are performed, adult patients are pushed back on the wait-list for their implants. However, this funding model does empower the healthcare providers in the audiology team to evaluate patients and assign the funding to those they determine require it most.

UNILATERAL VS BILATERAL IMPLANTATION

The Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA) published their official position in the Journal of Otolaryngology supporting bilateral cochlear implantation in all eligible children. Bilateral implantations provide advantages in sound localization, speech isolation in noisy conditions and improved development of the auditory system with few additional risks. Additionally, by implanting both ears, the “better ear” (the ear that will function better with the implant) is always implanted, maximizing benefits for the patient. Hence, for the most part, eligible Canadian children who receive implantation undergo simultaneous bilateral implantation as studies have shown no advantage to implanting the second ear on a later date, particularly at an older age.

While pediatric implantation has been shown to be cost effective by several studies, the cost effectiveness of providing bilateral implantation has been questioned due to the use of public funding of the implants. A systemic review done in the United Kingdom comprised of 33 trials, including two randomized control trials showed a far higher cost effective quality-adjusted life-year returns for unilateral implantation versus the bilateral implantation in pediatric and adult populations. With mounting evidence and strong recommendations in favour of bilateral implantation, why is the cost effectiveness of the second implant much lower than that of the first? Firstly, the quality of life measures used to gauge improvements following the second implant are much more uncertain and inaccurate, as Bond’s 2009 review acknowledges. For example, it is difficult to measure the improvement in quality of life gained from increased ability to localize sound or isolate speech. Secondly, with the ability of a unilateral implant to allow children to attend mainstream school and often requiring almost no specific educational assistance, the majority of savings are realized with the first implant and are hence not reflected in the addition of a second implant. Most significantly, the incremental improvement from having nearly no hearing to considerable hearing achieved with a unilateral implant is bound to be considerably higher than the improvement achieved with the second implant.

CONCLUSIONS

By many accounts, those who argue that cochlear implantation is unethical, ineffective or simply not the best choice for profoundly deaf children appear to have been unsuccessful in preventing their widespread use. However, as implantation shifts from being a novelty to the norm, the issues of funding and cost efficiency appear to have taken centre stage in Canada, and particularly in Ontario. With early bilateral implantation established as the best therapy for profoundly deaf children, funding must be available to implant all eligible children whose parents choose implantation. If such funding is not available, as seen in some centres, wait lists will persist and grow particularly in adults as pediatric patients are given priority.

Despite the effectiveness of implants, it is important not to discount the services and supports the deaf community provides to its members. Implantation is not a cure; rather, it is a supportive treatment that along with considerable training allows for increased functioning. Therefore, those implanted may still find they can benefit from participation in the deaf community through support and sign language training.

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"Is Beauty Truly in the Eye of the Beholder?" –
The Universal Nature of Facial Beauty

Michal Brichacek (Meds 2013), Robert Moreland (Meds 2013)
Faculty Reviewer: Dr. Damir Matic, MD MSc FRCSC, Plastic Surgery

Our face allows us to convey our every thought and feeling with those around us in a nearly instantaneous manner. Without our face, we would be stuck in an emotionless and depressing self-existence devoid of a primary vehicle of communication. As social beings, it is in our very nature to share our expressions with the outside world. It is likewise in our nature to subconsciously judge each face, assigning certain traits to particular facial characteristics. One of the most important characteristics that we judge is "beauty". Interestingly, there is an unusually consistent agreement of what is considered "beautiful" amongst different cultures, but only when we are referring to the face rather than the body, a topic that will be explored herein.

BEAUTY OF THE BODY

So what is it that makes a person "beautiful"? Beauty is an arbitrary and abstract concept that is seemingly difficult, if not impossible to define. Considering the vast diversity in this world and the countless cultures it contains, one would expect that surely there must be different culturally dependent standards of beauty. However, research suggests that this is only partially correct.

Research examining the physical attractiveness of the female body often uses the waist-to-hip ratio (WHR) as a quantifiable measure. Indeed, studies have found that males from most cultures and across history strongly prefer female figures with a low WHR. In the developed world, healthy females have higher levels of estrogen that cause more fat to be deposited on the buttocks and hips rather than on the waist, leading to a low WHR. Thus, the WHR is an indicator of health status and fertility, and male preference for low-WHR females is considered an excellent example of male assessment of mate quality.

Despite the overall preference of men for women with a low WHR, variations do exist, thereby casting doubt on the theory that this may be a universal ideal. Another measure of body habitus is the body mass index (BMI), which is a heuristic proxy for human body fat. Different cultures and populations prefer females of different BMI and WHR due to different sociocultural influences. Undeniably, the effect of "Westernization" may be contributing to a more universal standard of beauty, but this is not due to our innate evolutionary preferences. Regardless of these influences, a study comparing female physical attractiveness between Japanese and British participants found that Japanese men preferred images of woman with significantly lower BMIs than Britons and likewise were more reliant on body shape when judging physical attractiveness.

However, the flaw with these studies in general is that every culture tested so far has been exposed to the potentially confounding influence of Western media. A landmark study by Yu and Shepard assessed the WHR preferences of a culturally isolated population of Matsigenka indigenous people in Peru, who are located in an extensive nature park where access is restricted solely to scientific and official visitors and the vast majority of natives have never left the premises. Their results showed that the WHR preferences of males of this tribe differed strikingly from those of the United States control population as well as from other world cultures, with the "over-weight" female ranking highest in the factors of attractiveness, healthiness, and preferred spouse.

These were critical findings as they differed strikingly from the preferences of males in other cultures. The authors suggest that this difference may be due to the fact that in traditional societies, physical features may play a lesser role because mate choice is limited by kinship rules, and potential mates have access to direct information about mate quality, such as age and history of illness. As a result, they do not rely primarily on information inferred from physical appearance. In contrast, in industrialized societies, daily exposure to strangers from an early age may increase the importance of using physical features to assess potential mates based on these factors.

FACIAL BEAUTY

It seems reasonable to question whether these relative cultural norms likewise influence our perception of facial beauty. Counterintuitively, the answer is no. Before exploring this topic, we must first consider what exactly facial beauty is and how to define it. The quest to find a suitable definition of facial beauty dates back to antiquity, when the ancient Greeks believed that beauty appeared when the ratio of many different facial features to each other approached the value 1.618, the so called golden ratio. However, things are not so simple, as further research has shown that facial beauty is more a combination of symmetry and an ideal harmony of the facial features with each other. And most importantly, as humans we have an innate mechanism for detecting this elusive concept of beauty.

Symmetry is an important aspect of facial beauty and is tied to evolutionary fitness, where left-right bilateral symmetry describes health and high genetic quality, and deviations from it may indicate poor qualities and therefore form a basis for rejection of a potential mate.

There are several examples that seem to reinforce this concept. For instance, supermodels, arguably considered the most attractive members of Western society, have the least degree of facial asymmetry when compared to the general population. Facial asymmetry exists along a gradient in our population and it is clear that we have evolved to tolerate some degree of this asymmetry.

Interestingly, studies have shown that averaging a random group of faces results in a synthetic face more attractive than any of the original faces. The faces used in these analyses consisted of thirty-two completely random faces from a pool of different cultures, yet
observers always ranked the composite face as being the most attractive. Paradoxically, this suggests that the ideal harmony of the facial features that we consider to be “beautiful” is actually as close to “average” as possible. Naturally, such statements have drawn criticism from many individuals who refuse to believe that beauty may in any way related to “averageness”.

It is critical to note that the computational “average” of facial features that is considered attractive in this case is completely distinct from what culture commonly refers to as an “average” face, which naturally has a negative connotation and is not considered “beautiful”. There are certainly unique and interesting features that may add to the perceived attractiveness of an individual’s face, but it is important to realize that they must be associated with an “average” face and must be harmonious with the other facial features.

There have been arguments that beauty is a cultural phenomenon engrained in us repeatedly throughout our youth, resulting in a biased preference such as that of male for females with a low WHR ratio. However, there are many examples that disprove this theory. Eleven separate meta-analyses have revealed very high agreement in facial-attractiveness ratings by raters both within their own culture, and across other cultures. In fact, the effect sizes were more than double the size necessary to be considered large and thereby strongly suggest a universal standard by which facial attractiveness is judged.

In order to negate the possible influence of Western media, a study examining preferences for facial symmetry between British individuals and the Hadza, a hunter-gatherer society of Tanzania, likewise found that facial symmetry was more attractive than asymmetry across both cultures. These findings further question the assumption that ratings of facial attractiveness and ideals of facial “beauty” are culturally unique and are consistent with the fact that young infants prefer to look at faces that adults likewise consider to be attractive.

It is important to realize that there are exogenous factors that augment attractiveness and beauty as it pertains to mate selection, which is precisely why it is such an elusive concept to define. Dutton argues that based on Darwinian aesthetics, individuals consciously select mates who have certain characteristics, and that such characteristics in fact may make the person more attractive and “beautiful” to them. Dutton further states that it is human personality that adds another dimension of beauty, with traits such as a delightful sense of humor and generosity being attractive. Although it is still evolutionarily based on finding a healthy mate who is able to provide care, it is this rational intention combined with physical appearance that forms a complete view of beauty and attractiveness.

CONCLUSION

Beauty is an elusive concept that is envied and sought by many, yet is extremely difficult to define. Although the beauty of the body has an evolutionary basis, the concept of the ideal body is a cultural construct that has been influenced and continues to be influenced by culture and media. Conversely, facial beauty is a biologically ingrained concept based on symmetry and an ideal coalescence of that facial features with each other that transcend barriers of culture, media, and time. Ultimately, concepts of beauty and attractiveness are evolutionarily based, but cannot be looked at narrowly as based solely on appearance as they are augmented by exogenous factors.

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Incidence of acute respiratory distress syndrome and acute lung injury in patients requiring prolonged mechanical ventilation

Paul Kudlow, B.Sc. (Meds 2013), Chu L, B.Sc, Herridge MS, M.D., M.P.H

Faculty Reviewer: Nigel Paterson, M.D.

Primarily affecting critical care patients, Acute Lung Injury (ALI) and its more severe variant, Acute Respiratory Distress Syndrome (ARDS) are devastating clinical syndromes. Having long-term functional and neuropsychological consequences1,2,3. Further characterized by acute hypoxemia, bilateral pulmonary infiltrates on frontal chest radiography, and no clinical evidence of left atrial hypertension, ARDS/ALI are severe inflammatory conditions of the lung parenchyma4,5. The resulting severe hypoxemia combined with the extensive release of systemic inflammatory mediators often leads to multiple organ failure; responsible for high rates of morbidity and mortality in the population6. Despite many recent advances in our understanding of the pathophysiology, treatment, and long-term outcomes of ARDS/ALI, incidence and prevalence of these conditions remains uncertain. The uncertainty in turn reflects the heterogeneity of the syndromes, the lack of definitions for the underlying disease processes, and failure to uniformly define the population within which patients with ARDS/ALI are identified5. The incidence of ARDS/ALI in the United States has been estimated to be around 300,000 cases per year, but this may be an underestimate. A recent study, conducted by Rubenfeld et al. examined the general ICU population and found the incidence of ARDS/ALI to be somewhat higher, at approximately 58.7 and 78.9 per 100,000 respectively; giving an annual estimated incidence at around 141,500 and 190,600 cases of ARDS/ALI respectively in the United States per year6.

The purpose of the current study was to determine the incidence of ARDS/ALI in a pilot sample from a prospective multi-centre follow-up of critically ill patients mechanically ventilated for at least one week - the Towards RECOVER study7. The incidence of ARDS/ALI in patients requiring prolonged mechanical ventilation is not known. We hypothesized that the incidence of ARDS/ALI would exceed that found in general ICU patients, as cited above.

METHODS

As part of the Towards RECOVER study protocol7, patients were included if they were ≥ 16 years of age and mechanically ventilated for at least one week. (n = 82). Chest imaging was performed daily for the first ICU week and each Monday and Thursday thereafter. Investigators (PK, LC) underwent systematic training on Chest X-Ray (CXR) interpretation for ARDS/ALI by a standardized online educational tutorial8. CXRs were divided into 4 quadrants, each analyzed for the presence or absence of bilateral infiltrates consistent with non-cardiogenic pulmonary edema. Diagnosis of ARDS/ALI was based on American European Consensus Conference on ARDS (AECC) guidelines. Data was analyzed to determine the percentage of radiographs read independently as ARDS/ALI by each reader and interobserver variability was be calculated (kappa-statistic)9. All analyses were performed using appropriate software.

RESULTS

The study sample contained 82 patients. They had a median age 59 years, the male: female ratio was 1:4:1, and 45% of those sampled were found to have ≥ 2 comorbidities. The median APACHE II score of was 25 and a the median ICU LOS of was 37 days. In our study sample, 72% survived until ICU discharge.

