Magnetic Resonance Evaluation of the Brachial Plexus: Technique, Normal Anatomy and Pathology

Author(s)
Joshua A. Friedlander, MD
Resident Physician
Beaumont Hospital, Royal Oak

Role: Author
Kathleen Barry, MD, FACR
Section Chief of Neuroradiology, Beaumont Hospital, Troy. Associate Professor of Radiology, Oakland University William Beaumont School of Medicine
Beaumont Hospital, Troy

Role: Author
Kevin Welker, DO
Neuroradiology Fellow
Beaumont Hospital, Royal Oak

Role: Author
John Fox, MD
Neuroradiology Fellow
Beaumont Hospital, Royal Oak

Role: Author
Ay-Ming Wang, MD
Section Head, Neuroradiology. Professor of Radiology, Oakland University William Beaumont School of Medicine.
Beaumont Hospital, Royal Oak

Role: Author
Anant Krishnan, MD
Associate Professor of Radiology, Oakland University William Beaumont School of Medicine. Associate Radiology Residency Program Director
Beaumont Hospital, Royal Oak

Role: Author
Richard Silbergleit, MD
Professor of Radiology, Oakland University William Beaumont School of Medicine. Vice Chief, Department of Diagnostic Radiology and Molecular Imaging.
Abstract Details

Purpose:

To review magnetic resonance (MR) imaging of the brachial plexus, including imaging technique, normal anatomy and pathology.

Description:

Evaluation of the brachial plexus can be a daunting and challenging task, if one is not familiar with the normal anatomy and common pathology. We will first discuss MR technique, including recent advances, and normal anatomy of the brachial plexus. Attention will then be turned to a spectrum of brachial plexus pathology including trauma, infection, tumors (primary and metastatic disease), radiation changes and autoimmune disease. We will discuss pertinent features and findings to help distinguish these etiologies.

Summary:

MR imaging is a powerful and effective tool when evaluating the brachial plexus. Knowledge of current MR technique, normal anatomy and common pathology can help provide the radiologist with essential tools for accurate interpretation and diagnosis of brachial plexus pathology.
Simultaneous PET/MRI in the Evaluation of Head and Neck Cancer

Author(s)
Gregory Avey, MD
Assistant Professor
University of Wisconsin School of Medicine and Public Health

Role: Author
Tabassum Kennedy, MD
Assistant Professor
University of Wisconsin School of Medicine and Public Health

Role: Author
Alan McMillan, PhD
Associate Scientist
University of Wisconsin School of Medicine

Role: Author
John-Paul Yu, MD, PhD
Assistant Professor
University of Wisconsin School of Medicine

Abstract Details
Purpose:
Simultaneous PET/MRI is an emerging technology with the potential to increase the accuracy of diagnosis, staging, and post-treatment monitoring of head and neck malignancies. This educational exhibit will review the technological advances underlying this new imaging modality and present cases showing areas of clinical utility.

Description:
PET/CT has become the mainstay for staging oncologic patients and monitoring response to therapy. However, anatomic localization with CT has notable limitations, particularly in regard to radiation dose and the soft tissue contrast achievable using low-dose CT. Simultaneous anatomic localization of PET data with MRI has recently become achievable due to advances in PET detector technology and the development of practical MRI based PET attenuation correction techniques. The resulting high resolution PET data can be favorably paired with volumetric 3-D MRI techniques to aid in diagnosis and management of patients with head and neck malignancies.

This educational exhibit will review the technology underlying this new modality, including MRI compatible PET detectors, the addition of time of flight PET to better localize PET activity, and MRI based attenuation correction. Improved Dixon based fat-water separation techniques can also be utilized as part of the diagnostic neck MRI sequences to take advantage of the resulting homogenous fat-water separation.
throughout the neck (without the need for external water bags or excessive exam times).
The appropriate patent population for PET/MR has yet to be fully assessed. However, a portion of head and neck cancer patients require both MRI for local disease staging and a PET/CT exam to evaluate for more distant disease. For example, patients with perineural or intracranial spread of tumor often require both MRI and PET/CT exams for adequate evaluation. Tumors of the nasal cavity, nasopharynx or anterior skull base also benefit from PET/MRI evaluation, either primarily or immediately following the conventional PET/CT. Exemplar simultaneous PET/MRI cases from these anatomic sites will be reviewed.

