Intent MEDICAL GROUP

Issue 01 | May 2025

INTENT FOCUS

STAY INFORMED ABOUT THE WORLD OF HEALTHCARE

INTRODUCTION

The IMG Newsletter is meant to be an informative and current source of information about the clinical Neurosciences, both with the Endeavor System and Internationally. Given the time constraints on our professional lives, our hope is that this quarterly publication will allow a quick summary of the current literature in each of our areas of subspecialty, and provide some insight into the perspective our faculty has on current science, patient care and healthcare in general. Please use this newsletter in any way that suits your current practice. As always, we welcome any feedback about reviews you would like to see, questions you may have and general tips about making this newsletter fit your needs.

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Amin Kassam and Melanie Fukui

Metastatic cancer to the brain, once considered a terminal diagnosis, has seen significant advancements due to remarkable progress in immunotherapy and ongoing research in oncology. As a result, individuals with advanced cancer are now living for many years while maintaining a good quality of life. Survival outcomes are influenced by the primary cancer site—whether breast, lung, or another—yet the quality of life is primarily determined by the brain. The goal of surgical procedures is to prioritize the preservation of quality of life above all, depending on a patient's systemic disease burden.

Several methods for treating metastatic brain cancer are emphasized by our team:

Immunotherapy: Therapeutic stimulation of a patient's own immune system against the disease has transformed many cancers into chronic diseases. Cancer operates as a complex, genetically encoded organism that cleverly disguises its cells to attack and destroy healthy tissues and organs. However, in the past decade, researchers have made significant strides in unmasking many of these cancer cells and targeting them with specific therapies.

AI: With the advent of artificial intelligence (AI) and its capacity to process vast amounts of information simultaneously, we are on the verge of identifying these remaining masks. This will enable us to develop effective, targeted approaches. Ultimately, we aim to unmask cancer, allowing our immune system to combat it in real-time. AI provides an expansive ecosystem that allows us to tap into global knowledge and create tailored therapeutic treatments for patients. This means that individual patients do not need to qualify for a clinical trial and hope to be randomized to the treatment arm. Using their tumor's molecular data helps to guide more targeted, systemic treatments in conjunction with local therapies like surgery and radiosurgery. Our agenda is not to find the right patient to fit the right available trial and then to have them randomized as to whether they get treatment or not.

Our objective is to find the right treatment based on the best available science and the world's cumulative knowledge — everything the world has learned ever and everywhere — to then bring that to each patient.

Pre-operative trajectory planning: Before surgery, patients undergo advanced MR imaging including diffusion tensor imaging (DTI). Specialized planning software converts the DTI into 3D tractography, creating a white matter map of the entire brain. A dedicated neuroradiologist uses this map, after identifying critical vascular and neural structures, to design a safe pathway through normal brain structures. This approach minimizes injury to brain tissue surrounding the lesion to enhance functional outcomes.

Conscious Robotic Surgery: These minimally invasive techniques allow our team to remove tumors through a small port the size of a dime, enabling patients to remain awake and fully conscious during the procedure. This approach ensures that vital brain functions, including the ability to think, speak, and express emotions, are preserved.

Targeted Radiation Therapy: Many patients undergo focused beam radiation or radio surgery to treat tumors prior to surgical resection, while others may receive radiosurgery as a standalone treatment.

Today, patients who five years ago might have lived three to five months, may now survive many for many years with metastatic cancer and a very good quality of life. Our goal is to continue to use individualized, science-based therapeutics to preserve quality of life for each patient.

The combined goal of our multidisciplinary team is to treat patients with metastatic brain cancer in a manner which preserves vital functions such as personality, speech, movement, and cognition. This involves the use of sophisticated surgical and medical therapies, personalized to each individual patient.

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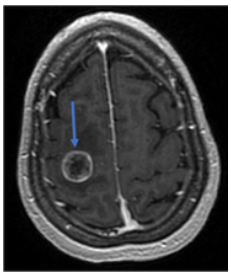
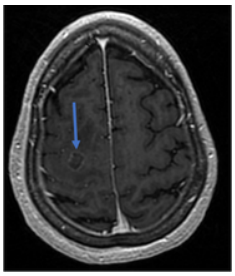
Each patient has their own story, and we need to listen. It's their story, not ours.

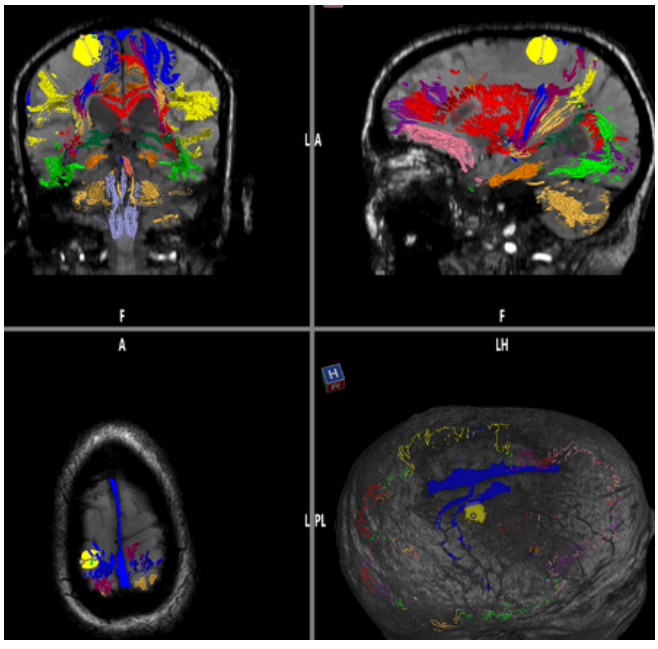


Before Surgery



After surgery –complete tumor removal

One such story is that of a patient with metastatic melanoma who arrived at our Emergency Department after falls due to upper and lower extremity weakness. We were able to complete the staging workup, which demonstrated that the only disease burden was a solitary brain metastasis to the motor strip. The patient underwent a conscious craniotomy – the patient was anesthetized with local nerve blocks to the scalp and minimal IV sedation – so that the patient could comfortably and fully participate in an ongoing neurological exam during the operation. During surgery, as the tumor was removed, the patient regained movement in the arm and leg while still in the operating room. The patient was discharged to home the day after surgery. The patient went on to receive focused radiation (CyberKnife) treatment to the operative bed and remains well controlled and fully functional 3 years later, while continuing to receive systemic therapy.

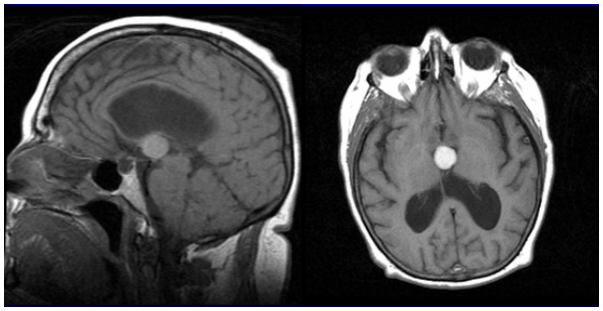


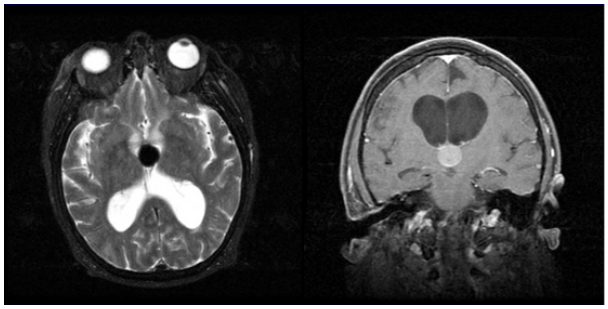
Surgical planning images using SynaptiveMedical 3D tractography allows a dedicated neuroradiologist to use brain mapping to identify critical white matter tracts, tumor, and crucial blood vessels to create a safe surgical trajectory for tumor removal.