To date, the records of 25/82 patients have been examined (by both co-authors) for the presence of ARDS/ALI. Of this sample, 21/25 (84%) had radiographic evidence of bilateral infiltrates and fulfilled AECC criteria for ARDS/ALI. Interobserver variability, measured by kappa score, was 0.60 (Figure 1).

DISCUSSION

In this limited sample, there were a high proportion of patients who fulfilled the criteria for ARDS/ALI. Although there was insufficient data to accurately calculate incidence at present, our preliminary proportion of 84%, suggest that the incidence of ARDS/ALI in those mechanically ventilated for at least 1 week, likely exceeds 58.7 and 78.9 per 100,000 person-years respectively as previously described by Rubenfeld et al. in their sample of general ICU patients6. Our results were strengthened by relatively good agreement between independent evaluators; we measured a kappa score of 0.60 (Figure 1).

Figure 1. The area of the circles is proportional to the number of subjects given a particular pair of ratings.
Taken together, our preliminary results suggest that ARDS/ALI are likely under recognized conditions, particularly in critically ill patients requiring prolonged mechanical ventilation. Earlier studies have estimated the mortality due to ARDS/ALI at around 133,500 deaths per year in the United States. Given the possible under recognition however, ARDS/ALI are conditions likely responsible for even more deaths in the population. Besides mortality, ARDS/ALI also leads to large amounts of costly and often debilitating morbidity in surviving patients and their caregivers.1,3,6. Outcomes studies have consistently found significant functional and neuropsychological derangements at both 1 year and 5 years post illness.1,2,3. Perhaps better identification of ARDS/ALI in the first place may help to more efficiently allocate health care resources – in turn potentially preventing some of the typical long-term sequelae currently experienced by survivors and their caregivers.

Before making any firm conclusions however, it should be noted that although the results of our preliminary study are suggestive of under recognition of ARDS/ALI, they are subject to a number of important limitations. Particularly, this study was not only limited by sample size, but also, data collected was subject to survivorship, selection, and ascertainment biases. Additionally, analysis of data collected was limited by the level of training of the independent evaluators (PK, LC). The independent evaluators were trained using an online standardized tutorial to assist in the determination of bilateral pulmonary infiltrates as per AECC guidelines.5,8. Although good agreement was measured between independent evaluators, the data remains to be formally evaluated by a trained physician. Therefore, larger future studies are needed to validate and confirm the preliminary results of this current study.

Funding provided by the Institute of Medical Science, University of Toronto, CHIR, MOH Alternative Funding Plan – Innovation Fund. Acknowledgements: We thank Dr. George Tomlinson for his assistance with statistical analysis. As well, thank you to Dr. Cathy Tansey, Andrea Matte, and Joel Elman for their assistance with recruitment and data collection.

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North Perth Family Health Team

North Perth Family Health Team/Listowel Clinic is recruiting two family physicians. We are a Medical Community of 10 Family Physicians providing a full range of services including ER/OR/OB/Inpatient/Office practice with comprehensive electronic medical records that links Listowel Memorial Hospital, Wingham Hospital & London Hospitals. We have under serviced designation and are located 30 minutes from Stratford and 40 minutes from Kitchener-Waterloo.

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For more information please visit our FHT website at www.npght.ca or contact us – 519-291-4200.
Shortness of breath in a 12 year-old boy: a classic presentation of stage IV Hodgkin's Disease?

Michael Livingston (Meds 2011)
Faculty Reviewer: Dr. Neil Merritt, M.D., FRCSC

S hane is a 12 year-old boy who presents to your office with worsening shortness of breath on exertion. His father explains that his son has severe asthma when he was younger. He was admitted to hospital when he was 2 years old and put on a ventilator in the intensive care unit when he was 4. His symptoms have been much better since then. In fact, Shane hasn't had to use puffers very much at all until a few months ago. He started using Ventolin again while playing soccer and does get some relief with this.

**IS IT ASTHMA?**
You take a thorough history from Shane's father. He notes that the shortness of breath has come on gradually over the last few months to the point where it causes Shane difficulties several times per week. There is no history of productive cough, and no fever, night sweats or weight loss. Shane has no other medical conditions, no known allergies, no previous surgeries, and his vaccinations are up to date. His parents are from Barbados but he has never been out of the country himself. Shane's 13 year-old brother had a cough recently but there are no other sick contacts.

On examination, Shane is a lean-looking child but otherwise appears well. Head circumference and height are above the 50th percentile and weight is above the 25th percentile. He has no cervical, supraclavicular, infraclavicular, axillary, or inguinal lymphadenopathy. His respiratory exam is significant for mild wheeze throughout but no crackles or areas of decreased breath sounds.

You explain that Shane's symptoms most likely represent worsening asthma. You give Shane a prescription for inhaled steroids and encourage him to use it twice per day. You also give him a refill for Ventolin and explain that he can use it whenever he feels short of breath. Shane's father agrees to follow-up with you in one month.

**IS IT INFECTIOUS?**
You see Shane and his father back in clinic one month later. His father looks very concerned. The shortness of breath continues to be an issue and now Shane has a rash. The rash started behind his knees and has spread to his trunk, arms, and neck. The rash is pruritic and bothers Shane quite regularly.

You do a full review of systems and discover than Shane has been feeling generally unwell recently. He reports no night sweats, fever, or weight loss, and no pain at night. Examination of the rash reveals numerous crusted papules measuring 3-5 mm in diameter (see Figure 1). His father assures you that Shane has already had chicken pox. The physical examination is otherwise the same as Shane's previous visit. There is no lymphadenopathy and the mild wheeze heard on respiratory exam is unchanged. You prescribe hydrocortisone cream for the rash and set up an outpatient referral to Infectious Disease.

**WHAT ELSE COULD IT BE?**
Shane is seen by your colleague in Infectious Disease six weeks later. Shane has now developed a dry cough. The rash is still present although the itchiness is relieved somewhat by the topical hydrocortisone. A review of systems reveals that Shane has now lost about 5 pounds since the worsening of shortness of breath began. Shane denies fevers and night sweats, but his father says that, "he's been feeling really unwell recently." Physical examination reveals anterior cervical and supraclavicular lymphadenopathy. The nodes are nontender, rubbery and range in size from 1 to 2.5 cm. Respiratory exam is significant for wheeze but there are no crackles or areas of decreased breath sounds.

Your colleague explains that he needs to get a chest x-ray as part of his workup. He agrees that Shane is quite sick and will need more tests. He sends Shane to the Pediatric Emergency Department for further evaluation.

**HOW BAD IS IT?**
Shane is assessed in the Emergency Department later that afternoon. He has a fever of 38.5 degrees Celsius, tachycardia with a heart rate of 105, and oxygen saturation of 94% on room air. The Emergency Physician orders a chest x-ray (see Figure 2) and bloodwork. The chest x-ray reveals mass-like pulmonary opacities in both lungs and enlargement of the hila and superior mediastinum.

Bloodwork is significant for a white blood cell count of 32.0, which consists of 24.0 neutrophils and 4.1 eosinophils. Hemoglobin is decreased slightly at 129. Platelets are elevated at 551, C reactive protein is 111.8, and erythrocyte sedimentation rate is 54. Lactate dehydrogenase is high at 616 but urate and calcium are normal.

**Figure 1.** Crusted papules measuring 3-5 mm consistent with pityriasis lichenoides [4].
Shane is admitted to hospital by the inpatient Pediatrics team for further workup. The differential includes infection, vasculitis, and malignancy. He is placed on airborne contact precautions and admitted to a negative pressure room until tuberculosis can be ruled out.

**IS IT CANCER?**

Shane undergoes a CT scan of the pelvis, abdomen and thorax the following day (see Figure 3). The CT reveals multiple solid nodules in both lungs, as well as mediastinal and hilar lymphadenopathy. Enlarged nodes are seen in the para-aortic area but there are no signs of a primary tumor.

General surgery in consulted to obtain a biopsy. Shane and his parents remain anxious over the next few days as they wait for a spot to open up in the operating room. In the meantime, Shane’s white blood cell count remains in the high 20s and platelets rise up to 762. Shane goes to the operating room three days after his admission for biopsy of a superficial supraclavicular lymph node and skin under general anesthetic. Frozen section of the lymph node is positive for malignancy but flow cytometry is normal. A definite diagnosis is deferred until permanent sections can be processed.

Over the next few days, Shane's shortness of breath worsens. The vasculitic bloodwork comes back normal and acid-fast cultures are negative for tuberculosis. The final pathology report is released one week later indicating Hodgkin’s Disease, Nodular Sclerosing subtype.

**IS THIS STORY TYPICAL FOR HODGKIN’S DISEASE?**

Shane’s story may seem somewhat convoluted but his symptoms are actually quite typical. In children, less than 20% of patients present with one of the classic “B” symptoms of Hodgkin’s Disease (weight loss, fevers, and drenching night sweats) [1]. In fact, the most common presentation in children consists of painless cervical lymphadenopathy (which occurs in 70-80% of cases) and/or a mediastinal mass (in 50% of cases) [2]. Shane’s initial chief complaint was shortness of breath due to the mass effect of mediastinal lymphadenopathy. This eventually progressed to a cough and hypoxia. The lesions in the lungs represent a combination of contiguous spread from hilar lymphadenopathy and metastases to lung parenchyma [3].

The rash and itchiness that Shane experienced isn’t that unusual either. In fact, some patients will give a history of insidious itchiness for months before being diagnosed with Hodgkin’s Disease [2]. The skin lesions in this case most likely represented pityriasis lichenoides, which is associated with lymphoma [4].

Shane’s initial bloodwork is classic for Hodgkin’s Disease. At first glance, the elevated white blood cell count consisting almost entirely of neutrophils would seem to suggest an infectious etiology. This is certainly supported by the high platelet count, C reactive protein, and erythrocyte sedimentation rate. (Indeed, in this case, Shane remained on airborne contact precautions until tuberculosis was formally ruled out with a negative acid-fast bacilli culture.) Nevertheless, a complete blood count characterized by neutrophilia, eosinophilia and thrombocytosis is classic for Hodgkin’s Disease in children, and is not due to underlying infection [1, 2, 5].

The presence of elevated lactate dehydrogenase would lead to some suspect tumor lysis syndrome. The elevated levels seen in this case actually represent a hemolytic anemia, which is not uncommon in Hodgkin’s Disease [6]. The normal serum electrolytes and urate levels seen here stand against the presence of ongoing tumor lysis.

**WHAT IS THE PROGNOSIS?**

Shane has stage IVB Hodgkin’s Disease according to the Ann Arbor Staging Classification [5]. He has diffuse involvement of 1 or more extralymphatic organs (stage IV) and has B symptoms (B). This places Shane in the high-risk category [5, 7]. Even so, with proper treatment and monitoring the 5-year survival for children like Shane is up to 90% [7, 8]. Shane was started on induction therapy while in hospital, consisting of cyclophosphamide, vincristine (Oncovin), procarbazine, and prednisone (COPP). He was discharged home once his breathing improved and will complete three more courses of treatment before receiving radiation therapy.
REFERENCES


Obstructive sleep apnea in children: the when, how and why of screening

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Faculty Reviewer: Dr. Murad Husein, Department of Otolaryngology, UWO

Obstructive sleep apnea syndrome (OSAS) is part of the spectrum of sleep disordered breathing (SDB) and is estimated to occur in about 2% of the pediatric population, whereas 2-5% of adults are affected. The peak incidence of OSAS is in pre-schoolers, when tonsillar hypertrophy is most common. Like adult OSAS, pediatric OSAS is caused by periods of complete or partial upper airway collapse during sleep, disrupting normal sleep patterns and resulting in intermittent hypoxia during apneic and hypopneic episodes. It is believed that OSAS results from a combination of anatomic abnormalities resulting in decreased space and increased pressure in the upper airway, and neuromuscular or functional abnormalities that cause decreased muscle tone while sleeping and lead to periodic airway collapse.

There is an increasing awareness about the prevalence and consequences of OSAS in the adult population among primary care physicians, allowing for improved screening, diagnosis and treatment. However, the recognition of this disorder in the pediatric population is much more difficult, and current screening among primary care physicians is inadequate. Children with OSAS present with different symptoms, have different risk factors, different pathophysiology, and require different management strategies than in adults.

CLINICAL IMPORTANCE

OSAS in children has been shown to contribute significantly to childhood morbidity with consequences seen in multiple systems. The severity of sleep apnea has a dose-dependent relationship with decreased left ventricular function leading to congestive heart failure and cor pulmonale. Plasma C-reactive protein levels, a marker of inflammation with an important role in atherogenesis, have also been shown to be elevated in children with SDB, and fasting insulin levels also seem to correlate with the disease severity, independent of BMI. Failure to thrive and a low weight index have been noted in children with OSAS, possibly due to changes in hormonal release during apneic episodes.