Summary:
Simultaneous PET/MRI is an emerging imaging technology, which takes advantage of the high tissue contrast of MRI and the metabolic data of PET. This new modality has the potential to allow for exams with lower radiation doses, improved primary tumor delineation, and more accurate staging.
Purpose
There is increasing use of texture or radiomic analysis to extract biologic and clinically relevant information beyond what is routinely obtained using qualitative visual assessment in current clinical practice. Dual energy CT (DECT) scans contain quantitative spectral information beyond what is available using conventional, single energy CT. Therefore, DECT may be advantageous for texture analysis compared to conventional single energy CT. On the other hand, the large data sets produced using DECT can also pose analytic challenges for texture analysis. When building a diagnostic tool, several machine learning methods are available, but not all would produce an accurate prediction. In this study, we devised and propose an approach for texture analysis of DECT images and examined this in detail in order to achieve a better understanding of their behavior and impact on the choice of an accurate machine learning method.

Materials & Methods
DECT scans from 46 patients with pathology proven head and neck squamous cell carcinoma (HNSCC) were evaluated to devise and test the approach for DECT texture analysis. For purposes of this study, the association between texture features of the tumor and nodal status was evaluated. Texture analysis with a filtration-histogram technique was performed using a commercial research software (TexRAD®, Somerset, England, United Kingdom) by manually delineating a region of interest (ROI) around the largest diameter of the tumor. Texture features of ROIs (mean, standard deviation, entropy, mean of positive pixels, skewness, and kurtosis) were extracted from identical ROIs from a total of 21 sets of virtual monochromatic images (VMIs) ranging between 40 and 140 keV in increments of 5 keV. Different machine learning models were tested for evaluation of spectral, DECT data.

Results
Using an ensemble method such as Random Forest (RF), a feature selection method that can handle highly correlated predictors and a parametric sweep with cross validation that tests all the possible models and determines their accuracy, an optimum model is found for the prediction of nodal status that is based on the area under the curve analysis. Multiple texture features as well as different filters were identified as potentially important outcome predictors. In addition, the top 10 predictors of importance for outcome determination included features extracted from VMIs ranging between 40 and 130 keV.

Conclusions
Random Forest analysis with an improved feature selection and parametric sweep can be used for the analysis of large quantitative data sets produced using DECT. The top extracted features of importance for
outcome prediction were based on texture features extracted from a wide range of VMIs energy levels. This suggests that DECT radiomic analysis may be superior to that performed based using single energy CT scans and could represent an additional advantage for dual energy CT acquisitions.
Abstract Details

Purpose
There can be significant variation in the imaging approach for the evaluation of salivary glands and many groups obtain unenhanced CT images for the evaluation of sialolithiasis. In this study, we performed a survey in order to assess variations in the imaging approach for sialolithiasis and evaluated the accuracy of dual energy CT (DECT) virtual unenhanced images (VUE) for the detection of salivary stones.

Materials & Methods
Practice variations were evaluated by an online survey of the membership of the American Society of Neuroradiology with 280 respondents. We then identified 28 patients having a total of 123 major salivary gland calcifications that included both an unenhanced and a contrast-enhanced acquisition acquired in DECT mode, matched with 28 patients without stones as negative controls. All subjects were scanned with a 64-section dual-energy scanner with fast kVp switching and VUE images were created from the CE acquisition using water-iodine material decomposition. The true unenhanced (UE), contrast enhanced (CE), and VUE images were independently evaluated by 2 head and neck radiologists in random order and any discrepancy resolved in consensus. To maximize the number of calcifications evaluated, both salivary stones and tonsilloliths were evaluated. The true unenhanced series was used as the gold standard reference.

Results
The survey revealed substantial variations in CT protocols used for sialolithiasis. CT was by far the most common first line imaging modality for the evaluation of sialolithiasis (92.9%). The most commonly used CT protocols were CT of the neck without contrast followed by a single phase post contrast acquisition (35.3%), CT of the neck without IV contrast only (28.1%), and a single phase post contrast CT of the neck (28.1%). On a per patient basis, DECT VUE had 96.4% sensitivity and 100% specificity. On a per calcification basis, sensitivity and specificity for the detection of stones larger than 2 mm was 100% but dropped when calcifications of all sizes, specifically those less than 2 mm, were included. For all calcifications (salivary gland and tonsils) regardless of size, sensitivity when the VUE and source CE images were combined was 85.1% and specificity was 95%. Accuracy was higher when the VUE was interpreted in conjunction with the source CE images. In this study, false negative cases on VUE corresponded to clinically insignificant, intra-glandular parotid calcifications, many of which were faint calcifications in two cases of Sjogren’s syndrome. None would have changed management in this series. One false negative when the CE series was evaluated in isolation was potentially clinically significant, representing a central hilar submandibular stone in a patient who had clear contralateral stones.