Dr. Fukuis Corner #1

Neuroradiology Quiz

(Answers on Page 18)



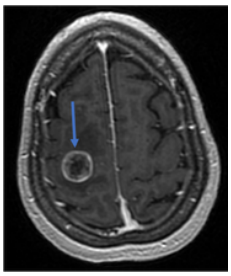


Questions

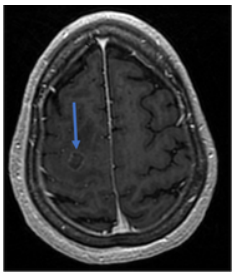
1. Specific anatomic location and imaging findings?
2. Diagnosis?
3. Is lumbar puncture indicated?
4. Presentation?
5. What is the most serious complication?

Continued on page 3

Each patient has their own story, and we need to listen. It's their story, not ours.



Before Surgery



After surgery –complete tumor removal

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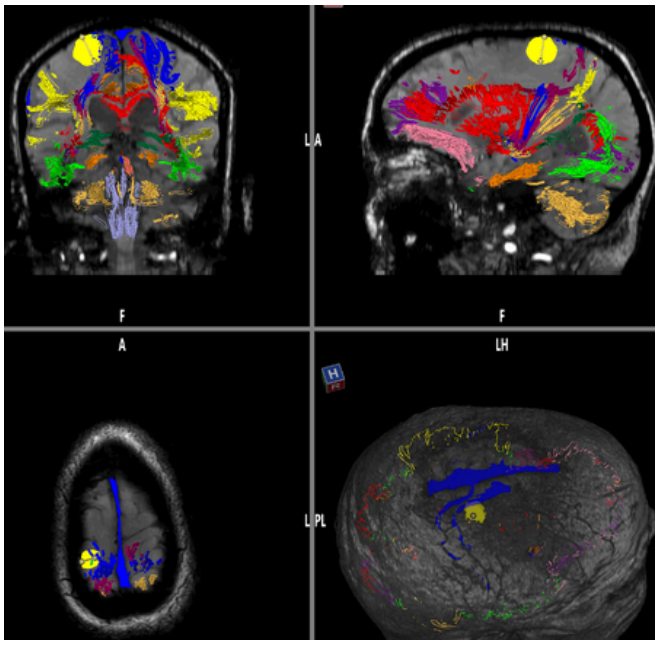

Surgical planning images using SynaptiveMedical 3D tractography allows a dedicated neuroradiologist to use brain mapping to identify critical white matter tracts, tumor, and crucial blood vessels to create a safe surgical trajectory for tumor removal.

ENT Service

IMG Multidisciplinary Case Study

Russel T. Wagner, Sammy Khalili, Blake Henning, and Neil S. Mundi

Nasopharyngeal stenosis is commonly iatrogenic and is the result of procedures performed in or around the nasopharynx which can include surgery and radiation therapy. It can also be the sequela of infectious disease such as diphtheria, rhinoscleroma, tuberculosis, and syphilis.1 The symptoms of nasopharyngeal stenosis usually include dysphagia, hyponasal speech, nasal obstruction, and difficulty sleeping. In prior nasopharyngeal stenosis repairs, various surgical techniques have been employed. Each has its own advantages and limitations depending on the severity and etiology of the stenosis. Traditional approaches have included the use of mucosal flaps, such as the laterally based pharyngeal flap, and the transposition of local tissue flaps to restore nasopharyngeal patency. For example, to address both nasopharyngeal stenosis and tonsillar pillar adhesions in a single-stage operation, a palatal eversion technique could be employed where the soft palate is divided and repositioned to separate scarred tissue.2 This approach was particularly useful in cases of post-adenotonsillectomy scarring where fibrosis caused significant airway obstruction. Similarly, another case described the excision of dense, avascular fibrotic tissue, followed by reconstruction using split-thickness skin grafts to prevent restenosis. Although these techniques have demonstrated efficacy, challenges such as restenosis, scarring, and incomplete resolution remain, necessitating innovative approaches like the dual robotic and endonasal method described in this report.

We present the case of a patient with severe nasopharyngeal stenosis caused by the use of hydrogen peroxide irrigations which he had been doing for approximately two years following functional endoscopic sinus surgery (FESS) for chronic sinus disease. A combined transoral and transnasal surgical approach with a robotically trained head and neck surgeon and rhinologist was devised to improve field visualization and surgical maneuverability.

Continued on page 4

The Da Vinci surgical robot has progressively translated its applications in general surgery, urology, gynecology, cardio thoracic, pediatrics, and ENT surgery. The surgical system has four EndoWrist robotic arms that offer enhanced manual dexterity and a three-dimensional magnified image for improved visualization.3,4 Traditional transoral approaches to the oropharynx have several existing limitations. Specifically, there is a confined operative field, limited range of instrument motion, and optical concerns such as reduced line of sight and depth perception. Other areas of ENT surgery including endoscopic thyroid and parathyroid also have inherent limitations such as video camera platform instability, restricted motion of straight endoscopic instruments, two-dimensional imaging, and suboptimal operator ergonomics. 5 Applications of the Da Vinci robot as well as combined surgical technologies may prove to solve these issues in the future upon further development and integration.

Nasopharyngeal Stenosis Classifications

Nasopharyngeal stenosis can be categorized into types I, II, and III, with each having different degrees of severity. Type I is a mild grade where the lateral aspects of the palate adhere to the posterior pharyngeal wall. Type II is a moderate grade characterized by circumferential scarring, resulting in a small central opening of the soft palate measuring 1 to 2 cm in diameter. Type III is a severe grade identified by the complete fusion of the entire palate with the posterior and lateral palatal wall, leaving a residual opening of less than 1 cm.6

Case Presentation

A 67-year-old male presented with nasal congestion, frequent, thick mucus drainage, and sores in his nostrils. He had a history of chronic sinus disease and had under-gone balloon sinuplasty at an outside institution, as well as two other surgeries in the past to help manage it. He was then instructed to use hydrogen peroxide sinus rinses, which was a regimen he continued for approximately 2 years. This ultimately led to the stenosis of his nasopharynx.

Despite previous surgical interventions including an FESS, the patient's symptoms worsened over time, particularly the nasal obstruction, sores, and drainage, none of which im-proved with antibiotic treatments. Imaging studies showed that while CT scans demonstrated some improvement from the earlier surgeries, an MRI revealed a Tornwaldt cyst, mucosal thickening in the left nasopharynx, and bilateral maxillary and ethmoid thickening.

During a follow-up visit, the patient reported that his nasal obstruction was progressively worsening. In-office nasal and oral endoscopy (See Fig. 1A, B) revealed type II nasopharyngeal stenosis, likely resulting from prolonged hydrogen peroxide irrigation. Based on these findings, further surgical intervention was deemed necessary to address the stenosis and restore airway patency (See Fig. 2

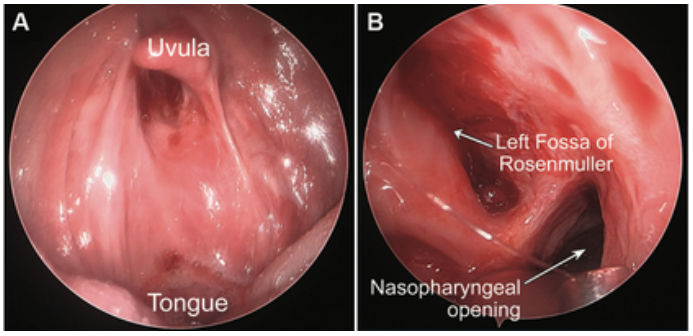

Fig. 1 *(A) Preoperative oral view of the enclosed nasopharynx using the endoscope. (B) Preoperative endonasal view of the enclosed nasopharynx using the endoscope.*

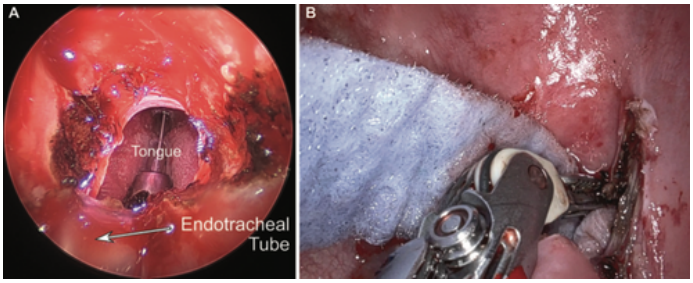

Fig. 2 *(A) Endonasal view of the nasopharynx after it had been opened up by the robot. (B) Oral view from the Point of view of the robot as it applies topical mitomycin C.*

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Surgical Procedure

To improve visualization of the surgical field and surgical dexterity, the senior authors employed a novel approach, utilizing both the Da Vinci Xi robot (with a 30-degree endoscope) and a 70-degree nasal endoscope. The surgical robot was equipped with Maryland bipolar forceps and a cautery spatula. The robotic surgeon was positioned at the robot console while the endonasal surgeon was positioned at the head of the operating room table; the latter acting as the assistant for the transoral robotic surgeon while visualizing the nasopharynx from above. This setup was employed to view the nasopharynx and soft palate from both inferior and superior simultaneously (See Fig. 3A, B).