It is known that OSAS in adults results in daytime hypersomnolence and psychological sequelae such as disturbed concentration and memory; however in children the deficits in neuropsychological and behavioural functioning caused by untreated OSAS can severely affect development, interfere with learning, and cause symptoms that may be diagnosed as attention-deficit hyperactivity disorder (ADHD). In one well-known study, it was found that 33% of children with ADHD exhibited symptoms of SDB while only about 10% of children without ADHD in the study exhibited such symptoms, with the authors postulating a causal relationship. This hypothesis has been strengthened by the finding that symptoms of inattention and hyperactivity predictably improve after surgical treatment for OSAS.

DIAGNOSIS

RISK FACTORS

Obesity is a common risk factor in both adults and children, as increased fatty tissue in the neck results in increased upper airway resistance. However in children OSAS is still most commonly related to adenotonsillar hypertrophy. Obstructive sleep apnea is also associated with other medical disorders such as Down syndrome, anatomic craniofacial abnormalities such as micrognathia, neuromuscular disease including cerebral palsy, and conditions such as sickle cell disease and laryngomalacia. Children with any of these conditions should be seen as high-risk and carefully screened.

HISTORY

A thorough sleep history should be taken from the parents, asking specifically about 1) snoring, 2) apneic episodes, 3) laboured mouth breathing, and 4) restlessness. Habitual (nightly) snoring is the most sensitive indicator, as OSAS is rarely seen in its absence. However, snoring occurs in up to 12% of children and therefore has poor specificity. Differentiating between primary snoring and OSAS can be difficult based on history alone. Note that the loudness of snoring does not necessarily correlate to the degree of obstruction.

Daytime symptoms may include excessive daytime sleepiness, or more commonly, hyperactivity with attention and concentration problems, possibly resulting in behavioural difficulties and learning problems. The Canadian Paediatric Society and College of Family Medicine recommend that all children with ADHD be screened for OSAS.

Table 1. Differences in the Clinical Presentation of OSAS between Children and Adults

<table>
<thead>
<tr>
<th>Most Common Risk Factor</th>
<th>Children</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonsillar hypertrophy</td>
<td>Obesity is secondary</td>
<td>Obesity</td>
</tr>
<tr>
<td>Hyperactivity/Inattentin</td>
<td>Daytime sleepiness</td>
<td></td>
</tr>
<tr>
<td>Epidemiological Distribution</td>
<td>1:1 Males to Females</td>
<td>2:1 Males to Females</td>
</tr>
<tr>
<td>Polysomnograph Findings</td>
<td>Awakening during REM sleep</td>
<td>Awakening during slow-wave sleep</td>
</tr>
<tr>
<td>Surgery (adenotonsillectomy)</td>
<td>More arousals</td>
<td>CPAP</td>
</tr>
</tbody>
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Physicians of Canada endorse the Greig Health Record which recommends asking about sleep habits, daytime somnolence as well as concentration and irritability at all periodic health visits for children ages 6-17. The ‘BEARS’ screening questions, a user-friendly tool that encourages obtaining sleep information from pediatric patients, has been shown to increase the likelihood of identifying sleep problems in a primary care setting, although it has not been validated to specifically identify OSAS.

**PHYSICAL EXAM**
Adenotonsillar hypertrophy may be suspected on physical exam by the observation of mouth breathing, hyponasal speech, or direct visualization on examination of the oropharyngeal cavity. Although visual inspection may give a false impression of tonsillar size and is therefore not a reliable method of diagnosis. Refrigeration to an otolaryngologist will allow closer visualization of the tonsils, adenoids, tongue base, and soft palate through flexible laryngoscopy, and may detect subtle structural abnormalities in the airway.

Recognition of risk factors for OSAS such as craniofacial abnormalities or obesity on physical exam may also increase the clinician’s suspicion of the diagnosis.

**FURTHER TESTING**
Audiotapes or videotapes taken by the parent of the sleeping child may sometimes be used by healthcare teams to listen and watch for observable apneic episodes. Studies examining the reliability of this method of testing have found mixed results with generally poor predictive values. While this is a non-invasive and available means of screening and may be of some use to clinicians, if the results are negative and you are still suspicious of OSAS in a patient, they should be referred for a sleep study.

The gold standard for diagnosis of OSAS is a sleep study, or polysomnography. It will reliably differentiate between primary snoring and OSAS, and can determine the severity of the syndrome. Results must be interpreted based on age-adjusted criteria, as OSAS affects sleep patterns in children differently than in adults. Children with OSAS experience greater obstruction during REM sleep, 16 and have fewer arousals associated with apneic episodes. Children also experience greater desaturation during apneic episodes. The duration of obstruction required for a definition of apnea and the threshold number of apneic episodes for a diagnosis of a disorder must be adjusted due to the increased respiratory rate seen at baseline in children, and it is common to see hypoxia due to prolonged partial obstruction rather than the cyclical complete obstruction seen in adults. This is known as obstructive hyperventilation.

Worldwide, the demand for polysomnography is high but provision is limited and is costly. Therefore, it is often difficult to obtain this test in a timely fashion. In the absence of an easily accessible sleep lab, night oximetry testing may be considered, measuring episodes of desaturation throughout the night with an O2 saturation probe on the child’s finger. This test generally has a good positive predictive value, but if it is negative the patient should still undergo polysomnography to rule out OSAS.

**MANAGEMENT**
Adenotonsillectomy is usually the most appropriate therapy for children with OSAS. In children with documented adenotonsillar hypertrophy, 75 to 100% will have symptom resolution as well as normal polysomnographic results after surgery. Patients with obesity or uncorrected craniofacial abnormalities may see poorer results on post-operative polysomnography.

**REFERENCES**

"BEARS" Screening Questions:
B=Bedtime Issues
E=Excessive Daytime Sleepiness
A=Night Awakenings
R=Regularity and Duration of Sleep
S=Snoring

Studies have repeatedly shown dramatic improvements in quality of life scores, behavioral symptoms, depression, hyperactivity and somatization for children with OSAS after adenotonsillectomy. Interestingly, children with milder forms of sleep disordered breathing also show similar improvements after the surgery.

As with all therapies, the risk of the procedure must be considered. The most serious risks of adenotonsillectomy include respiratory complications, and it is thought that patients with more severe OSAS on polysomnography pre-op are more likely to experience respiratory compromise post-op. Therefore these patients should be hospitalized overnight and monitored carefully post-operatively.

For patients with incomplete resolution of symptoms after surgery, or for those patients who are not surgical candidates, continuous positive airway pressure (CPAP) therapy has been shown to be effective. It is often not tolerated in the younger population and must be frequently adjusted to fit the growing child, resulting in poor compliance.

It is also important to assess for and treat behavioural sleep disturbances in children diagnosed with OSAS, especially those that continue to have daytime symptoms. Behavioural sleep disturbances including bedtime resistance, problematic sleep associations, and prolonged nocturnal awakenings, have a high co-morbidity with OSAS in children, and independently put the child at an increased risk for neurocognitive and behavioural issues. Therefore it is important to implement behavioural interventions while concurrently investigating and treating for OSAS.

**SUMMARY**
Primary care physicians have an important role to play in the identification and diagnosis of OSAS in children. However, sleep disorders are underdiagnosed in primary care practices, primarily because physicians do not ask parents about the symptoms of disordered sleep. In general, it is difficult to accurately diagnose OSAS on history and physical examination alone. However, primary care physicians should be performing regular screening for symptoms of OSAS, as recommended by American Academy of Pediatrics. Snoring is the most sensitive indicator. If clinical suspicion is high based on risk factors and/or history and physical examination, the child should be referred to an otolaryngologist or directly to polysomnography for further testing. Complex patients, including infants and those with congenital abnormalities, should be referred to an otolaryngologist. It is important to identify and treat pediatric OSAS early in order to prevent serious morbidity, including neurobehavioural sequelae such as symptoms of inattentiveness and hyperactivity.
An interdisciplinary approach to voice disorders

Emma Farley (Meds 2013), Ashley Kim (Meds 2013)
Faculty Reviewer: Dr. K. Fung

The larynx serves the dual purpose of airway protection and phonation. It is covered by the epiglottis during swallowing, and is patent during respiration and phonation, during which air passes past the modified sides of the larynx, the vocal folds or cords. The upper border of the conus elasticus is thickened, which forms the true vocal folds. Histologically, the outermost layer of the vocal fold is composed of stratified squamous epithelium. Deep to this lies the lamina propria, a flexible fibrous layer containing elastin, collagen, and fibroblasts. The lamina propria is divided into three clinically important layers – superficial, intermediate and deep, which become gradually more stiff as the collagen to elastin ratio increases. Deep to this membranous cover lies the body of the thyroarytenoid muscle.

Phonation requires the presence of not only the vibratory vocal folds, but other upper airway structures – the pharynx, oral and nasal cavities - for resonance and articulation. Phonation is produced during the glottis cycle. The first step is the accumulation of air pressure beneath the approximated vocal folds. At a particular pressure, called the phonation threshold pressure, the vocal folds begin to part in a wave-like fashion from inferior to superior. The vocal folds are simultaneously moved laterally by the air column, and quickly return to the midline due to their intrinsic elastic properties. This cycle repeats approximately 100 times per second in men and 220 times/second in women. The amplitude, frequency, wave morphology and periodicity (volume, pitch and vocal quality, respectively) are varied by changes in air pressure and/or tissue quality. Amplitude is increased or decreased by providing a greater or lesser exhaled force, paired with an increase or decrease in tension of vocal folds (affected principally by the thyroarytenoid muscle). Pitch is increased by contraction of the cricothyroid muscle, which lengthens and thins the vocal folds, and decreased by contraction of the thyroarytenoid muscle, which shortens the fold and increases their mass.

Disorders of and disruptions to the vocal folds may have devastating consequences in everyday communication, and especially for those who rely on their voices professionally. This article will address some of the most common vocal disorders of professional singers, their cause, identification, management, prevention, and the role of a multidisciplinary team in maintaining vocal health.

VOCAL HYGIENE AND THERAPY

First-line treatment for many organic vocal disorders, such as nodules, polyps and cysts is vocal therapy. Vocal therapy serves to improve vocalization technique, and to minimize harmful behaviours, while maximizing healthful ones. Holmberg et al. used voice therapy in the treatment of vocal fold nodules, and showed perceptual improvement in vocal quality, and reduction in nodule size. Their protocol for vocal therapy consists of 5 different approaches to vocal health, and it was concluded that the therapy as a whole is required to significantly improve vocal quality. The first is vocal hygiene, which entails patient education on normal phonation, types of abusive behaviours (voice overuse) and abusive substances (smoke and caffeine), and etiology and consequence of vocal nodules. The second is respiration – a focus on reducing the effort of speech breathing and exercises to train the proper management of air supply. Third are direct facilitation measures which aim to reduce loudness, coupled with “yawn-sigh” exercises, which relaxes vocal musculature and softens vocal onset. The fourth is relaxation techniques and stress management. Last, the patients were instructed to carry over all of the above techniques to real situations. One randomized control trial demonstrated the efficacy of vocal therapy in patients who acquired vocal impairment after treatment (either laser or radiotherapy) for early glottic cancer. Significant improvements were noted both subjectively by patient questionnaires and through objective voice parameters.

A second element in vocal technique is the vocal warm-up. Warm-up exercises include stretches of the face and torso, deep breathing triggers, sustaining vowels on various pitches with varying intensity, humming and lip-buzzing, glides, and the production of consonants. The aim of the warm-up is to maximize phonation, resonance and respiration. Elliott et al., showed that vocal warm-up reduces viscosity of the vocal folds, but that this result alone does not uniformly increase ease of phonation (phonation threshold pressure) among subjects. It is instead hypothesized that the vocal warm-up affects other properties of the vocal folds, such as amplitude, vibration periodicity, and nervous control of laryngeal muscles. Baylock conducted preliminary research that studied the effect of vocal-warm up in four subjects with voice disorders. He reported a significant improvement in voice production according to acoustic measures and self-rating, but noted that more studies were needed to corroborate these results. A recurring problem in the literature seems to be the inter-subject variability in vocal physiology, and the difficulty of finding an adequate measure to assess the different effects of the warm-up. Therefore, the efficacy of warm up in voice disorders is still inconclusive.

A third consideration in the management of any vocal disorder is the prompt treatment of secondary dysphonia. Examples are acid reflux, acute laryngitis, and allergic laryngitis. One of the most important causes that should be ruled out is laryngopharyngeal reflex (LPR). Unlike the stomach, the larynx does not have the intrinsic ability to protect from gastric acid related mucosal damage. In addition to the inherent susceptibility of the larynx to acid damage, carboxic anhydrase type 3 (important in regulating pH by producing alkaline bicarbonate) is normally present in true vocal folds, however, diminished or absent in vocal folds affected by LPR.
symptoms of LPR include throat clearing, hoarseness, excessive mucus, cough, globus sensation as well as laryngoscopic findings which include posterior laryngeal edema, true vocal fold edema, and pseudosulcus14(Figure 2). The general approach to the treatment of LPR is similar to the treatment of gastroesophageal reflux8. Dietary modifications consist of limiting foods and beverages containing caffeine, alcohol and peppermint, which may weaken lower esophageal sphincter tone11. The evidence surrounding the use of PPIs for the management of LPR remains somewhat inconclusive6-11. However, for patients with LPR who have symptoms that impact their professional or social responsibilities (like singers, actors, lecturers), it is recommended that treatment with PPIs be started at high doses11, as well as administration of H2 blockers and antacids when reflux is anticipated after meals9.