Conclusions

There is significant variation in the CT protocols used for the evaluation of sialolithiasis. Creation of VUE images from DECT scans improves accuracy compared to CE images alone and an approach using a single CE DECT acquisition with reconstruction of VUE may represent an attractive uniformly acceptable alternative, enabling the elimination of the true UE phase and associated radiation exposure.
(CN_01) The Branchiomeric Cranial Nerves Are a Breed Apart

Abstract Details
PURPOSE: Cranial nerves (CNs) V, VII, IX, and X are branchiomeric developing in association with the branchial arches. They share common features of embryology, form and function which may predispose to various clinical entities. We investigate relative prevalence for perineural tumor spread, paragangliomas and primary cranial neuralgias in this group compared with the other CNs.
MATERIALS AND METHODS: Literature searches were performed including search terms “perineural tumor spread”, “paraganglioma, extra-adrenal”, “neuralgia” in combination with “cranial nerves”. We also tabulated and analyzed relevant patient case series of perineural tumor spread in the literature.
RESULTS: While we demonstrate predominance of perineural tumor spread, paragangliomas and primary cranial neuralgias among the four branchiomeric CNs, each clinical entity principally involves only one or two CNs from this group.
CONCLUSION: Greater awareness of both the shared and distinct qualities of the branchiomeric CNs can be a powerful tool toward better understanding each of these complex nerves as well as the predominance and skewed distribution of their pathologies.
Abstract Details
Purpose

To enumerate various incidental lesions picked up on routine screening of the internal acoustic meati in the visualized brain, base of skull and neck.

Description
A limited MR Internal Acoustic Meatus (IAM) screening protocol comprising of a 3D pre-excitation refocused GRE sequence across the cerebello-pontine (CP) angles and a screening spin echo T2 sequence of the entire brain (vertex to medulla) is used the world over for initial assessment hearing loss, tinnitus, neuralgia etc. The outcome of which are usually results in detection of CP angle/IAM mass lesions or evidence for neurovascular conflict. The general focus of attention in this kind of a study is naturally upon the IAM, inner ear structures and the cisternal segments of the traversing cranial nerves. Unfortunately this may result in only a cursory assessment of the remaining intracranial components and truncated head and neck structures. Detection of incidental lesions in these "peripheral"regions is often crucial and the reading radiologist has to be aware of such potential pitfalls. We hope to depict a wide range of lesions ranging from suspicious lymphadenopathy, head and neck tumours, vascular anomalies to intracranial masses.

Summary
Non IAM or CP angle lesions are often overlooked on routine limited MR IAM screening. Depiction of various such lesions would help the reporting radiologist to pay closer attention to the more "peripheral" structures seen on the study and increase detection of them.
Stop Touching Me! - Imaging Features of Neurovascular Compression

Author(s)
Michael Cathey, MD
Neuroradiologist
Naval Medical Center, San Diego

Role: Author
Joseph Yetto, MD
Radiology Resident
Naval Medical Center, San Diego

Role: Author
Tabassum Kennedy, MD
Assistant Professor
University of Wisconsin School of Medicine and Public Health

Role: Author
Gregory Avey, MD
Assistant Professor
University of Wisconsin School of Medicine and Public Health

Role: Author
Lindell Gentry, MD, FACR
Professor Radiology, Neurology, Neurosurgery, Otolaryngology
University of Wisconsin

Abstract Details
Stop Touching Me! Imaging Features of Neurovascular Compression

Purpose
This electronic educational exhibit reviews the clinico-radio-pathologic spectrum of neurovascular compression (NVC) within the central nervous system using a case-based approach to identify the important anatomical characteristics of NVC, potential NVC mimics and its treatment.