The surgery began with the robot incising the scar band present between the soft palate and posterior pharyngeal wall in the oropharynx. Once the soft palate had been released, the upper limit of the field of view of the surgical robot was reached. Further division of scar tissue was performed from inferior to superior along the posterior pharyngeal wall using the robotic instruments under the guidance of the endonasal surgeon who was visualizing the nasopharynx from above. Dissection continued from medial to lateral on both sides to recreate the fossa of Rosenmuller that had been scarred due to hydrogen peroxide irrigations.

((See Fig. 2A). Once the soft tissue dissection was complete, mitomycin C was applied topically to the raw edges of the field to aid in preventing scar reformation postoperatively

(See Fig. 2B). Two nasal trumpets were placed into the nasal cavity and through the stenosis site to retain airway patency in recovery and were sewn to the nasal septum.

Postoperative Course

In the days following the surgery, the patient utilized nasal saline sprays as prescribed. On postoperative day 8, the patient presented with intolerance of the nasal trumpets and these were removed without incident. He continued to use the nasal saline spray once the trumpets were removed.

At 3 weeks into his recovery, the patient reported a substantial improvement in nasal breathing with no nasal regurgitation of solids or liquids. His speech was mildly hypernasal but the patient did not report any difficulty with speech intelligibility. Diagnostic nasal endoscopy revealed an expanded nasopharyngeal opening and minimal excess scarring, signifying effective healing (See Fig. 4A).

At 1 year following his surgery, nasal endoscopy shows a maintained opening of the nasopharynx with minimal scar-ring (See Fig. 4B).

Discussion

The utilization of a dual approach combining the Da Vinci Xi robot and the nasal endoscope in nasopharyngeal stenosis repair represents a pioneering advancement in the field of robotic-assisted surgery. This novel combination offers a multitude of benefits that synergistically enhance the surgeons' capabilities, improves visualization, and increases precision during the surgical procedure.

One of the major advantages of this dual approach is the ability to access and navigate small and challenging anatomical spaces with greater ease (See Fig. 5A, B). The DaVinci Xi robotic arms equipped with EndoWrist instruments provide the surgeon with enhanced dexterity and a wider range of motion, allowing delicate maneuvers within confined areas of the nasopharynx. 7. The nasal endoscope further complements these capabilities by providing top-down visualization of the surgical site, especially in areas such as the nasopharynx that are difficult to visualize with the robotic endoscope when it is positioned in the oral cavity. The integration of these technologies facilitates improved maneuverability, granting the surgeons greater control and finesse in navigating intricate anatomical structures utilizing the robotic instruments while having a 360-degree view of the surgical field. Alone, neither the transoral robotic nor endonasal approach to nasopharyngeal stenosis can accomplish this.

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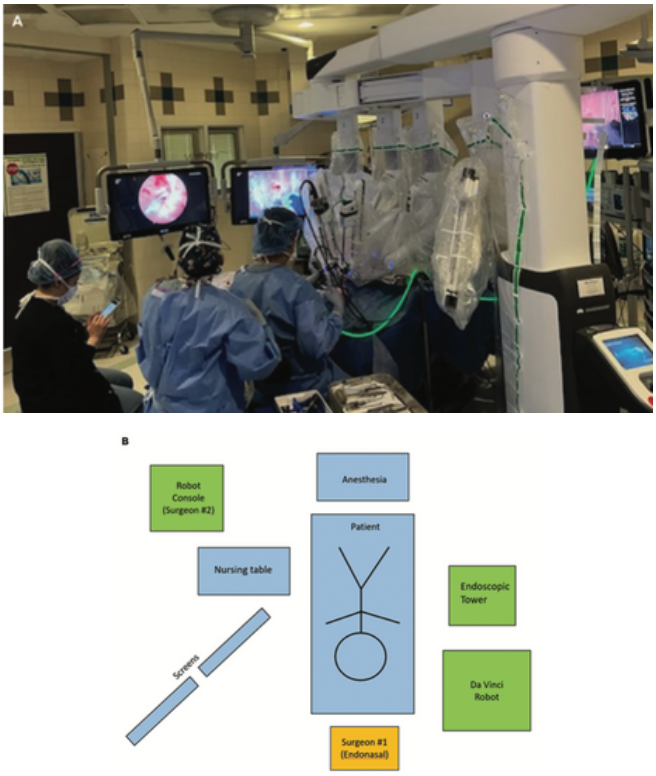

Fig. 3 *(A) A real photo of surgical setup showcasing the intricate surgical setup during the nasopharyngeal stenosis repair procedure. The image captures the simultaneous utilization of the Da Vinci Xi robot and a reverse-posted nasal endoscope. (B) Animated diagram of an aerial view of the operating room (OR) setup offering a better visual representation of where the equipment and surgeons were strategically positioned.*

Moreover, this dual approach has the potential to lead to improved surgical outcomes for future procedures. The enhanced visualization, precision, and maneuverability offered by both the robot and the endoscope may contribute to reduced surgical complications, preservation of vital structures, and overall patient safety. The successful application of this dual approach in nasopharyngeal stenosis repair opens the door to expanding applications in robotic-assisted surgeries. As surgeons gain experience and expertise with this novel technique, its potential may extend to other complex anatomical regions and surgical procedures. The combination of different surgical technologies may also inspire further research and innovation, leading to the development of new approaches and protocols for various medical conditions.

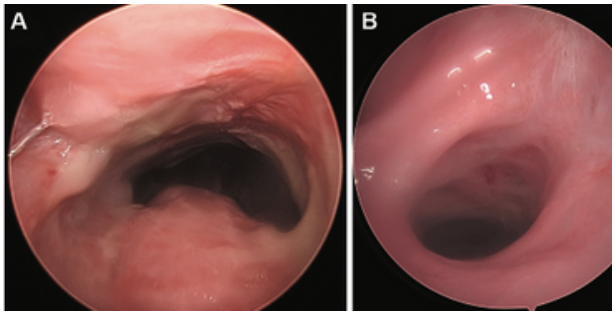

Fig. 4 (A) Nasal endoscopic view of the opened and healing nasopharynx at 3 weeks following surgery. (B) Nasal endoscopic view of the opened nasopharynx at 1 year following surgery.

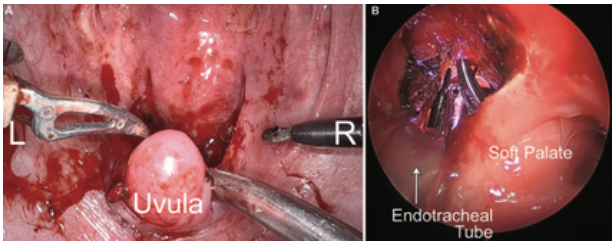

Fig. 5 (A) Oral view of the nasopharynx from the point of view of the robot during the operation. Note the difficult angle and view of the opening. Labels'L' and'R' indicate the left and right sides of the surgical field, respectively, for orientation. (B) Endonasal view of the opened nasopharynx from the point of view of the endoscope during the operation. Note the much clearer view of both the opening and walls of the nasopharynx.