In all cases of voice disorders, a multidisciplinary team consisting of otolaryngologists, family physicians, speech pathologists and vocal teachers are required. While speaking voice is sometimes unaffected by vocal fold lesions, the reduced vocal range, increased effort and impaired endurance experienced by professional singers, have far greater implications to their career12. The possibility of secondary causes of dysphonia such as LPR, highlights the significance of a thorough history and physical, which can reveal risk factors and possible etiologies that lie outside the larynx. The role of the family physician is particularly important in isolating and directing appropriate treatment or referral13. The role of the speech language pathologist lies in the education of regular speech, assisting in phonation, articulation, respiration and resonance12. Vocal teachers contribute specialized expertise in vocal hygiene, warm ups and education of proper singing techniques, as well as professional guidance. Not surprisingly, it is widely appreciated that combined interdiscipliary treatment modalities support better outcomes for patients8,24.

PROBLEMS FOR SINGERS: VOCAL FOLD LESIONS

Benign vocal fold lesions are common in professional voice users. The most likely culprit of these lesions include vocal overuse, misuse (excessive muscle tension) and abuse (voice overuse or whispering)15. During any of these acts, there is excessive mechanical stress applied to the vocal folds. The mechanical stress of excessive vibrations of the vocal fold affect the vocal fold mucosa itself, rather than the underlying musculature16-17, resulting in fatigue damage18. Vocal tissue traumatized by repeated collision forces, vocal fold accelerations and decelerations, and heat dissipation, which result in tissue breakdown and remodelling16,17,19. The remodelling phase induces mass lesions, including vocal fold nodules, polyps and cysts. While the histology and pathology of benign vocal lesions is not fully understood, some studies try to correlate the different types in order to determine the best possible management13.

Vocal polyps are benign, hyperplastic lesions of the laryngeal mucosa. They are normally situated unilaterally20 and anteriorly on the vocal fold21. It is hypothesized that vocal polyps are due to areas of vibration-induced hyperaemia and vasodilation resulting in edema21. The edema then leads to degeneration or fibrosis21. Vocal polyps are also associated with smoking and acid reflux22. First-line treatment is generally regarded to be vocal behavioural therapy13, but debate remains over whether patients should primarily attempt vocal therapy measures (as in the case of vocal fold nodules), or proceed immediately to surgical intervention. A well-defined microphonosurgery exists, developed by Hochman and Zeftels, which preserves more of the vocal fold microstructure than typical cold instrument or laser removal22. Stajner-Katusc et al. investigated the vocal quality of five males, before, one month after and six years after surgical vocal polyp removal. Their data showed significant improvement of vocal quality across several vocal measures, including self-estimation by the participants23. Conversely, Cohen and Garrett showed that vocal therapy was effective in improving vocal quality, by reducing the size of vocal polyps (but not eliminating vocal polyps) in 50% of their participants, while the other half required surgery24. The response to treatment was attributed to the polyp type. Translucent (immature, edematous) polyps, seen by videostroboscopy, were significantly more likely to benefit from vocal therapy, when compared to fibrotic, hyaline, or hemorrhagic (mature) polyps24. In addition, incomplete glottal closure after vocal therapy was discussed as a potential indication for surgical referral. Without glottal closure, air would still escape during singing and phonation, resulting in persistently inefficient vocal use, suggesting the need for aggressive treatment24. In this study, long-term follow-up was not performed, and there was no accounting for differences in methodology between vocal therapists. It was concluded that although not for everyone, there is a specific patient population that would maximally benefit from vocal therapy alone, while others should proceed directly to surgery24.

Nodules, or “singer’s nodes” occur bilaterally and symmetrically on the vocal folds and are attributed primarily to vocal abuse or misuse12,24(Figure 3). Vocal fold nodules, similarly to polyps, are benign areas of edema and fibrosis25. It is worth noting that the difference between nodules and polyps is not always evident, and there is a lack of clear histological distinction20. Vocal fold nodules present with hoarseness and breathiness due to a failure of the vocal folds to approximate, pitch breaks and fatigability25. As detailed above, the first line treatment for vocal nodules is behaviourally-based vocal therapy1. An intervention review in 2009 found that there were no high quality randomized controlled trials, which compared surgical and non-surgical interventions for vocal nodules26. The article reiterates the lack of definite histologic distinction between nodules and polyps, as well as the lack of gold-standard assessment measures of vocal quality as barriers to performing adequate trials26. Other vocal fold pathology that is important to rule out by an otolaryngologist, include laryngeal papillomatosis, granulomas, dysplasia and carcinoma, all of which have been documented in singers as causes for voice impairment.

CONCLUSIONS

Like many other occupational health issues, dysphonia is associated with decreased quality of life, and may lead to loss of work in populations whose professions rely on vocal ability27. Otolaryngologists provide a major role in both surgical and non surgical corrections of nodules that are not amenable to conservative, behavioural or vocal therapy treatments. Surgery was once believed to be professional suicide for singers a decade ago3, but this rapidly changing perspective reflects the advances in microsurgery that have created positive outcomes for appropriately selected patients22,28. Voice medicine reiterates the importance of multidisciplinary care and combined expertise that cater to the overall goals of a particular patient population. As always, health care professionals should be aware of these modalities that lie outside of traditional medicine.

REFERENCES

Minimally invasive surgery has revolutionized surgical practice in the past two decades and is quickly becoming the standard of care across multiple disciplines. In head and neck surgery, organ-preservation protocols and transoral laser microsurgery have laid the foundation for the recent development of transoral robotic surgery (TORS), which uses the da Vinci surgical robot to orally approach the throat rather than traditional cervical incisions into closed neck spaces.\(^1\) The technique was developed at the University of Pennsylvania, initially by demonstrating wide access to the laryngopharynx using mouth gag retractors and performing procedures on a canine model.\(^1\) In 2006, they described its application in human patients for resection of oropharyngeal squamous cell carcinoma (OPSCC).\(^3\) The FDA approved the use of TORS in December of 2009 for resection of selected head and neck tumours.\(^2\)

In December of 2010, Dr. Kevin Fung and Dr. Anthony Nichols from the Department of Otolaryngology – Head and Neck Surgery at the University of Western Ontario (UWO) performed the first TORS procedure in Canada: a TORS supraglottic laryngectomy (Figure 1). Other options for the patient were either open supraglottic laryngectomy with bilateral neck dissections or full course radiotherapy for 7 weeks (70 Gy). With TORS, the patient was able to avoid temporary tracheotomy and nasogastric tube (NG) feeding, and with negative margins and nodes the patient completely avoided postoperative radiotherapy as well. This case highlights some of the advantages of TORS for the treatment of head and neck cancer, which will be discussed further below along with details of the procedure and future directions.

**SURGICAL PROCEDURE**

The Da Vinci surgical platform consists of a console, a surgical cart, and a manipulator unit. The TORS procedure involves the transoral insertion of two wristed instruments arms and a central 3D endoscope.\(^4\) The console offers the surgeon a three-dimensional magnified view and allows control of the two-endowristed robotic arms, which helps to enhance manual dexterity.\(^5\) The system allows for the surgeon’s hand movements to be motion-scaled and thereby eliminates physiological hand tremor.\(^6\)

The first clinical use of the Da Vinci robot for head and neck surgery involved the removal of a benign oropharyngeal lesion and a thyroidectomy.\(^7,8\) Applications have expanded to procedures such as parathyroidectomy and skull based surgery.\(^9,10\) However, the main application of TORS is in the treatment of malignancies caused by squamous cell carcinoma (SCC) which can include the oral cavity, oropharynx, hypopharynx, and larynx.\(^6\) Such cases include TORS tonsillectomy, TORS tongue base resection, and TORS supraglottic laryngectomy.

The primary advantages of robotic surgery include the minimization of surgical trauma, superior visualization, improved precision, and the ability to recreate an open surgical experience.\(^6\) Additional advantages include better safety and morbidity outcomes for the patient, which are discussed below. Conversely, there are certain disadvantages of TORS such as a confined operative field and financial limitations such as the high initial cost of the robotic system (over a million dollars) and the high cost of instruments (about one thousand dollars per case). However, in centers where a robotic console already exists for general or urologic surgery, adding head and neck cases will augment value of the machine and increase productivity.\(^1\)

![Figure 1. Dr. Anthony Nichols (left) and Dr. Kevin Fung (right) from the Department of Otolaryngology – Head and Neck Surgery at the University of Western Ontario, standing next to the control console of the Da Vinci surgical robot.](image-url)
blood loss (<200 mL) when compared to open surgery, and none have required blood transfusions. TORs patients also have a shorter hospital length of stay, as most are discharged six days after OPSCC resection. In contrast, patients after open supraglottic laryngectomy would typically stay 10-14 days in hospital post-operatively.

**CONCLUSIONS**

The procedure was developed in Korea and has been performed in over 300 patients as of 2009.17

**FUNCTIONAL**

Preserving airway and swallowing function is an important determinant of quality of life following oropharyngeal surgery, and largely depends on whether the patients receive post-operative radiation or chemotherapy. To date, none of the four patients treated with TORs at UWO have required adjuvant radiation therapy as they all had negative margins and nodes post-surgery. (negative nodes were determined by pathological staging of a staged neck dissection two weeks post-TORS). In the event that patients do have positive nodes, the adjuvant radiation dosage needed (60Gy) will be smaller than primary radiation treatment (70-72Gy), minimizing side effects.

At other centers, reported rates of temporary tracheotomy in patients who undergo TORS range from 3% to 31%, with an average time to decannulation of seven days.4,11,15 The use of NGtubes for enteral feeding shows greater variance due to surgeon and center preference. In a case series of 45 patients at the Mayo Clinic, NGtubes were used in 48% of patients, with a mean duration of 12.5 days.4 In another case series of 18 patients at the Mount Sinai School of Medicine, no feedingtubes were used and patients were fed a pureed diet one day after surgery.14 These data suggest an advantage over primary chemoradiation, where 17-30% patients are gastrostomy-tube dependent after one year due to dysphagia.18, and open surgery, where all patients are typically kept on NG tubes for several weeks due to aspiration risk.

**FUTURE DIRECTIONS**

With the increasing popularity of robotic surgery, training guidelines and opportunities must be developed for current practitioners looking for certification. Similarly, as more residency programs acquire robot access, standardization of residency and fellowship curriculums will also be important. Currently, all Head and Neck Surgery fellows graduating from the University of Pennsylvania are trained in TORS.1 The university also runs a TORS training program for surgeons from around the world.

As surgeons become more comfortable with TORS, new and innovative procedures are being developed as well. One example is transaxillary thyroidectomy, where the thyroid gland is removed without having to create an unaesthetic cervical scar. The procedure was developed in Korea and has been performed in over 300 patients as of 2009.17

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The role of FDG-PET and PET/CT in the diagnosis and staging of head and neck cancer

Adrian Matthews (Meds 2013), Jai Prashanth Jayakar (Meds 2013) and Joshua Rosenblat (Meds 2014)
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An estimated 644,000 cases of head and neck cancer are diagnosed worldwide each year, with head and neck squamous cell carcinoma (HNSCC) accounting for over 90% of these. Common presenting sites include the oral cavity, oropharynx, nasopharynx, hypopharynx, and larynx.1 While chronic tobacco use and alcohol consumption are well-established risk factors,2 human papillomavirus (HPV) infection of the upper aerodigestive tract has been causally linked to tumorigenesis.3 In particular, the increasing rates of oropharyngeal cancers, especially young non-smokers, has been directly attributed to HPV infection.

The diagnostic workup of HNSCC typically includes history and physical examination, endoscopic-guided biopsy and high-resolution contrast-enhanced computed tomography (CT) or magnetic resonance imaging (MRI). While CT and MRI have traditionally been the cornerstones of the imaging workup, 2-fluoro-[18F]-deoxy-2-D-glucose positron emission tomography (FDG-PET) plays an increasing role in the diagnosis, staging and follow-up of HNSCC patients.1,4,5

FDG-PET AND PET/CT IMAGING
FDG, a glucose analog labelled with the radionuclide 18F, preferentially accumulates in cells that have an increased glycolytic rate – a characteristic feature of cancer cells.6 FDG-PET is thus a functional imaging modality that detects cellular metabolic changes, unlike CT and MRI, which rely on structural abnormalities. The positrons emitted by the radionuclide anihilate nearby electrons and create photons that are captured by an array of detectors and reconstructed into a 3D image. Although PET alone is limited by its lack of anatomic localization, the advent of the hybrid PET/CT scanner has overcome this by fusing PET and CT images acquired in a single session, permitting detailed visualization of both structural and functional aspects of disease.1,4,6

STAGING OF HEAD AND NECK CANCER

TNM STAGING
HNSCC is staged according to the size and extent of the primary tumour (T), regional lymph node involvement (N) and the presence of distant metastases (M).4 Accurate staging at the time of diagnosis is the most important factor for planning management and determining prognosis.4,7 Since the preservation or restoration of function is a top priority in the management of patients with HNSCC, function-sparing strategies such as minimally invasive surgery or (chemo)radiotherapy are often considered as first-line treatments.8 Thorough clinical assessment, including imaging, is vital to optimal staging of HNSCC. Furthermore, re-evaluation of patients following treatment may be especially challenging in HNSCC due to difficulty in obtaining pathology. The following subsections review the clinical indications for FDG-PET and PET/CT in staging HNSCC.