Materials and Methods
Case-based overview demonstrating the imaging abnormalities associated with a wide variety of syndromes relatable to NVC, particularly those involving cranial nerves. A review of the proposed neuropathic mechanisms leading to these syndromes will be presented. The key anatomic relationships most associated with NVC will likewise be emphasized and illustrated through the use of high resolution
MR imaging including balanced steady state free precession / heavily T2-weighted sequences.

Results
MR imaging abnormalities associated with various clinical syndromes referable to NVC are increasingly encountered in clinical practice, which if unrecognized, can delay the diagnosis of primary CNS abnormalities. In properly selected patient populations, microvascular decompression has shown promise for durable treatment of clinical symptoms. An understanding of NVC, its mimics as well as its treatment is an important part of a neuroradiologist's practice.

Conclusions
NVC is a debilitating disease. If unrecognized, this can lead to misdiagnosis and unnecessary treatment delays. Sadly, the most severe and recalcitrant cases have been associated with suicide. The neuroradiologist plays a critical role in the diagnosis of NVC and a comprehensive knowledge of these entities is paramount.
(CN_04) Interconnections between Cranial nerves 5 and 7: illustrated and anatomical review

Author(s)
Dinesh Rao, MD
Assistant Professor, Department of Radiology
University of Florida

Role: Author
Alexandra High, DO
Resident Department of Radiology
University of Florida

Role: Author
Sandhu Sukhwinder, MD
Assistant Professor, Department of Radiology
University of Florida

Role: Author
Natter Patrick, MD
Assistant Professor, Department of Radiology
University of Florida

Abstract Details
Purpose: To review the anatomy of interconnections between cranial nerve 5 and 7

Description: We will review the anatomy of cranial nerves 5 and 7 with specific regard to intersections of these nerves. Anatomical relationships will be illustrated and examples of perineural spread of tumor using CT and MR images will be used to demonstrate the clinical importance of these interconnections.

Summary: The 3 major interconnections between cranial nerve 5 and 7 are important and often overlooked in imaging. An illustrated guide of this anatomy with correlative imaging examples of perineural spread of tumor will be presented.
Perineural Spread of Head and Neck Tumors

Author(s)
John Kim, MD
Fellow
Brigham and Women's Hospital

Role: Author
Ashok Srinivasan, M.D.
Associate Professor of Radiology
University of Michigan

Role: Author
Toshio Moritani, MD
CLINICAL PROFESSOR
UNIVERSITY OF IOWA

Abstract Details
Purpose: The purpose of this presentation is to elucidate the anatomy of the major cranial nerves and to help the radiologist identify perineural spread of head and neck tumors.

Description: Perineural involvement is a common and important route of spread in head and neck cancers. Perineural invasion is a histologic diagnosis, whereas perineural spread is an imaging finding where tumors use the peripheral nerves as a channel for spread. It is important to identify perineural spread and invasion as it portends a poorer prognosis with change in management (e.g., effects on radiation fields). Our presentation will first define the anatomy and imaging of the common cranial nerves, such as CN V1, V2, V3, and VII, involved by perineural spread.

We will then show imaging findings on MRI/CT/PET with pathological correlation of perineural spread/invasion of each of the cranial nerves in the head and neck. We will describe MRI and CT features and emphasize anatomical landmarks (e.g., effacement of the major fat pads) that will help the radiologist identify perineural spread.

Summary: Identifying perineural spread of head and neck cancers is crucial as it changes management and patient outcomes. Our presentation outlines key steps to help radiologists correctly identify anatomical landmarks and imaging findings of perineural spread of disease.
(CN_06) Comprehensive Imaging Review of Cranial Nerves IX, X, XI and XII, From Anatomy to Pathology

Author(s)
Peter Will, MD
Radiology Residents
Wake Forest School of Medicine

Role: Author

Thomas West, MD
Assistant Professor
Wake Forest School of Medicine

Role: Author

Christopher M. Lack, MD,PhD
Assistant Professor
Wake Forest School of Medicine

Abstract Details
Purpose:
To provide a detailed review of cranial nerves IX, X, XI and XII, highlighting their central and peripheral anatomy as well as common pathology encountered in routine clinical practice. This submission is one part of a complete review of all twelve cranial nerves.