Conclusion

This case report highlights an innovative combination of surgical approaches utilizing the Da Vinci Xi robot and a nasal endoscope in nasopharyngeal stenosis repair, offering improved visualization and surgical precision. This innovative technique not only benefits current patients by improving outcomes but also opens avenues for future advancements and expansion of applications in robotic-assisted surgical interventions for nasopharyngeal and skull base surgery. Continued research and exploration of this dual approach are critical to unlock its full potential and shape the future landscape of surgical practices.

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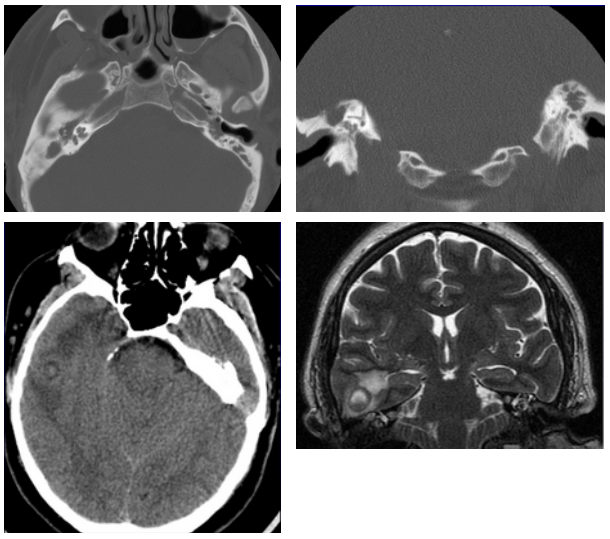
Dr. Fukuis Corner #2

Neuroradiology Quiz

(Answers on Page 18)



Questions

1. Imaging findings?
2. Diagnosis?
3. Common presentation?
4. What imaging completes the workup?

APP Notes: Inpatient

Use of Tracheostomy in the Management of Severe Obstructive Sleep Apnea

Samreen Hussain, PA

While tracheostomy is commonly associated with airway obstruction or prolonged ventilatory support, its role in managing adult severe obstructive sleep apnea (OSA) is less frequently considered. This paper provides a brief overview of OSA and its treatment modalities, focusing on tracheostomy for severe OSA.

OSA is a disorder defined by repetitive collapse of the upper airway during sleep causing oxygen desaturation. It is most common in middle-aged men and is diagnosed by an apnea hypopnea index (AHI) greater than five events per hour of sleep. Symptoms often include snoring, witnessed apneic episodes, gasping/choking during sleep, and daytime sleepiness. It is important to distinguish OSA from other sleep disorders such as narcolepsy, central sleep apnea, restless leg syndrome, etc. prior to determining appropriate management. This is often done in collaboration with a sleep medicine specialist.

TABLE. APNEA-HYPOPNEA INDEX SCORE CLASSIFICATION FOR ADULTS

APNEA SEVERITY	APNEA-HYPOPNEA INDEX (AHI) (EVENTS/HOUR OF SLEEP)
Normal	<5
Mild	5 ≤ AHI < 15
Moderate	15 ≤ AHI <30
Severe	≥30

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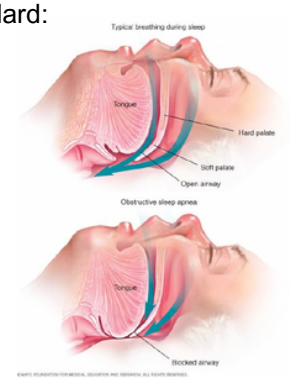
Objective testing is required for diagnosis; this is completed via the gold standard: polysomnography or more commonly known as a sleep study. Severity of OSA is stratified by the number of respiratory events per hour of sleep, with severe being defined as greater than 30 events per hour. Additionally, there are maneuvers that can be observed via laryngoscopy and anatomical measurements that can assist in diagnosis.



In addition to lifestyle modifications such as weight loss, positive airway pressure is the mainstay treatment of mild to moderate OSA. Continuous positive airway pressure (CPAP) provides the same level of pressure during inhalation and exhalation via nasal or oronasal mask to maintain a patent airway. In patients who are intolerant to CPAP or have correctable anatomical obstructions, there are various surgical options to consider. These include adenotonsillectomy, uvulopalatopharyngoplasty (UPPP), and lingual tonsillectomy among others.

A tracheostomy by definition bypasses the structures that collapse and contribute to apneic episodes, making it the most effective surgical treatment for OSA. This treatment modality is indicated for patients who have failed medical management or who are not candidates for other surgical techniques.

It has been proven to decrease apnea index and improve subjective sleepiness and mortality in patients with severe OSA. If left unmanaged, severe OSA has long term risks such as hypertension, coronary artery disease, and cardiac arrhythmias.

Tracheostomies are often thought of as a last resort intervention for treatment of OSA, as long-term management of a tracheostomy can be difficult for patients. The patient must be comfortable and compliant in performing daily tracheostomy and stoma care including suctioning and daily inner cannula changes. There are additional social factors that may concern patients such as cosmetic appearance, frequent coughing up of secretions, and change in voice/communication. The complications of tracheostomy include but are not limited to pneumonia, mucus plugging, tracheal-innominate fistula, granulation tissue, and dislodgement. These points should be taken into consideration when selecting an appropriate patient for this procedure.

Conclusion

Workup and management of OSA often requires a multidisciplinary approach as well as lifestyle changes, medical management, and surgical intervention when indicated. Tracheostomy for treatment of severe OSA can be utilized in a select patient population and has been found to be largely effective.

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Neurocritical Care

IMG Multidisciplinary Case Study

Asad Rehman, MD

An 86 year old male with a past medical history of a right cheek squamous cell carcinoma (excised one year ago) presented with a growing right neck lymph node. Biopsy of the lymph node confirmed squamous cell carcinoma and PET scan was ordered (Figure 1). After biopsy the patient states that the lymph node became very painful and the neck skin over it became red and inflamed. He also stated that the lymph node seemed to be getting larger every day. He was evaluated in clinic by Dr. Mundi and was taken to the operating room for removal of the lymph node and a formal neck dissection. Figure 2 demonstrates the neck tumor with the planned incision lines.

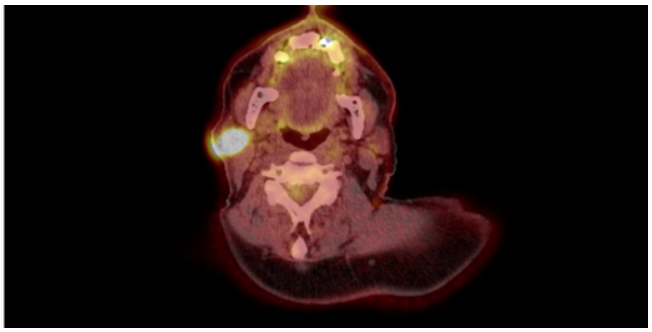

Figure 1: PET CT reveals an FDG avid right upper cervical lymph node (arrow) with direct extension to the skin and to the underlying sternocleidomastoid muscle.

During surgery, it was noted that the cancer had not only spread from the lymph node into the overlying neck skin but that the cancer also invaded the sternocleidomastoid muscle, greater auricular nerve and marginal mandibular nerve. These structures were removed along with the cancerous lymph node. The spinal accessory nerve, hypoglossal nerve, and internal jugular vein were preserved. After the resection and neck dissection, the patient had a 7 x 5 cm wound of the right neck (See Fig. 3).

Given the size of the wound, primary closure was not possible and so a supraclavicular artery island fasciocutaneous rotation-advancement flap was performed (See Fig. 4). The patient is recovering well from surgery and will undergo additional treatment with chemotherapy and radiation.

Figure 2: Right neck tumor with surgical markings

Case comment: When a patient presents with a lymph node harboring squamous cell carcinoma, a complete head and neck examination is required. This included careful examination of the scalp and facial skin as well as the aerodigestive tract. Given that this patient has a history of cutaneous squamous cell carcinoma, it was likely the source of this nodal metastasis. When neck skin, muscles, nerves and blood vessels are sacrificed during neck dissection, it is termed a radical neck dissection. Typically, only lymph nodes are removed and cranial nerves, neck muscles and major blood vessels are spared.