PRIMARY TUMOUR

While PET and PET/CT have been shown to be at least as effective as CT or MRI at detecting primary tumours, these modalities are not used in standard practice to T-stage newly diagnosed HNSCC because their anatomic resolution is not as high as that of MRI or contrast-enhanced multislice CT.9-13 An early tumour may have poor FDG uptake and its detection on the scan may be obscured by cross contamination of physiologic activity from surrounding tissues – the so-called ‘spillover effect’.14 CT and MRI are useful for initial T-staging, since their high spatial resolution and soft-tissue contrast can demonstrate subtle abnormalities and accurately delineate tumour volume.

CARCINOMA OF UNKNOWN PRIMARY

In 2-9% of patients with newly diagnosed HNSCC, cervical node metastases are clinically evident at biopsy but the primary tumour cannot be identified by conventional workup, which includes physical examination, CT, MRI and endoscopic-guided biopsy.15 PET/CT has proven to be significantly more sensitive than CT (94.0 versus 71.6%, respectively, P < 0.001) at detecting carcinomas of unknown primary.16 Rusthoven et al. reviewed 16 studies published between 1994 and 2003 and found that among 302 patients with a negative conventional workup, FDG-PET detected the primary tumour in 74 patients (24.5%).17 In a more recent review, Al-Ibraheem et al. performed a meta-analysis of 8 studies published between 2000 and 2009.5 FDG-PET or PET/CT were able to detect the unknown primary in 51 of 180 patients with an otherwise inconclusive workup. Delineation of a primary tumour is essential for delivering targeted therapy, minimizing therapeutic morbidity caused by wide-field irradiation and improving prognosis.18 A recent report noted that findings made by FDG-PET changed therapeutic management in 25% of patients.19 In light of this evidence, PET/CT may have an important role in the diagnostic assessment of carcinoma of unknown primary.5

CERVICAL NODE METASTASES

Cervical node status is the most important prognostic factor in HNSCC.7 Cure rate declines by nearly 50% when cervical metastases are present.20 Metastatic lymph nodes are found in approximately half of patients at the time of diagnosis.21 PET/CT has been shown to have better sensitivity and specificity for pathologic cervical nodes than MRI and CT, likely because the latter rely on nodal size and contrast-enhancement criteria which are not specific and can miss metastases in normally sized nodes.22,23 Nevertheless, CT is generally used for local staging of clinically manifest cervical nodes at initial diagnosis, due to its clinical availability and accurate T-staging of the primary tumour.
CLINICALLY NEGATIVE (N0) NECKS

If clinical examination fails to identify metastatic cervical lymph nodes in patients with primary HNSCC, these patients are said to have a clinically negative (N0) neck. Since the probability that these patients actually have a pathological neck varies between 10-45%, elective neck dissection is recommended in cases where the risk of occult cervical mets is greater than 20%.4 While PET/CT is the most accurate imaging modality for detecting occult metastases, the role of PET/CT in the assessment of N0 necks is still controversial.7 Microscopic disease or nodal metastases located adjacent to the primary tumour may evade radiographic detection and contribute to false-negatives. Two studies reported sensitivity and specificity ranging from 67-79% and 82-95%, respectively, leading the authors to conclude that PET/CT is not yet accurate enough to inform the need for surgical dissection in cases of occult nodal disease.24,25

SECOND PRIMARY (SYNCHRONOUS) MALIGNANCY AND DISTANT METASTASES

Patients with advanced HNSCC are at higher risk for developing distant metastases and for presenting with a second primary (synchronous) tumour.26 the latter being defined as a histologically distinct malignancy, separated from the primary tumour by at least 2cm of normal mucosa.27 The cost of missing distant metastases or synchronous tumours at the time of initial diagnosis is high. Curative therapies are often associated with significant morbidity, necessitating the careful selection of patients with nonmetastatic disease who may benefit from the treatment and not eventually succumb to previously undetected distant disease.28 Aggressive subtypes, such as nasopharyngeal carcinoma, have a tendency to metastasize to the lungs, liver and bone; hence, the conventional imaging workup for distant metastases is comprised of chest radiography, abdominal ultrasound, and skeletal scintigraphy (bone scan). Several reports have assessed the efficacy of PET/CT in staging distant metastases and synchronous tumours and found that it is the most sensitive, specific and accurate modality and may replace conventional techniques.14,28,29 A multicentre prospective study of 92 patients found that PET/CT had a higher sensitivity (63%) than chest CT (37%), due to its ability to image the whole body with a single scan and detect distant hypermetabolic foci.30 PET/CT can therefore be considered as the modality of choice for the diagnostic workup of distant metastases and synchronous tumours.7

RESIDUAL AND RECURRENT DISEASE

The reliance of CT and MRI on morphologic criteria often makes the detection of post-treatment residual tumour activity or recurrent disease difficult, since the regional head and neck anatomy may be distorted after therapeutic (chemo)radiotherapy and/or surgery.4 Al-Ibraheem et al. reviewed the utility of PET and PET/CT for identifying disease recurrence in head and neck cancers.5 Among 7 studies published between 2004 and 2009, PET or PET/CT demonstrated high sensitivity (83-100%) and relatively high specificity (78-98%) and accuracy (81-90%), often significantly outperforming CT and MRI. Inflammation and infection are common treatment sequelae that may increase FDG uptake in certain tissues; hence, the addition of CT to PET is especially important in these situations in order to distinguish truly pathologic areas from post-irradiated tissue.12,22 The anatomical landmarks provided by CT have been shown to decrease the number of equivocal hypermetabolic foci and therefore reduce the amount non-invasive imaging and invasive biopsies required for diagnosis of recurrence.12

LIMITATIONS

False-positives

In addition to the post-irradiation changes discussed above, increased FDG uptake may occur in benign hyperplastic conditions such as thyroid or pleomorphic adenomas. Regional physiologic FDG uptake in lymphoid tissue, salivary glands, strained or excessively used skeletal muscles and activated brown fat tissue may also confound interpretation and be erroneously attributed to malignancy.4,6 It is recommended that positive results be confirmed by biopsy.6

False-negatives

Since the spatial resolution of FDG-PET is limited to 4-10mm, its ability to precisely localize small tumours or microscopic tissue involvement is often diminished in the head and neck region. Tumours with low metabolic rate and poor avidity for FDG uptake may also be difficult to characterize on PET scans.6

SUMMARY AND RECOMMENDATIONS

In 2009, Yoo and Walker-Dilks reviewed the data and made recommendations for the use of FDG-PET in head and neck cancer.31 The guidelines, part of an initiative of the Program in Evidence-Based Care for Cancer Care Ontario, are consistent with the findings reviewed here and are summarized in Table 1. It is worthwhile to note that studies examining PET and PET/CT were not distinguished in the report; however, the hybrid system clearly confers a diagnostic advantage over either modality alone.4-7 Despite its limitations, increasing use of PET/CT for the diagnosis, staging and follow-up of HNSCC patients has provided physicians with a powerful tool that will continue to improve patient outcomes as the technology advances and clinical guidelines are refined.

REFERENCES


Table 1. Recommendations for FDG-PET in head and neck cancer. Adapted from Yoo and Walker-Dilks.31

<table>
<thead>
<tr>
<th>FDG-PET and PET/CT are recommended for:</th>
</tr>
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<tbody>
<tr>
<td><strong>Diagnosis/Staging</strong></td>
</tr>
<tr>
<td>- M and bilateral nodal staging of advanced HNSCC displaying equivocal conventional imaging</td>
</tr>
<tr>
<td>- identification of unknown primary site, in addition to conventional imaging and diagnostic panendoscopy</td>
</tr>
<tr>
<td>- staging of nasopharyngeal carcinoma without evidence of distant disease</td>
</tr>
</tbody>
</table>

| **Recurrence/Restaging**                |
| - restaging patients who are being considered for major salvage treatment (surgery or other) |


Marijuana use: sequelae and implications for health promotion

Karline Treurnicht Naylor (Meds 2013), Daniel James (Meds 2013) and Stephanie Gottheil (Meds 2014)
Faculty Reviewer: Dr. Donald Farquhar

A s of 2003, 40% of Americans aged 12 years and older had smoked marijuana at least once.1 Approximately 30% of Canadian youths from Grades 7-12 have tried cannabis at least once.2 Marijuana is the most widely-used illicit substance in Canada, with 10.6% of the Canadian population reporting use in 2009.3 This is similar to the US annual figure of 9%.4 Global reports indicate that the average age of first marijuana use is decreasing, even as the average delta-9-tetrahydrocannabinol (THC) content of cannabis is on the rise. This may lead to an increase in both addictive potential and adverse effects of marijuana use.5

A survey of the adult US population comparing figures from 1992 and 2002 suggested that the prevalence of marijuana use remained stable over the decade, but the prevalence of marijuana dependence increased significantly. This increase in marijuana use disorders has occurred in the absence of increased frequency or quantity of marijuana use, suggesting that the enhanced potency of THC may have lead to the rise in rates.6 Treatment admissions for cannabis abuse have risen steadily over the past ten years, including a 2-fold increase in the US and 3-fold increases in Australia and Europe.7

Although public perception remains that cannabis is “softer” and less dangerous than other illicit substances, cannabis use is becoming a major public health concern; some research even suggests it may serve as a gateway drug to “harder” substances.8 Furthermore, multiple studies have shown an increased risk in marijuana users of other long-term health consequences. In this paper, we review current research and understanding of marijuana’s impact on health outcomes. We also provide an overview of at-risk populations for use and abuse of marijuana, summarize marijuana’s potential positive effects, and discuss implications for health promotion and various levels of prevention.

PULMONARY EFFECTS

Numerous studies have shown that the combustion of tobacco and marijuana produces similar harmful compounds.9,10 The risks of marijuana may be increased by three factors. Marijuana smoke has three times more tar and 1.5 times more carcinogenic substances than tobacco smoke.10 Marijuana smoke is typically inhaled more deeply and held in the lungs longer; there is more time for deposition of particulate matter. Furthermore, marijuana cigarettes do not contain the same filter apparatus as conventional tobacco cigarettes. On the other hand, even heavy marijuana use involves far less smoke inhalation than the equivalent amount of tobacco in a pack-a-day smoker. One analysis of 19 previous studies defined marijuana use as smoking 10 or more marijuana cigarettes per week for 5 or more years.1 One pack of tobacco cigarettes contains 20-25 cigarettes, and the cigarettes generally contain more combustible material than their marijuana counterparts.

Smoke - whether from marijuana, tobacco or any other combustible - is noxious to the airways. This stimulates short-term bronchitic reactions, including coughing, sputum production and wheezing. In turn, these activate the mucociliary escalator, which carries particulate matter from the bronchi cranially to be expectorated or swallowed.

One systematic review found that inhaling marijuana smoke can cause clinical dyspnea and pharyngitis, as well as exacerbating pre-existing pulmonary illnesses such as asthma and cystic fibrosis; these effects persisted after adjusting for concurrent tobacco use.2 Despite these apparently harmful effects, the review found no association between marijuana smoke inhalation and effects on FEV1 (forced first-second expiratory volume) or FVC (forced vital capacity), DCO (diffusing capacity of the lung of carbon monoxide) or airway hyperreactivity. The authors explained these findings by suggesting that cannabinoids promote the Th-2 anti-inflammatory immune response while nicotine suppresses it. One study noted that the use of a vapourizer when consuming marijuana was associated with decreased respiratory symptoms.11 A vapourizer is a device that heats the marijuana to the vaporization point of the cannabinoids without the use of flame, thereby obviating the consequences of smoke inhalation. Although there are many confounders in these analyses, not the least of which is the fact that many marijuana users cut the dried marijuana with commercially-available tobacco, it can be concluded that smoking marijuana exacerbates pre-existing respiratory complaints by directly irritating the respiratory epithelium. However, contrary to tobacco smoke, marijuana smoke does not seem to cause obstructive pulmonary diseases.