Description:
Thorough knowledge of the anatomy and pathology specific to cranial nerves IX, X, XI and XII is fundamental for those interpreting head and neck imaging. Although these nerves are rarely the specific focus for imaging they are incidentally imaged on most head and neck studies. Still, the complex anatomy and wide-ranging pathology associated with these nerves can be a cause for substantial consternation for both inexperienced and experienced imagers alike. As such, this educational exhibit will provide an in-depth anatomical review of the central and peripheral portions of cranial nerves IX, X, XI and XII including their distal innervation. Important anatomic relationships with other regional structures will be illustrated. A thorough, image-rich review of pathology encountered with cranial nerves IX, X, XI and XII will be shown, emphasizing key findings radiologists should include in their report in order to better assist referring clinicians. Finally, optimal imaging protocols and potential technical pitfalls will be discussed.

Summary:
Cranial nerve imaging can be challenging for both experienced and novice head and neck imagers. However, following completion of this educational exhibit, the viewer will be able to describe the anatomic course of the cranial nerves IX, X, XI and XII, optimize the imaging protocol based on a patient’s clinical presentation, and develop a practical differential diagnosis.
Purpose: The oculomotor nerve provides somatic motor innervation to the extraocular muscles aside from the lateral rectus and superior oblique muscles as well as parasympathetic innervation to the pupillary constrictors. The nerve has a complex anatomic course, originating from the midbrain, exiting ventrally into the interpeduncular cistern, travelling in-between the posterior cerebral and superior cerebellar arteries in the suprasellar cistern, into the oculomotor cistern, within the lateral wall of the cavernous sinus into the medial limb of the superior orbital fissure, and subsequently ramifying into different branches within the orbit. Knowledge of the course and appearance of the nerve and its
branches as well as knowing the types of lesions that occur along the course of the nerve can help the
radiologist diagnose the various etiologies of oculomotor palsies.
Description: We review the normal anatomy of oculomotor nuclei, brainstem fascicles, and the different
peripheral segments of the nerve. Clinical description of different types of third nerve palsies including
pupillary sparing and pupil involving lesions as well as mimics of CN3 palsy are discussed.
Representative cases are then used to demonstrate various etiologies of 3rd cranial nerve palsy
including lesions that can occur along the entire course of the 3rd cranial nerve. These include
leptomeningeal, neuromuscular, ischemic, compressive, restrictive, and neoplastic processes.
Summary: Oculomotor palsy can result from lesions anywhere along its path between the origin nuclei
in the midbrain and the extraocular muscles within the orbit. A comprehensive understanding of the
anatomy and knowing where the nerve is susceptible to various processes can aide in making the
diagnosis.
Abstract Details
Purpose:
To provide a detailed review of cranial nerves VII and VIII, particularly highlighting their central and peripheral anatomy as well as common pathology encountered in routine clinical practice. This submission is one part of a complete review of all twelve cranial nerves.

Description:
Thorough knowledge of the anatomy and pathology specific to cranial nerves VII and VII is fundamental for those interpreting head and neck imaging, particularly considering the frequency with which patients are imaged for symptoms referable to these nerves. However, the complex anatomy and wide-ranging pathology associated with these nerves can be a cause for substantial consternation for both inexperienced and experienced imagers alike. As such, this educational exhibit will provide an in-depth anatomical review of the central and peripheral portions of the cranial nerves including their distal innervation. Important anatomic relationships with other regional structures will be illustrated. A thorough, image-rich review of pathology encountered with cranial nerves VII and VIII will be shown, emphasizing key findings radiologists should include in their report in order to better assist referring clinicians. Finally, optimal imaging protocols and potential technical pitfalls will be discussed.

Summary:
Cranial nerve imaging can be challenging for both experienced and novice head and neck imagers. However, following completion of this educational exhibit, the viewer will be able to describe the anatomic
course of the cranial nerves VII and VIII, optimize protocols depending on the particular clinical question, and develop a practical differential diagnosis.
Abstract Details
Facial nerve enjoys special attention from the trainees, educators as well as referring clinicians for different reasons. Its complex origin, long course and an array of pathology complicated by imaging pitfalls. Image interpretation can be a daunting task when a patient presents with facial nerve symptoms. A systematic approach as well as appropriate imaging protocol is the key to correct diagnosis.