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Figure 3: 7 x 5 cm right neck surgical defect following tumor resection and neck dissection. Visible within the base of the wound is the sternocleidomastoid muscle (single arrowhead), parotid gland (double arrowhead) and carotid sheath (triple arrowhead)

After resection of the tumor and lymph nodes was complete, the patient had a large wound with exposure of vital structures including the carotid sheath. In cases where the wound is small, a local rotation flap or primary closure can be employed. Alternatives to these reconstructive options include free tissue transfers or regional flaps. Given the patient's age, a regional flap was deemed the best option as it is relatively straightforward to harvest and has minimal donor site morbidity.

The supraclavicular artery island flap was first described in the 1990's and has gained popularity over the past decade as a thin, pliable reconstructive option for cutaneous defects of the neck and face.

As its name suggests, the flap is based on the supraclavicular artery which is a branch of the transverse cervical artery and its venous drainage occurs through the venae comitantes of the artery which drain into the external jugular vein or transverse cervical vein. With knowledge of the vascular anatomy, it is crucial that the surgeon avoids sacrificing the transverse cervical artery and vein during level IV neck dissection.

Figure 4: Right supraclavicular artery island fasciocutaneous flap following inset into right neck wound. Note the excellent color match between the flap and the patient's neck skin. The donor site on the right shoulder is closed primarily over a suction drain.

Literature Review

Ryan Jones, MD

Ceftriaxone to prevent early ventilator-associated pneumonia in patients with acute brain injury: a multicentre, randomised, double-blind, placebo-controlled, assessor-masked superiority trial.

Quick Summary: a single dose of ceftriaxone in those with acute brain injury at high risk of need for mechanical ventilation for at least 48 hours decreased risk of early ventilator-associated pneumonia (VAP): the PROPHY-VAP trial.

Adults with acute brain injury due to trauma, stroke or subarachnoid hemorrhage and GCS < 12 who were predicted to require mechanical ventilation for more than 48 hours underwent randomization to receive either a single dose of ceftriaxone 2g IV once or placebo. Authors measured the proportion of subjects who developed early (VAP).

Continued on page 11

Findings:]

- Primary outcome: lower risk of developing early VAP (HR 0.6, p = 0.03)
- Secondary outcomes: more ventilator and antibiotic free days, lower Modified Rankin score (measured on hospital day 28), lower mortality (measured on hospital day 28), ICU and hospital-free days (measured on hospital day 60)
- No differences in adverse events

Comment: the PROPHY-VAP trial benefits from a strong study design (multicenter, randomized, double-blind, placebo-controlled, assessor-masked) and mostly generalizable findings (though all eight centers were in France) that addresses a common problem (VAP) we see in patients who suffer from acute brain injuries. The relatively benign intervention (a single dose of ceftriaxone, not a full course) resulting in reduction in incidence of VAP with no difference in adverse events makes this study design widely acceptable to practitioners of neurocritical care.

Dahyot-Fizelier C, Lasocki S, Kerforne T, et al. Ceftriaxone to prevent early ventilator-associated pneumonia in patients with acute brain injury: a multicentre, randomised, double-blind, placebo-controlled, assessor-masked superiority trial. The Lancet Respiratory Medicine. 2024;12(5):375-385. doi:10.1016/S2213-2600(23) 00471-X

Adults with acute brain injury due to trauma, stroke or subarachnoid hemorrhage and GCS < 12 who were predicted to require mechanical ventilation for more than 48 hours underwent randomization to receive either a single dose of ceftriaxone 2g IV once or placebo. Authors measured the proportion of subjects who developed early (VAP).

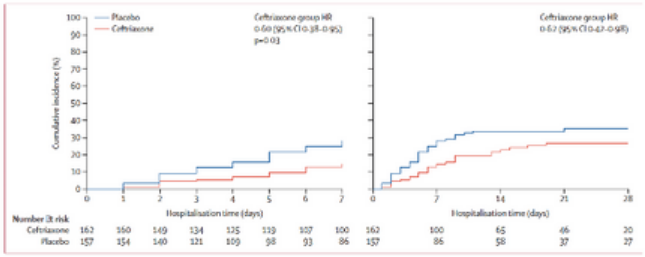
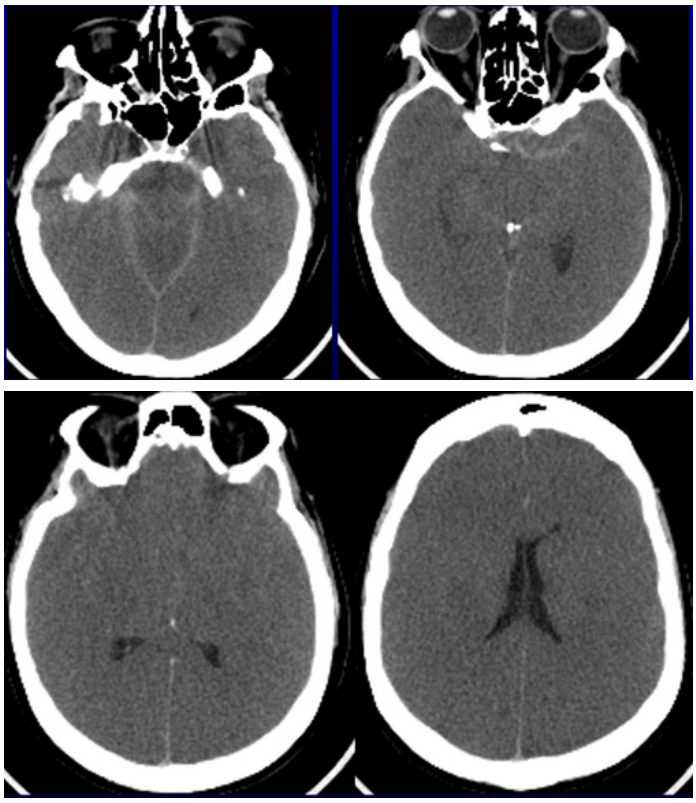


Figure 2: Cumulative incidence of (A) early and (B) all cases of ventilator-associated pneumonia
Cumulative incidence curves of early (from the second to the seventh day of mechanical ventilation) and all cases of ventilator-associated pneumonia were compared using the Fine-Gray approach between patients assigned to receive ceftriaxone and those assigned to receive placebo. HR=hazard ratio.

Dr. Fukuis Corner #3

Neuroradiology Quiz

(Answers on Page 18)



Questions

1. Imaging findings?
2. Is SAH present?
3. Diagnosis?
4. Common History?
5. What imaging may help with prognosis?

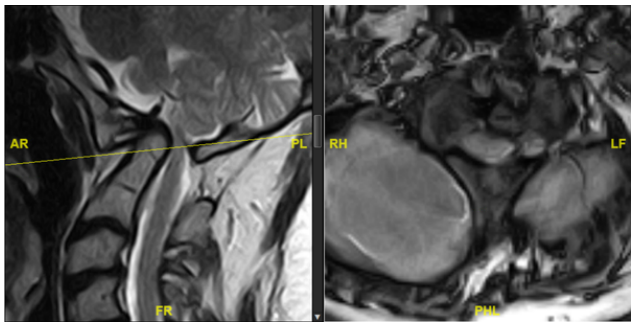
Continued on page 12

SPINAL Service

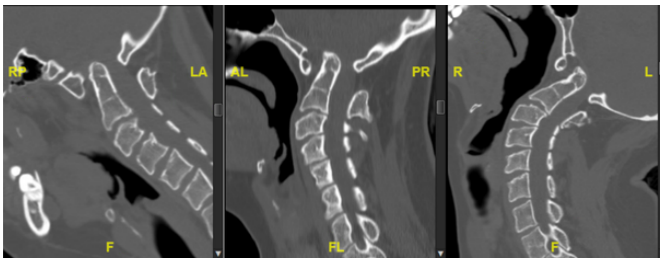
IMG Multidisciplinary Case Study

Russ Nockels, MD

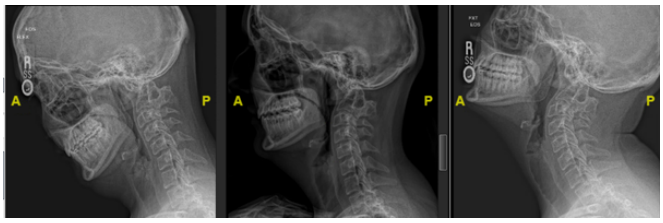
A **23 year old female** has been experiencing debilitating neck and hip pain since her teenage years. She has been evaluated by numerous doctors across various medical specialties without ever being given a diagnosis. Her search for an answer led to her evaluation at Endeavor Health Advanced Neurosciences Center at Northwest Community Healthcare in Arlington Heights, Illinois. She was referred to Dr. Russel Nockels, a neurosurgeon and the Vice Chairman of the Department, by Dr. Bailes who had noted an abnormality after performing an x-ray of her neck. Despite living with this pain for several years, her path to a diagnosis — and soon thereafter a solution — began in October 2023.