LUNG CANCER

The extant literature on marijuana and lung cancer presents conflicting information. On the one hand, marijuana smoke contains benzopyrene, a carcinogenic hydrocarbon also found in tobacco smoke, which has been implicated in mutations related to lung cancer. Experimental studies have also demonstrated THC-induced malignant cell proliferation and suggested that THC inhibits antitumour immunity, thus promoting tumor growth. In contrast, other in vitro models suggest that cannabinoids may actually exhibit anticarcinogenic effects.12 In an attempt to reconcile these divergent streams of thought, Mehra, Moore, Crothers et al. undertook a systematic review to determine the associations between marijuana smoking and lung cancer incidence, risk factors, or premalignant changes.1 The authors found that marijuana smoking has increased tar delivery to lungs compared with cigarettes, and marijuana smoke contains similar carcinogens as tobacco smoke, often in increased
concentrations. Marijuana smoking was associated with the presence of more metaplastic cells, impaired alveolar macrophage function, and increased oxidative stress when compared with non-smokers. Six studies included in the systematic review reported histopathologic and molecular findings from bronchial biopsy; in all studies, marijuana smoking was associated with abnormal and/or precancerous alterations when compared with either non-smokers or tobacco smokers. One study in particular reported an additive effect between marijuana and tobacco use. All these findings suggest a biological plausibility for the association between marijuana use and lung carcinogenesis. However, a cohort study of 65,000 subjects showed no increase in lung cancer incidence in marijuana smokers after controlling for tobacco use. The authors suggested that there may be methodological concerns underpinning the lack of empirical support for increased lung cancer incidence in marijuana users, including the need for more detailed assessment of marijuana exposure and longer follow-up periods. They also cautioned that physicians should still advise their patients of the potential adverse health effects of marijuana use, including premalignant lung changes.

While methodological factors may well account for the lack of evidence for an association between lung cancer and marijuana use, Melamede\textsuperscript{13} has summarized another line of thought: although marijuana and tobacco smoke contain similar carcinogens, cannabinoids and nicotine present with very different cellular effects. Firstly, although low-doses of THC may indeed promote tumour growth, the response appears to be biphasic; alternate doses of cannabinoids have been capable of destroying cancer cells (including lung, breast, prostate, skin, and glioma) in vitro and in animal models. Secondly, both nicotine and cannabinoid receptors are linked to signaling pathways that can turn on anti-apoptosis (i.e. preventing cell death). Nicotine receptors are found in respiratory epithelial cells, while cannabinoid receptors are not. As such, when nicotine receptors are stimulated in respiratory cells, there is an anti-apoptotic signal; the prevention of cell death under exposure to such mutagenic conditions (i.e. smoking) is likely to amplify carcinogenic potential. Thirdly, while nicotine promotes neovascularization and thus tumour growth, cannabinoids inhibit angiogenesis and results in tumour regression. Finally, the introduction of particulate matter and carcinogens into the respiratory system results in the creation of a pro-inflammatory state. In this circumstance, cannabinoids reduce the associated free radical production by driving a relatively anti-inflammatory Th2 immune cytokine profile. Melamede suggests that all these critical factors can explain the lack of association between cannabis use and lung cancer.\textsuperscript{13}

Even in light of this controversy surrounding cannabinoids and their association with lung carcinogenesis, Guzmán has gone so far as to suggest that cannabinoids could be used to develop novel anticancer therapies.\textsuperscript{14} In addition to evidence suggesting inhibition of tumour growth, marijuana may also be beneficial to chemotherapy patients — it has the potential to mitigate nausea, vomiting, and pain while also stimulating appetite.

**NEUROPSYCHOLOGICAL EFFECTS**

Aside from its respiratory and pulmonary effects, marijuana use has been associated with neuropsychological consequences. Chronic marijuana use has historically been associated with impaired cognition, including reduced attention, memory, higher cognitive function (e.g. executive function) and psychomotor deficits. One study showed that after 25 days of abstinence, moderate (8-35 marijuana cigarettes/week) and heavy (53-84 marijuana cigarettes/week) users had decreased activity in the right lateral orbitofrontal cortex and the right dorsolateral prefrontal cortex, and increased activity in the left cerebellum, compared to the control group, during a decision-making game.\textsuperscript{15} Another imaging study, using transcranial Doppler sonography, showed increased cerebrovascular resistance in chronic light to heavy users.\textsuperscript{16} However, these studies were small, with 11 and 54 subjects, respectively. One meta-analysis of studies totalling 623 chronic marijuana users found that although these individuals may show decreased ability to learn and remember new information in the long term, other cognitive processes were unaffected. Thus, while there may be neurophysiological and neurovascular effects of chronic marijuana use, some of these effects may be silent.

Marijuana use has been shown to have negative psychological consequences, specifically an increased risk of psychosis. It is possible that cannabinoids' effects on dopamine release contribute to the onset of psychosis.\textsuperscript{17} A systematic review of 35 population-based longitudinal studies concluded that individuals who had ever used marijuana had an increased risk of developing psychosis later in life.\textsuperscript{18} Furthermore, a dose-dependent relationship was observed where heavier users had a further increased risk of psychosis (adjusted OR 1.41, 95% CI 1.20-1.65 vs. 2.09, 1.54-2.84, respectively). Of course, a possible interpretation of these results is that an underlying, undiagnosed psychotic disorder leads to cannabis use, which facilitates the discovery of the pre-existing psychological illness.

Similarly, the oft-cited 'amotivational syndrome', in which the sufferer is chronically unproductive, aimless and unmotivated, is associated with chronic marijuana use. One study found that individuals who have used marijuana a minimum of 5000 times were significantly less likely to graduate from college and less likely to earn more than $30 000 (US) per year.\textsuperscript{16} However, like psychosis, this may be explained by the presence of many confounders including pre-existing depression. Gruber et al. have recently published data indicating significant alterations in frontal white matter tracts in chronic marijuana smokers. The authors suggest that these changes are associated with increased impulsivity, which may contribute to the initiation of chronic marijuana use or the inability to discontinue use.\textsuperscript{20}

**HEALTH PROMOTION**

**Risk factors for marijuana use and abuse**: Risk factors for marijuana use include male gender and age 18-25, while risk factors for dependence, defined as a maladaptive pattern of use despite negative effects, increased use, unsuccessful attempts at cessation and physiologic withdrawal, include male gender, age 12-17 and absence of post-secondary education.\textsuperscript{19} Stinson et al.\textsuperscript{21} have underscored that cannabis abuse and dependence are generally phenomena of adolescence and young adulthood, and onset of dependence after age 30 is rare. Stinson et al.'s results confirmed that, unlike with alcohol (where risk of dependence persists for decades after first use), there is a shorter developmental period of risk for cannabis dependence. As such, there is a window of opportunity in early adolescence for the implementation of prevention and intervention programs, in order to have maximum impact. A prospective longitudinal study of a community sample (n = 3021) aged 14-24 years in Munich, Germany,\textsuperscript{22} found that 56% of all repeated cannabis users (five times or more) still reported cannabis use at 4-year follow-up. At 10-year follow-up, this proportion had decreased only slightly to 46.3%. Among young who are repeated cannabis users, patterns of use remain stable, and rates of cessation are low, until age 34. Such patterns suggest that preventive measures should delay first use and reduce the number of uses, as these factors appear crucial in the transition to persistent and dependent use of cannabis.\textsuperscript{22}

Although males may have higher rates of marijuana use, Schepis et al.\textsuperscript{23} have suggested, based on results from a cross-sectional survey of Connecticut adolescents, that females may have a more rapid transition from initial marijuana use to regular or dependent use. The
authors also suggested that marijuana use was associated, not surprisingly, with risk behaviour participation (e.g. other substance abuse) and that participation in extracurricular activities was protective against marijuana use. A prospective cohort study of Swiss teenagers and young adults was performed to evaluate different leisure time activities and the persons (e.g. partner, friend, sibling) with whom the activities were undertaken. The choice of companions for leisure activity was more important than the activity itself as a predictor of initiation and progression of cannabis use, supporting the widespread view that peer influences are particularly important in young people's risk behaviours. This finding was reinforced by data from the German study cited above, in which peer use of cannabis, stressful life events and alcohol dependence predicted long-term marijuana use.

Marijuana and tobacco: Health promotion for marijuana cessation is particularly important given the high co-morbidity between marijuana and tobacco use, and the potentially damaging interaction of these two substances on respiratory outcomes. Leatherdale, Hammond, Kainenman et al. described results from a 2004 tobacco use survey of 20,000 young adult Canadians (aged 15-24). The rates of marijuana use were highest among current tobacco smokers, and lowest among youth who had never smoked. Those who use marijuana are less likely to quit smoking (odds ratio 1.94); those who use marijuana daily are even less likely to quit than those who have used at some point in the past 30 days. Thus, while marijuana use itself may or may not be associated with an increased risk of lung cancer, marijuana use may secondarily increase the risk of lung cancer through its association with persistent tobacco use. Conversely, through use of prospective survey methodology, Schaub et al. found that nicotine use increases the risk for both the initiation and the progression of marijuana use. The authors also reported that tobacco use remained high even after reduction or cessation of cannabis use. Thus, there appears to be a bidirectional risk between tobacco and marijuana use, with use of either substance increasing the likelihood of using the other. Clinicians should ask about marijuana history and take marijuana use into account when recommending tobacco smoking cessation measures for their patients, and vice versa.

Mental health disorders and use of cannabis: A study of 8841 Australian adults aged 18-85 years found that participants with affective disorders and anxiety disorders were at increased risk of harmful drug use and drug dependence. This correlation was particularly strong for young males, a group already identified earlier as high-risk for marijuana dependence. Another study reporting on cannabis use disorders and mood and anxiety disorder comorbidity showed that bipolar disorders, panic disorder with agoraphobia, and generalized anxiety disorder had the strongest associations with cannabis abuse and dependence. While the directionality of this association remains unclear, one theory is that the experience of untreated affective disorders and anxiety disorders may lead to self-medication with psychoactive substances such as marijuana. As such, it is important for health practitioners to identify and treat underlying mental health conditions in a timely and effective manner. Indeed, there is evidence that such practices can reduce marijuana use, as demonstrated by two randomized controlled trials included in a systematic review. For example, in a fluoxetine treatment group, cannabis use decreased in patients with depression. In patients with psychotic disorders, both olanzapine and risperidone treatment groups also reduced cannabis use. From a health system-level perspective, overcoming the treatment fragmentation between mental health and drug and alcohol services would mean that the issue of comorbidity among clients (particularly young people) can be more adequately addressed.

Treatment of marijuana use disorders: Despite public perceptions of marijuana as a relatively innocuous drug, exposure to psychoactive cannabinoids can induce strong drug-seeking behaviours; these are mediated by increased dopamine release in the brain's reward pathway. Abrupt withdrawal of cannabinoids after long-term exposure can produce dysphoric effects, which may contribute to relapse. Although cannabis shares neurobiological features associated with dependence on other drugs, only approximately one-tenth of individuals who abuse cannabis had ever received treatment. Psychosocial interventions, although effective in the short-term, often lead to long-term relapse, and the available behavioural treatments are only modestly effective. As such, there is a need to develop pharmacological intervention, and currently none have been validated through clinical trials.

As described above, cognitive impairments may not be fully reversible even 1 month after cessation of marijuana use. It remains unclear if these findings reflect long-term effects of marijuana, or simply an impairment of baseline cognitive functioning in marijuana users. Nonetheless, cognitive impairments in marijuana users may result in poor treatment response, particularly in light of the lack of motivation and increased impulsivity that is associated with chronic marijuana use. Studies have suggested that cholinesterase inhibitors may have a role in improving cannabis-induced cognitive impairments, but these drugs have not yet been evaluated in humans for the treatment of marijuana dependence. Cognitive rehabilitation has improved function and treatment outcomes in individuals addicted to other drugs. Soffuol et al. have thus suggested that improving cognitive function may serve as an important treatment strategy for marijuana use disorders.

Harm reduction through use of vapers: Given the widespread use of marijuana, the increasing abuse and dependence on this substance, and the paucity of effective treatment strategies, it is important to consider harm reduction approaches to mitigate marijuana's potential adverse consequences. This pragmatic approach is particularly compelling given marijuana's increasing use for medicinal purposes. According to results from a 1998 Canadian survey, medical use of marijuana was less common than its recreational use (2% versus 7%), but this picture may change in light of the shifting legal landscape surrounding medicinal marijuana. Cannabinoids activate the same neurotransmitter pathways as endocannabinoids, producing effects ranging from analgesia to appetite stimulation to nausea reduction. They also cause a reduction of intraocular pressure, hence the usefulness of marijuana in treating the symptoms of glaucoma. The main challenge for the medical use of cannabinoids is the development of safe and effective methods of use that lead to therapeutic benefit, without respiratory consequences or other adverse effects.

Earleywine and Barnwell have described the use of vapers among marijuana smokers: vapers release active cannabinoids but not smoke or carcinogens associated with combustion. The use of a vaper is associated with decreased respiratory symptoms, and this effect increases with the amount of cannabis used. Furthermore, vapers can deliver cannabis with no carcinogenic potential. This has important implications for safe use of medical marijuana as well as harm reduction among recreational smokers. In one study, twenty frequent cannabis users who reported respiratory complaints were evaluated before and after the use of a vaper for one month. Among participants who did not develop a respiratory illness during the trial, there was a significant improvement in respiratory symptoms and FVC, and a non-significant improvement in FEV1. These improvements could be even more meaningful in cannabis users who also smoke tobacco. The authors concluded, given these meaningful recovery of respiratory function, that a randomized clinical trial of the cannabis
vapourizer should be performed. The vapourizer has potential for the administration of medical cannabis and as a harm reduction technique, particularly for those uninterested in marijuana cessation or who have been chronic, heavy users.

CONCLUSION
Although the prevalence of marijuana use has not changed significantly in recent years, the higher cannabinoid content of current plants may be contributing to the observed increase in rates of dependence in adolescents. Both phenomena – increased dose of psychoactive drug, and increased rates of serious dependence – have catalyzed more research into the long-term neuropsychiatric effects of marijuana use. Long-term marijuana use is associated with an increased risk of psychosis and ‘amotivational syndrome’. However, the direction of causation remains unclear, not least because the risk of marijuana dependence during adolescence is clearly increased by co-morbid psychiatric disorders and has been characterized as a form of ‘self-medication’. Marijuana is also associated with specific long-term cognitive abnormalities; the possibility of reverse causation seems remote for these findings, but further research is needed. Marijuana has immediate adverse effects on respiratory mucosa similar to tobacco; however, evidence for chronic respiratory disease related to marijuana is weak. For lung cancer, similarly, heavy marijuana use produces metastatic changes but there is no compelling evidence for an association with clinical disease. The contradictory evidence for both conditions may reflect differences in the chemistry and cellular effects of marijuana as contrasted with tobacco, as well as the high frequency of joint exposure. In that latter regard, the more significant risk for respiratory illness, including malignancy, may result from the strong association of tobacco and marijuana use, and the reduced likelihood of smoking cessation in the presence of joint dependence.

From the standpoint of health promotion, we can draw a number of key conclusions. Primary prevention of marijuana dependence will require health education targeting pre-adolescence. The prevalence of comorbid psychiatric disorders in dependent adolescents highlights the need for an integrative approach to treatment and secondary prevention. Awareness of the joint use of tobacco and marijuana is important for clinicians seeking to promote smoking cessation. Lastly, vapourizers have the advantage of mitigating respiratory risk and may serve as an effective harm reduction strategy for those who are chronically dependent or using cannabinoids for clinical indications.

REFERENCES


An Interview with Dr. David Leasa

Lauren Sham (Meds 2014), Abdul Naeem (Meds 2014), Joyce TW Cheung (Meds 2013)

In disaster management, where etiologies of disease can be unknown and every second is of the essence, a well-functioning intensive care unit (ICU) is paramount. The SARS (Severe Acute Respiratory Syndrome) outbreak in 2003 highlighted the importance of efficiency in meeting the challenges of medical urgencies. In an area where resources are limited, crises exacerbate challenges with staffing shortages and bed reductions, compounded by disease transmission within the ICU, staff quarantine, emotional stress, and a constant influx of critically ill patients. However, the 2003 outbreak also presented itself as an opportunity to improve critical care delivery, with respect to implementing better infection control measures, developing software for handheld devices specific for SARS, and having regular teleconference calls to both combat the feelings of isolation and increase information dissemination on this unknown illness. One needs passion and proficiency in handling “acute medical problems where problems often come in undefined,” says Dr. David Leasa, a London, Ontario based ICU physician.

Dr. Leasa was born and raised in Waterloo, Ontario, and studied Physiology and Pharmacology at the University of Western Ontario (UWO). He continued his studies at UWO in medicine and completed his internal medicine residency there as well. After specializing in Respiratory and Critical Care he moved to Seattle, Washington to pursue a year of research. He moved back to Canada, worked at St. Joseph’s Hospital and later moved to University Hospital where he is currently working as an ICU physician and Respiriologist. When not in the hospital, Dr. Leasa enjoys being outdoors. He likes to ski (even hopes for a retirement in Whistler!), swim, and run - all activities he feels help him lead a balanced healthy life.

Being an ICU physician and a Respiriologist is demanding. Dr. Leasa leads a very active and busy work life. He tends to have a week of “days” (12 hour shifts) in ICU, alternating with a week of “nights,” and is on-call some weekends. During nights, a new initiative is in place where the ICU staff has critical care outreach. Qualified ICU physicians extend their expertise to other departments if they feel a patient might end up in the ICU. By extending their services outside of their usual boundaries, they are assisting patients earlier, with the aim of preventing ICU admissions. He also has a week in Extended ICU (EICU) where he provides care for patients needing prolonged ventilator care for greater than three weeks. In addition to ICU, he spends one week every 2 months on the Respiricall service taking consultations. Finally, he also has a chest clinic that is evolving into providing care for chronically ventilated patients.

In the ICU, Dr. Leasa emphasizes, “You need to have a team of people put forth what is the best management for that individual.” This team approach reflects the dynamics on the wards. In the ICU, all the physicians come from different specialties but have added skills in critical care. (Critical care is an additional two-year RCPSC subspecialty after having completed a base specialty.) Dr. Leasa admits that as he gets older, ICU may be too demanding (especially nights!) and that it will be nice to be able to fall back on his outpatient practice. He enjoys chatting with his patients and meeting people in this setting. This provides continuity with patients who get very ill initially, but he can follow and see them in a different setting as they recover - see their personality and who they are as individuals, something he cannot always experience in the ICU. However, his passion has always been intensive care. He enjoys managing and problem-solving acute care Respiriology cases in the ICU, from pneumonia to acute respiratory distress syndrome (ARDS), to bronchoscopies and pleural effusions.

The practice of both ICU and Respiriology has led Dr. Leasa to his interest in long-term mechanical ventilation – he is known as the “home ventilation doctor.” He is presently involved in an initiative to provide care for stable chronically ventilated patients by moving them from the ICU environment to other community venues, including home if possible. Dr. Leasa believes that “to do it safely, properly and effectively, we need to do it using a systems approach.” He would want to not only prevent patients from ending up in the ICU again but also improve their overall quality of life through care at home or in the community. At the moment, he is trying to advocate that this initiative needs the proper funding: if we can prevent these patients from using ICU beds and shift these resources to the community, there would be benefits for all. His vision for this project involves developing a community-based
model for the region of Southwestern Ontario. Currently there are more than 180 patients who are on both non-invasive and invasive ventilation in our catchment area. Ventilator technology has changed dramatically over the past decade including its ease of use and increasing application using a noninvasive mask interface. However, several hurdles remain including cost, need for trained community care providers and for patients/family members to be educated and empowered. Dr. Leasa is currently trying to create a coordinated system of people who understand the complicated nature of the care for these chronically ventilated patients. One important task is to identify and support those patients for whom chronic ventilator care at home improves quality of life. Importantly, this needs to be done in a way that coordinates all caregivers’ skills so that patients do not end up back in the hospital. There are many patients that can benefit from this type of technology (especially those with chronic neuromuscular disease), but in order to do this safely and effectively, a preplanned system needs to be in place, and this is what Dr. Leasa is trying to help establish.

The future of critical care holds a plethora of possibilities, but also many difficult ethical issues. Because patients in the ICU are often amongst the sickest people in the hospital, the difficult issue of death and dying often arises, and proves to be a challenge for both families and the ICU team. Dr. Leasa believes that an important step in improving care for patients in the ICU lies in education on the taboo subject of dying. Due to advances in medical technology, patients can be kept alive for longer than their bodies would naturally be able to sustain. Difficult issues arise when one has to consider the quality of life for a patient who is unconscious and unable to survive without the aid of sophisticated machinery.

Dr. Leasa is not one unfamiliar with making difficult decisions. Recently, he had to sit down with the family of a 95 year old man who had a myriad of comorbidities, none of which were easy to manage. As medical students, we learn: “primum non nocere,” or “first do no harm.” You would think that everyone would want to give this man as comfortable a death as possible. However, his family expressed that he wanted to live until he was 104, and wanted everything possible done for him, from intubation to chest compressions. Perhaps it was guilt from neglect in previous family conflicts, or a just desperation to cling onto any semblance of life possible, but these situations are not always as clear as they appear, neither to the family nor to the clinician.

So how do we open up and begin talking about these difficult issues? Dr. Leasa believes the family unit is critical in these discussions. The difficulty in talking about the deteriorating health of a loved one is trying to figure out what the patient would have wanted for him or herself. He recalls some families who have not seen or talked to Dad in ten years but think that prolonging care is what he would want. As critical care has bettered itself with improved communication, so too would families. Dr. Leasa lives out this philosophy, which was inspired by the mentors he has had over the years: “The physicians I learned a lot from were those who sat with patients and talked honestly to them,” he said, noting that they didn’t keep a distance but instead liked to understand the person they were treating.

As past-president of the Canadian Critical Care Society (CCCS), Dr. Leasa has participated in many activities to enhance the quality of care in ICUs across the country. The CCCS has guidelines on how to assist in difficult issues at the bedside, as well as advocate for improvement of patient and family experience in the ICU. He notes that critical care has had its shake ups, including the SARS outbreak which was an eye opener for governments and health care professionals alike, but they learned that critical care had to be done as a collective. He believes that they have been doing a good job in Ontario in dealing with increased occupancies and having clear planning for surges. He notes, “If you stop critical care, you stop everything. Everything starts to back up.” He also thinks we need more discussions on the ethical use of resources: not just at the level of the individual, but on a societal level. He poses the question, “If we had SARS again, and we ran out of ventilators and ICU beds – what would we do? Would we use a predetermined algorithm to see who gets a ventilator and who does not?” He acknowledges that it is difficult to have these discussions, but working through these scenarios is necessary. After going through SARS, politicians finally understood it, even expressing that “SARS was good for critical care – it created outreach teams, put more nurses into the system, and looked at what’s going on with respect to resources – what they are, and where they are.”

Dr. Leasa believes that the general public needs to be better educated on the purpose of the ICU, but also that it has its limits. He and his colleagues spend a lot of their time discussing what critical care resources can and cannot do. Education of the general public becomes increasingly important as the volume in the ICU increases. With the current advances in life support systems we are able to extend life that previously would have ended. This leads to new challenges. He wants people to understand that we cannot cure everything, and we cannot always delay death. Many times patients are chronically ill at the end of their lives and are in a process of dying. Should ICU care and a ventilator be part of that death process? There is still a gap between what patients and or their families expect and what our current medical technology can ethically and reasonably deliver. Dr. Leasa is hoping we can bring the two closer together.

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A lung mass and digital clubbing in a young woman

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Faculty Reviewers: Dr. David Leasa, Dr. S. Nelson

Inflammatory myofibroblastic tumours (IMT), also known as plasma cell granulomas or inflammatory pseudotumours, are the most common paediatric primary lung tumours.¹ Patients present at a mean age of 9.7 years, making it an unusual adult diagnosis.² IMTs are extremely rare, accounting for only 0.05% of all thoracic procedures.³ IMT has traditionally been classified as a benign tumour, but recent studies suggest locally aggressive behaviour and malignant potential.¹ Radiographically, it is impossible to differentiate between an IMT and a malignant mass,⁴ as the presentation of the tumours are highly variable. IMT may be cystic or homogeneous, endobronchial or parenchymal.¹ It is thought to result as an inflammatory reaction to an infection or an underlying low grade malignancy. Patients usually present with local mass effects with or without systemic features such as fever, weight loss, microcytic hypochromic anemia, polyonal hyperglobulinemia, elevated ESR, and hypertrophic osteoarthropathy (HOA).² Due to its variable natural history, complete surgical excision is the treatment of choice.³

CASE REPORT
A 24-year-old female presented to our institution with a four-month history of left sided pleuritic chest pain. The patient had a history of hypochromic microcytic anemia and was currently taking oral contraceptive pills and iron supplements. Upon physical examination, a review of systems revealed that she had a non-productive cough, drenching night sweats, fatigue and had lost 10 pounds. She also reported joint pain and morning stiffness, predominantly involving her wrists, knees and ankles. The patient had recently finished a ten-day course of antibiotics with no symptomatic improvement. She was a non-smoker with occasional marijuana and alcohol use. Her family history was negative for malignancy, but her brother had asthma.

The patient had tenderness to palpation over lateral chest wall on physical examination. Bilateral clubbing of the digits was noted.

Laboratory investigations revealed hypochromic microcytic anaemia (haemoglobin level of 80 g/L, a mean corpuscular volume of 77.1 fl, microcytic hypochromasia). Chest plain film showed a mass-like consolidation in the left lower lobe with enlargement of the left hilum. Computed tomography (CT) showed a heterogenous soft tissue mass extending from the lateral chest wall to the inferior aspect of the left hilum. No cavitation or characteristic calcification was identified. Small blood vessels were seen within the lesion, but did not have the appearance of normal lung vessels. The mass extended centrally to contact the inferior aspect of the left hilum. No lymph node, chest wall invasion or rib destruction were identified.