Despite being otherwise healthy, this young patient was born with a congenital abnormality at the site where the base of the skull meets the top of the spine in the neck. Normally, there is a natural opening in the skull to allow for the transition between the brainstem, a structure in the brain involved in the most critical of functions, and the upper spinal cord. Due to the maldevelopment, the top of her spine was pressing into the opening in the skull, a condition termed “basilar invagination.” As a result, the bones were causing compression in this vital area at the junction of the brain and spinal cord. In addition, this anomaly results in challenges maintaining head posture. As a result of her body attempting to compensate, she experienced pain in her ribs and hips.



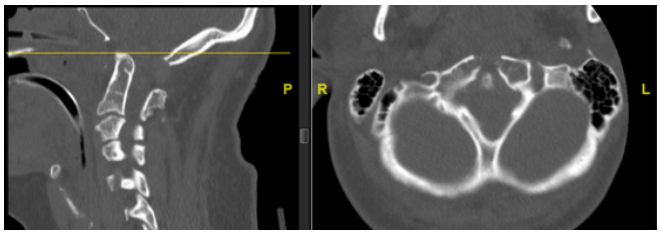
After providing a diagnosis, discussion across multiple disciplines — including spine surgery, cranial surgery, otolaryngology, and neuroradiology — was required. Such collaboration is the culture at the neurosciences center in Arlington Heights, Illinois in order to provide high-level, personalized care. Only through the representation of different specialties under one team is such dedication and compassion possible. Ultimately, a three-stage surgery was required to remove the pressure off the neurologic structures, correct the malalignment of the bones, and stabilize the area where the skull meets the top of the spine in the neck.



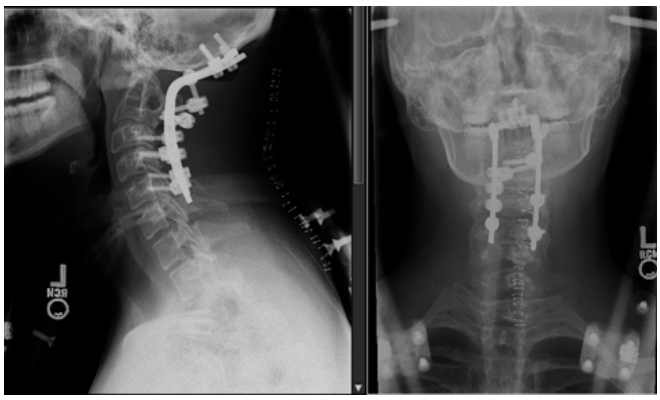
The first stage was performed on the back of the skull to relieve pressure on the back of the brainstem and spinal cord. The second stage was performed through the nose to relieve pressure on the front of the brainstem and spinal cordwhile also helping to realign the bones. In fact, Dr. Amin Kassam is a pioneer in this approach who first described the technique in 2005. This approach is an alternative to going through the mouth which is routinely done and associated with a higher complication profile.

Continued on page 13

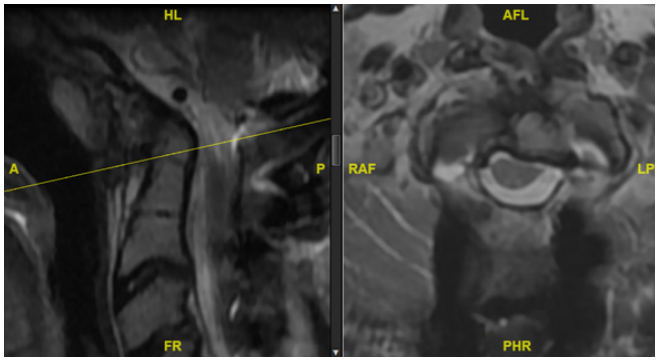
The third stage was performed on the back of the skull and the neck to further realign the bone and ultimate stabilize the skull and spine in place using plates, screws, and rods. Throughout each stage, advanced technology and imaging modalities are utilized, including the use of an intra-operative computed tomography scan that was interpreted in real-time by a dedicated neuro-radiologist.



Despite the complexity of the surgery, our patient tolerated all steps of the surgery well, which went without complication. The first few days were challenging, requiring intubation in the intensive care unit. However, she made a strong recovery as she was able to eat a general diet, ambulate in the hallways, and ultimately be discharged home. She was seen in the clinic approximately two weeks after her discharge where she was already reporting notable improvement in her pre-operative pain. She returned to work after approximately two months since her surgery.



Even though her condition is complex, the collective approach across disciplines enables for the safe and effective management of these rare diseases. Moreover, this devotion to service fosters motivation among all team members and inspires a sense of purpose.



HPI

- Generalized headaches, worse with certain neck positions
- Neck pain, hip pain, rib pain

PMH

- Occupation – software engineer

Exam

- Intact with hyper-reflexia

Diagnosis – basilar invagination with retropulsion of the dens at the cranio-cervical junction

- Basilar invagination
    - Retropulsion of the dens through the basion, including the lower third of the clivus
    - Stenosis at the cervico-medullary junction
- Congenital anomaly with dysgenesis of the lower third of the clivus
- Surgical goal
    - Resect the lower third of the clivus + ligaments
    - Open reduction of odontoid to allow dens to be in a more natural position

Surgical Approach

- Stage I (01/26/2024) – Nockels
    - Application of halo device
    - Suboccipital craniectomy with retainment of the occiput bone near the inion for future instrumentation

Continued on page 14

Surgical Approach

- Stage II (01/26/2024) – Khalili, Kassam
  - Bilateral maxillary antrostomies
  - Bilateral total ethmoidectomies
  - Expanded endonasal skull base approach for inferior third clivus resection
    - Sphenoidotomy
    - Anterior transplanum, transcavernous
    - Vertebrobasilar fascia + inferior third of clivus
      - AInferior third of clivus drilled and resected to expose odontoid process and ventral posterior fossa
      - Apical ligament between odontoid process and foramen magnum divided
    - Intra-operative CT scan with O-arm
      - Assessed position of the odontoid process
      - Due to satisfactory position, decision made to not resect the odontoid
    - No cerebrospinal fluid leak
  - Reconstruction using nasoseptal flap pedicled on sphenopalatine artery
  - Reverse flap pedicled on ethmoidal vessels for donor site septal coverage
- Stage III (01/29/2024) – Nockels
  - C1 laminectomy
  - Occiput to C5 fusion
    - C2 laminar screws
    - C4 lateral mass skipped due to being too small
  - Cantilever maneuver to further reduce the dens by rotating the dens anteriorly through distraction on the rod at C2
  - Re-application of halo device

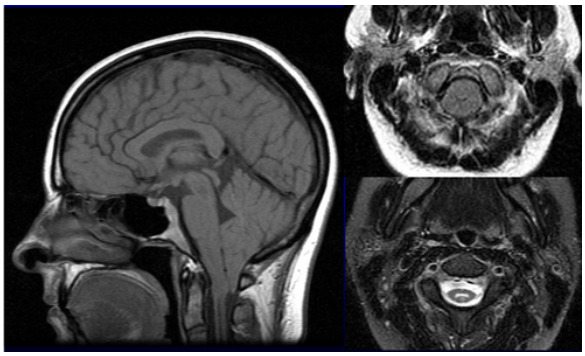
Post-operative course

- Tolerated all procedures well, which went without complication
- Tolerated general diet and ambulated in hallways
- Discharged home
- Halo device removed on 02/21/2024, Aspen cervical collar placed
- Aspen cervical collar removed on 04/24/2024

Dr. Fukuis Corner #4

Neuroradiology Quiz

(Answers on Page 18)



Questions

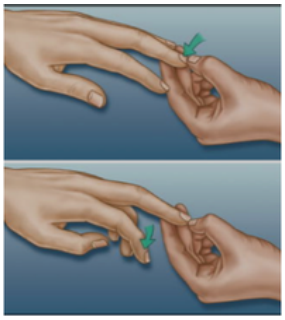
1. Imaging findings?
2. Diagnosis?
3. Common presentation?
4. Name the MRI sequences:
   - Sagittal, axial (upper), axial (lower)
1. What imaging completes the workup?
2. Associations?

APP Notes: Outpatient

Occult Cervical Myelopathy in Patients with Adult Thoracolumbar Deformity

Erin Schilling APN

In assessing patients with Adult Spinal Deformity (ASD) such as scoliosis or sagittal imbalance, it is important to remember that the entire spine can affected by abnormal curvatures,



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even affecting the cervical spine in the presence of thoracolumbar deformity. This can be challenging since the cervical spinal cord has no pain fibers, or nociceptors, and therefore even severe cervical spinal cord compression may be painless and therefore occult to the patient because they are fixated on their low back complaints.

Performing lumbar surgery without paying attention to possible cervical spine pathology could potentially lead to postoperative spinal cord injury. Therefore, it is imperative to ask pertinent questions regarding myelopathy, as well as examine both the upper and lower extremities in order to rule out this potential diagnosis. Myelopathy refers to symptoms related to compression of the spinal cord.

Being aware of these potential findings is essential to properly assess the spine patient population. A combination of spinal imaging including MRI and cervical flexion/extension x-rays are needed if patients are complaining of any of the classic symptoms of myelopathy, or if there are abnormal findings on exam.

Myelopathy can be subtle or dramatic. Again, patients will not be as attuned to the symptoms associated with myelopathy, as compression of the spinal cord does not cause pain, although if associated with degenerative disc and facet joint disease, neck pain is not uncommon. The three classic signs of myelopathy are fine motor dysfunction (frequently dropping objects, difficulty with buttons/handwriting), gait imbalance (with or without falls), and bladder dysfunction. Patients can have any combination of these symptoms, or even none at all. That is why it is also important to examine the reflexes and strength of both the upper and lower extremities. In patients with myelopathy, hyperreflexia can be detected in the upper and/or lower extremities with + Hoffman's sign and/or clonus. However, keep in mind that in patients with a history of such conditions as diabetes or chemotherapy, reflexes may be blunted. Subtle or dramatic hand atrophy can also be a sign of cervical myelopathy.

APP Notes: Inpatient

Evaluation and Treatment of Osteoporotic Vertebral Compression Fractures: A PA perspective

Lauren Birschbach PA

As Advanced Practitioners we are often called upon to see elderly emergency room patients who have suffered thoracolumbar fractures due to a fall. While our initial response is to consider the majority of spinal fractures worthy of surgical intervention, we've learned that actually the opposite is true with regard to thoracolumbar compression fractures. In the following, I try to relate what I have learned about these fractures and how this experience has helped guide my assessment and treatment.

Osteoporotic vertebral compression fractures (OVCFs) represent a significant health concern, particularly among postmenopausal women and individuals on long-term corticosteroid therapy. This review aims to provide a comprehensive overview of the current evidence-based approaches to the evaluation and treatment of OVCFs. By definition, these fractures occur most commonly in the thoracolumbar spine at T11-L2, the junction of the T and L spine. These are commonly diagnosed on X-ray or CT after the patient complains of back pain after a fall. It is important to note that the bony injury involves the anterior column of the vertebrae (see figure). The anterior column represents a 'crumple zone' which allows the energy of the trauma to be displaced anteriorly and therefore away from the spinal canal. This explains why neurological deficit is rare withe these injures. We will sometimes advance to MRI imaging in the event of significant trauma, neurologic deficit, or to assess posterior ligament integrity.

Continued on page 16

Additionally, MRI helps us assess the chronicity of the compression fractures. Stable fractures can be defined by injury restricted to the anterior column, absence of neurologic deficits, and ability of the patient to physiologically load the thoracolumbar fracture (30 degrees or more in bed) without intractable pain. Under these circumstances, acute neurosurgical intervention is not required. These patients are treated conservatively or in consultation with our pain management partners. When managed non-surgically, we will have the patients follow up with us in clinic with repeat upright x-rays (important for determining progression of the fracture, further loss of vertebral height, and subsequent kyphosis), as well as a DEXA scan to assess bone density. This frequently encountered diagnosis is often managed as an outpatient by our service, and we continue to monitor for kyphosis, worsening compression and neurologic changes which would then necessitate the need for surgery.

Treatment Take Aways:

Conservative Management

Conservative treatment remains the first-line approach for most OVCFs:

1.Pain management:
- Short-term bed rest for severe pain
- Analgesics: NSAIDs, acetaminophen, and short-term opioids for severe pain

2.Bracing:
- Thoracolumbosacral orthosis (TLSO) or lumbosacral corset for 4-12 weeks

3.Physical therapy

Vertebral Augmentation

For patients with persistent pain despite conservative management:

1.Percutaneous vertebroplasty (PVP)

2.Balloon kyphoplasty (BKP)These minimally invasive procedures involve injecting bone cement into the fractured vertebra. While some studies suggest efficacy in pain relief and functional improvement, controversy remains regarding their superiority over conservative treatment.

Indications for Surgery (all rare):

1. Progressive neurological deficit
2. Progressive kyphosis
3. Intractable pain with physiological loading (inability to bear one's own weight standing)

Reserved for rare cases with neurological compromise or spinal instability:

1.Decompression and stabilization
2.Anterior or posterior reconstructions

Emerging Trends and Future Directions

1.Personalized treatment algorithms based on fracture characteristics and patient factors
2.Development of novel anti-osteoporotic agents with improved efficacy and safety profiles
3.Refinement of vertebral augmentation techniques to minimize complications and optimize outcomes

Continued on page 17

Conclusion

The management of OVCFs requires a multidisciplinary approach, combining conservative measures, pharmacological interventions, and, in select cases, minimally invasive or surgical procedures. While significant progress has been made in understanding and treating OVCFs, further research is needed to establish definitive treatment guidelines and improve long-term outcomes for patients with this challenging condition.

Literature Review

Russ Nockels, MD

Preoperative Care

1. J Neurosurg Spine 41:726–733, 2024
Hounsfield units of vertebrae as a predictor of cervical deep paraspinal muscles atrophy and neck pain in degenerative cervical myelopathy (DCM).
Jia Li, MD, et al

Quick Summary: Among those patients older than 50 years with DCM, those with decreased HU values demonstrated elevated Fatty Infiltration (FI) levels in the multifidus and semispinalis cervicus (SCer)muscles. Moreover, these patients presented with pronounced muscle atrophy, which correlated with axial neck pain. A significant relationship was also identified between MCs and diminished HU values.

This study investigated the relationship between vertebral Hounsfield units (HU) and cervical deep paraspinal muscle atrophy in patients with degenerative cervical myelopathy (DCM). 136 patients aged 50-79 years who underwent surgery for DCM were analyzed retrospectively.