Exploratory left thoracotomy with enucleation of the tumour was performed and an intra-operative frozen section of tumour (3.2 x 2.0 x 1.5 cm) showed histology consistent with benign spindle cell tumour. Following this procedure, the tumour increased in size from 4.1 cm to 5.4 cm over a six month period. This recurrence of the tumour suggested locally aggressive behaviour; and it was decided to perform a left pneumonectomy. Surgical pathology showed no overt cytolitic atypia, however vascular invasion and involvement of the diaphragmatic tissue were evident. Clear resection margins were achieved in the pneumonectomy and resection of diaphragm. Adjuvant chemotherapy or radiation was not recommended.

DISCUSSION

Clinical manifestations
Inflammatory myofibroblastic tumour (IMT) is a rare tumour that is most commonly associated with the paediatric population. Numerous studies, however, has shown that IMT can affect people of any age and equally affects both genders.²⁻⁴ It is also important to note that IMT can occur throughout the body. In a review of 44 patients with IMT, Kovach et al. reported IMT occurring in the liver, gallbladder, orbit, mediastinum, neck soft tissue, trachea, bowel, brain and others.³ The organ with the highest frequency of diagnosis is the lung (9 of the 44 patients).⁴

The presentation of IMT depends on the location of the tumour and is influenced by local mass effects from the tumour size.⁴ IMT can present with a variety of symptoms, both systemic and localized, such as anaemia, weight loss, fever, pain, and mass.² For example, in this case, the patient presented with pleuritic chest pain.

The lung is the most common location of this neoplasm but has been reported to present with extrapulmonary symptoms. There have only been a small number of case reports where hypertrophic osteoarthropathy (HOA) was observed.⁵⁻⁶ Furthermore, these cases occurred in children with no reported adult cases with HOA. The etiology of HOA in association with IMT of the lung is unknown.⁵

Pathology
Inflammatory myofibroblastic tumours pathologically consist of myofibroblastic spindle cells with an inflammatory cell infiltrate.⁵ The appearance of IMT under microscopic examination is variable both between the different site of occurrence and between patients with tumours in the same location.⁴

The etiology of IMT is still under debate and current opinion is changing as new information, especially genetic analysis of the tumour cells, comes available. It was initially proposed that IMT arises from uncontrolled, excessive immune response to tissue injury (most likely from infection); however, more recent studies suggest that it might in fact be a true malignancy.⁴ This is supported by reports of distinct mutations in the cells of these tumours and by the tendency for local recurrence and invasion, distant metastasis and potentially sarcomatous degeneration.¹,⁴
Diagnosis

A diagnosis of IMT impossible to determine clinically as it is generally a diagnosis of exclusion. Upon imaging, a mass will typically be identified; however since IMTs occur with a wide range of radiological characteristics, imaging does not often contribute to the diagnosis. Radiological reports on IMT, show that these tumours can be cystic or homogenous, endobronchial or parenchymal, and with or without clear margins. These qualities make IMT difficult to distinguish from infectious or malignant pathologies. Furthermore, biopsy of these lesions rarely results in a conclusive diagnosis, as IMT can mimic many other pathologies such as fibrous histiocytoma, leiomyosarcoma or fibromatosis. A confident diagnosis can thus only be made following surgical resection and pathological analysis of the mass.

Treatment

There are several treatment options to consider after IMT is diagnosed. The first line treatment is surgical excision since IMTs have the potential to local recur, be locally invasive, and occasionally metastasise. Other suggested options include NSAIDs, steroids, radiation, chemotherapy and observation only.

In a retrospective study, 25 patients had complete resection of the tumour. The 30-day post-operative mortality was 4% and morbidity was 8%. The 10-year survival was 89%, with one patient's death due to extensive sarcomatous recurrence 2 years post surgery. This study demonstrates that IMT has an excellent prognosis with complete surgical excision, however must still be considered a malignancy with the potential to have distant metastasis, local recurrence and sarcomatous degeneration.

While surgery has shown positive results in patient cure rates, the natural history of IMT has not been well studied. In a case series, it was noted that local recurrence occurred in 8% of patients where resection was attempted. Local recurrences tended to occur where complete resection of the tumour was not possible or where radiation or chemotherapy was not received.

CONCLUSIONS

IMT is more common in the paediatric population and rare in adults. However, it should be considered on the differential diagnosis when a mass presents in a non-smoking adult.

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The economics of health and healthcare: a primer for the medical student

Hang Shi (Meds 2013)
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The Canadian medical student, much like the Canadian public, is proud of its healthcare system but believes it is in need of serious reform. The perception is often that costs are increasing to unsustainable levels, with the conundrum that the system still does not deliver as much as it should, to as many as it should, or in a timely enough fashion. In a 2011 national survey, only 5% graded the healthcare system as excellent. However, less than a third of all respondents believed they had a strong understanding of how the healthcare system worked. How can one properly rate a system they do not understand? While medical students have a basic practical understanding of the medical system, they are found lacking when it comes to the economic theories and principles that govern healthcare. This is not surprising given the very limited time that can be allocated out of packed medical curriculums. The concern nevertheless remains that medical students may be unequipped and unprepared for their future roles in healthcare resource allocation and management. Without an appreciation of some basic tenets of healthcare economics, having a healthy discussion, taking a position, and making a well-informed decision on issues of healthcare systems will be difficult. The purpose of this primer is to introduce to the medical student the most fundamental economic concepts and how they are pertinent to healthcare. Ultimately, it will be up to the students themselves to buttress their knowledge in this increasingly important subject area, this editorial can only hope to what the palate just enough to encourage further exploration.

HEALTHCARE IS A SCARCE GOOD

The fundamental problem that underlines the study of economics is based on the simple premise that resources are finite while human needs are infinite. Thinking about a tangible good such as fossil fuels, the idea is easy to grasp. Everyone wants an unlimited supply of fossil fuels to power their generators and run their machines. However because this resource is scarce, there needs to be a system that decides the allocation: namely who gets it and how much they can get. Economists concern themselves over the best way this allocation should be made, and ask themselves how this allocation can be the most efficient while at the same time the most equitable.

When it comes to any good produced in the economy, even one as complex as healthcare, the fundamental problem still remains. The production of healthcare requires the multitude of raw materials and supplies required for equipment and facilities. In addition, it requires the time and training of healthcare workers. All of these, including time, are scarce resources. Individuals sell their time for wages and will even refuse work and wages if it “isn’t worth their time.” People view their time as a valuable resource that if used for work, can no longer be used for other activities such as leisure. In much the same way, once scarce resources are devoted to the production of healthcare, they can no longer be used in the production of other valuable goods. Each joule of energy used to power a Magnetic Resonance Imaging (MRI) machine is one that could have been used to power a school. Each year training one doctor could have been used to train several economists. (It takes more resources to train a doctor than an economist).

One aspect of macroeconomic theory tries to determine how a nation’s scarce resources should be best allocated between its various sectors. When policymakers decide on more MRIs and increasing the number of residency spots, it means we have to give up more of something else. Consider the following: Canada’s Gross Domestic Product (GDP) has increased an average of 1.7% annually over the last decade. GDP is a measure that adds up all the goods and services that an economy produces per year. This indicates that on average, the Canadian economy grew by 1.7% each year over the last decade. The healthcare sector has increased by an average of 4.7% annually over a similar period. If the entire economy is viewed as a pie, then this means that while each year the pie gets a little bigger, it has not been able to keep up with the increasing size of the healthcare slice. If more of the pie is being distributed to healthcare, then less is left over for various sectors such as education, agriculture, or high-tech industry. Everyone realizes that healthcare is important. The difficult question is how important. If for example, we value an additional unit of healthcare more than an additional unit of national defense, then foregoing more defense for increased spending on healthcare benefits society. If our values were reversed, then additional spending on healthcare would result in less social benefit. Deciding how much a nation should spend on healthcare is a difficult question because it calls into question our values and forces us to ask how much we value healthcare over everything else.

ECONOMICS AS A SOCIAL SCIENCE: UNDERSTANDING THE POWER OF INCENTIVES

While the field of modern economics relies on an empirical-based approach with statistical analysis, the field has its roots in the social sciences. At its heart lies the desire to understand the decision making of individuals in their production or consumption of goods or services. Economists assume that decision makers are rational and make choices that best further their own ends. By understanding the incentives that individuals face and how these then motivate a particular course of action, economists can predict and therefore model the outcomes.7,8

When this modeling is applied on a larger scale to groups of individuals, economists hope to better understand and predict the consequences in the economy based on changing incentives. For example, when it comes to physicians deciding their location for practice, incentives play a huge role. As recently as 2006, 1 in 9 physicians educated in a Canadian medical school practiced in the
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United States. Therefore, they contributed nothing to the production of healthcare in Canada. In trying to understand and reverse this phenomenon, Canadian economists and policymakers have identified a number of incentives at play. The most familiar is the remunerative differential with the appeal of higher net income in certain specialties in the US (due in part to their lower taxation rates). By identifying the pertinent incentives, policymakers can devise new strategies to alter them.

However, policymakers also need to be careful due to the undesirable consequences that may result when all incentives have not been taken into account. In many cases, hidden incentives are overlooked and lead to unintended consequences. For example, in the physician-patient relationship, the physician is not only an agent hired to act in the best interest of the patient but is also the seller of health services. In a fee-for-service compensation method, the idea is to compensate the physician based on the services the patients receive. Physicians who perform more services are thought to provide more healthcare and should be compensated accordingly. However, since the income of the physician is linked to how many services he or she provides, there is an incentive to promote more procedures than would otherwise be necessary. These additional services are not only wasteful for the economy and lower efficiency, but they may in fact do harm by leading to poorer outcomes in patients who receive superficial procedures.

**HOW TO COMPARE APPLES AND ORANGES: VALUATION AND COST-BENEFIT ANALYSIS**

The focus of healthcare discussion is frequently directed at curbing the rising costs, and this cost crisis of healthcare dominates the headlines. It sometimes becomes easy to forget that we value healthcare because we want more of its output: health itself. The value of healthcare is not in the number of patient appointments or pills prescribed, but in the number of lives saved and the improvement in health outcome. By placing a valuation on health, the important outcomes such as quantity and quality of life can be measured and expressed. If two medical interventions have equivalent cost, and intervention A can add 3 years to life expectancy and intervention B only adds one year, it becomes quite clear which is superior. In evaluating any project or program, it is important to compare the value of what was bought to its cost. Economists use this principle of cost-benefit analysis when evaluating healthcare programs.

When applied on a larger scale, it offers the potential for comparing different healthcare interventions and even comparing programs in health and non-health sectors. Notice that the interventions in the examples above could have been completely unrelated. Intervention A could be a cancer fighting drug and intervention B a surgical procedure for coronary heart disease. By placing a valuation on both the inputs (the costs of production) and the outputs (the benefits of health improvement), unrelated interventions can be compared. Through a comprehensive cost-benefit evaluation, economic analysis can help policymakers make difficult decisions such as which projects to allocate more resources into, assessing whether a new intervention is superior to the old standard, and in choosing between comparable alternatives. If applied across all healthcare sectors, policymakers can transfer funding from high-cost low-benefit programs with the reallocation of these resource into low-cost high-benefit programs. By minimizing costs and maximizing benefit, the overall effect has to potential to improve efficiency in the system and increase productivity.

**CONCLUSIONS AND LIMITATIONS**

Economic principles and methods offer an approach to addressing healthcare problems. Many observers claim that economics is irrelevant to the study of health and some have argued that health care is fundamentally so different from other goods that financial incentives do not play much of a role. Many will argue that when dealing with life and death, healthcare consumers cannot be expected to maintain rational thinking. Empirical evidence suggests this is too extreme a position. Price and financial incentives definitely do influence both the production and the consumption of healthcare. The more challenging question is to what extent it does. The healthcare sector has a unique combination of features: the prominent public sector, restrictions on competition, and lack of information. Combining this with the extensive uncertainty that exists both in the supply and demand side of healthcare complicates economic analyses. With certain goods, both suppliers and consumers have a good understanding of the product. For example, with orange juice, suppliers know how many oranges are needed to produce the juice and are confident of the quality of the juice, and consumers know how much satisfaction they will receive when drinking a unit of the juice. With healthcare, both the physicians and patients are often uncertain of the outcomes. Rheumatologists are often uncertain of how patients will respond to a particular anti-inflammatory and patients themselves are unsure of the benefit to their length or quality of life. With difficulties in measuring outcome and valuation, the accuracy of the analysis can often be called into question. In the end, modeling can only be as good as the information input. Nevertheless, economic principles and their methods can be a powerful and important tool when thinking about issues in healthcare. One simply has to realize that like all tools, economic analysis in healthcare is imperfect and subject to limitations.

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