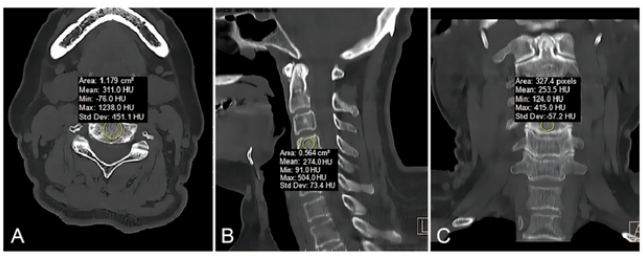

FIG. 1. Measurement technique for determining the HU value at the C4 vertebral body. The center of the vertebral body is identified using the localizer tool on the axial (**A**), sagittal (**B**), and coronal (**C**) images, and a *best-fit circle* of cancellous bone is outlined with the circle tool. The largest possible elliptical ROI was drawn for each measurement, excluding the cortical margins to prevent volume averaging. The HU values from the 3 images were averaged to give a mean HU value for each cervical vertebral body. Figure is available in color online only.

Lower HU values were associated with increased fatty infiltration and atrophy of the multifidus and semispinalis cervicis muscles, as well as higher rates of axial neck pain. Patients with HU ≤319 showed significantly reduced functional cross-sectional area to vertebral cross-sectional area ratios for these muscles compared to those with HU >319. The findings suggest that decreased vertebral bone density correlates with cervical muscle degeneration and neck pain in DCM patients.

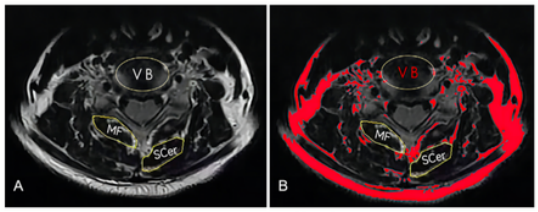

FIG. 2. A: The relevant parameters of paraspinal muscle on MRI. The CSAs of the vertebrae and muscles were calculated with ImageJ software, namely the vertebral body (VB) CSA, multifidus (MF) CSA, and SCer CSA, by outlining the ROI of the vertebral posterior paraspinal muscle group. **B:** FIA was obtained with the threshold technique, and then functional CSA was calculated as follows: functional CSA = CSA − FIA. The fat infiltration of muscle was defined as FI = FIA/CSA. Figure is available in color online only.

Comment: Although not an earth shattering finding, this study is demonstrative of an increasing trend to consider the supportive soft tissues as playing a potential role in a patients symptoms, and perhaps surgical outcome. I think many more of these studies will be forthcoming as imaging granulation progresses and therefore potentially help understand why some patients do better than others after spinal surgery when all other variables except paraspinal muscles are taken into consideration. RPN

J Neurosurg Spine 40:708–716, 2024
A novel approach to evaluation of lumbar bone density using Hounsfield units in volume of interest on computed tomography imaging
Masashi Fujimoto, MD, PhD, et al

Quick Summary: Newer imaging capabilities in CT scanning, such as the ability to measure HU in a Volume of Interest (VOI) rather than a Region of Interest (ROI) is bringing us closer to obviating the need for radio nucleotide imaging to assess bone density.

Continued on page 18

This retrospective study evaluated the relationship between bone mineral density (BMD) assessed by dual-energy x-ray absorptiometry (DEXA) and Hounsfield units (HU) measured in volumes of interest (VOIs) and regions of interest (ROIs) on lumbarspine CT. The researchers analyzed 712 lumbar vertebrae from 201 patients. Key findings include:

- HU values in the VOI showed stronger correlations with BMD than those in ROIs at all lumbar levels.
- HU values in the VOI increased sequentially from L1 to L4, consistent with BMD values.

Comment: I'm not certain how widely available this technology is, but the authors conclude that HU measurements in the VOI may be a viable screening tool for osteoporosis diagnosis and bone quality assessment in the lumbar spine and replace DEXA scanning. We've used ROI frequently for this purpose, but according to this study, we would miss a few patients with poor bone health if we substitute ROI for RPN scan.

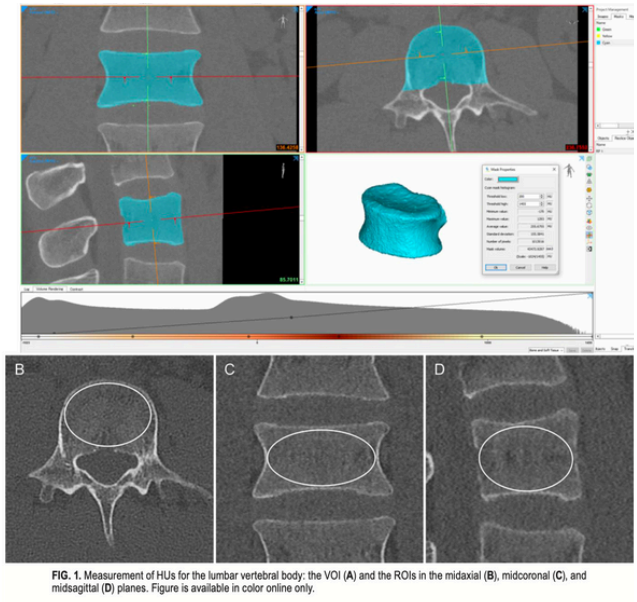

FIG. 1. Measurement of HUs for the lumbar vertebral body: the VOI (**A**) and the ROIs in the midaxial (**B**), midcoronal (**C**), and midsagittal (**D**) planes. Figure is available in color online only.

Dr. Fukuis Corner Answers

#1

1. *Specific anatomic location and imaging findings?*
    - *Foramen of Monro: rounded proteinaceous cyst (T1 bright before contrast, T2 dark, minimal wall enhancement); hydrocephalus of lateral ventricles*
2. *Diagnosis?*
    - *Colloid cyst*
3. *Is lumbar puncture indicated?*
    - *NO! Contraindicated. LP can precipitate deadly herniation of cerebellar tonsils into Foramen Magnum*
4. *Presentation?*
    - *Headaches worse upon awakening, N/V, blurry vision; asymptomatic and incidentally discovered*
5. *What is the most serious complication?*
    - *Sudden death*

#2

Answers

1. *Imaging findings?*
    - *Upper: CT temporal bone- Sclerotic, opacified R mastoid/middle ear with erosion of tegmen tympani (roof of middle ear)*
    - *Lower: axial CT and coronal T2W MRI- rounded lesion right temporal lobe with surrounding edema*

Continued on page 19

2. Diagnosis?
   - Chronic mastoiditis v cholesteatoma, complicated by temporal lobe abscess
3. Common presentation?
   - Hearing loss, otorrhea, ear pressure, dizziness, vertigo
   - Headache, seizure, altered consciousness
4. What imaging completes the workup?
   - Full brain MRI w/wo including DWI
   - Brain MRI will show the enhancing rim of abscess and central restricted diffusion as well as dural enhancement and possible empyema

#3

Answers

1. Imaging findings?
   - Diffuse hypoattenuation of cerebrum and cerebellum with loss of grey/white differentiation and sulcal and ventricular effacement
2. Is SAH present?
   - No. This is pseudo-SAH: the appearance of increased attenuation of the SAS is mostly the result of juxtaposition to edema in cortex, a common imaging pitfall
3. Diagnosis?
   - Hypoxic-ischemic encephalopathy, AKA global hypoxic-ischemic injury
4. Common History?
   - Cardiac arrest, MI, shock, systemic hypotension, arrhythmia, trauma, metabolic
5. What imaging may help with prognosis?
   - MRI may demonstrate the extent of ischemia and the presence or absence of brainstem involvement

#4

Answers

1. Imaging findings?
   - Pointed cerebellar tonsils extend >10mm below F magnum; deformity of dorsal medulla; effacement of CSF in F magnum; superior cervical cord syrinx
2. Diagnosis?
   - Chiari I malformation with cervical syrinx
3. Common presentation?
   - Headache with cough or Valsalva (tussive cough); syncope; neck pain; unsteady gait
4. Name the MRI sequences:
   - Sagittal: T1W (wo)
   - axial (upper): T2 FLAIR
   - axial (lower): T2W (with syrinx)
5. What imaging completes the workup?
   - MRI brain (with or without cine CSF flow); MRI T and L spine (extent of syrinx and r/o tethered cord)
6. What imaging completes the workup?
   - Klippel-Feil Syndrome
     - Incomplete segmentation of cervical vertebrae, Sprengel's deformity