The purpose of this educational exhibit is to familiarize the radiology with the embryology, anatomy, function and pathology of the facial nerve. The pathology will be classified by the different segments of the facial nerve covering common and uncommon entities from traumatic and vascular to infectious/inflammatory and neoplastic processes. Special focus will be placed upon differentiating imaging features of the various entities on CT, MRI and PET/CT to increase the radiologist's confidence in making the correct diagnosis.
Comprehensive Imaging Review of Cranial Nerve V, from Anatomy to Pathology

Author(s)
Thomas West, MD
Assistant Professor
Wake Forest School of Medicine

Role: Author

Richard C. Leach, MD
Radiology Resident PGY 3
Wake Forest

Role: Author

Michael Zapadka, DO
Associate Professor
Wake Forest University School of Medicine

Role: Author

Abstract Details
Purpose:
To provide a detailed review of cranial nerve V, highlighting the central and peripheral anatomy as well as common pathology encountered in routine clinical practice. This submission is one part of a complete review of all twelve cranial nerves.

Description:
Thorough knowledge of the anatomy and pathology specific to cranial nerve V is fundamental for those interpreting head and neck imaging, particularly considering the frequency with which patients are imaged for symptoms referable to this nerve and its branches. The complex anatomy and wide-ranging pathology associated with this nerve can be a cause for substantial consternation for both inexperienced and experienced imagers alike. As such, this educational exhibit will provide an in-depth anatomical review of the central and peripheral portions of cranial nerve V including its distal innervation. Important anatomic relationships with other regional structures will be illustrated. A thorough, image-rich review of pathology encountered with cranial nerve V will be shown, emphasizing key findings radiologists should include in their report in order to better assist referring clinicians. Finally, optimal imaging protocols and potential technical pitfalls will be discussed.

Summary:
Cranial nerve imaging can be challenging for both experienced and novice head and neck imagers. However, following completion of this educational exhibit, the viewer will be able to describe the anatomic course of cranial nerve V (including its major divisions and peripheral branches), optimize the imaging protocol based on a patient’s clinical presentation, and develop a practical differential diagnosis.
Abstract Details

Purpose:
To provide a detailed review of cranial nerves I and II, highlighting their central and peripheral anatomy as well as common pathology encountered in routine clinical practice. This submission is one part of a complete review of all twelve cranial nerves.

Description:
Thorough knowledge of the anatomy and pathology specific to cranial nerves I and II is fundamental for those interpreting head and neck imaging, particularly considering the frequency with which patients are imaged for symptoms referable to these nerves. However, the complex anatomy and wide-ranging pathology associated with these nerves can be a cause of substantial consternation for both inexperienced and experienced imagers alike. As such, this educational exhibit will provide an in-depth anatomical review of the central and peripheral portions of cranial nerves I and II. Important anatomic relationships with other regional structures will be illustrated. A thorough, image-rich review of pathology encountered with cranial nerves I and II will be shown, emphasizing key findings radiologists should include in their report in order to better assist referring clinicians. Finally, protocol optimization and potential technical pitfalls will be discussed.

Summary:
Cranial nerve imaging can be challenging for both experienced and novice head and neck imagers. Following completion of this educational exhibit, the viewer will be able to describe the anatomic course of the cranial nerves I and II, optimize the imaging protocol based upon a patient's clinical presentation, and develop a practical differential diagnosis.
Abstract Details

Purpose:
To provide a detailed review of cranial nerves III, IV, and VI, highlighting their central and peripheral anatomy as well as common pathology encountered in routine clinical practice. This submission is one part of a complete review of all twelve cranial nerves.

Description:
Thorough knowledge of the anatomy and pathology specific to cranial nerves III, IV, and VI is fundamental for those interpreting neurologic imaging, particularly considering the frequency with which patients are imaged for symptoms referable to these nerves. Knowledge of the entire anatomic course of these nerves is important in order to detect treatable pathology. When imaging is incorrectly interpreted as normal in a case of a palsy of cranial nerves III, IV, or VI, the palsy is then often attributed to ischemia, and the causative pathology can go undetected without further search. Additionally, some of the pathologic entities causing palsies of these nerves are neurosurgical emergencies that need to be recognized immediately. As such, this educational exhibit will provide an in-depth anatomical review of the central and peripheral portions of cranial nerves III, IV, and VI including their distal innervation. Important anatomic relationships with other regional structures will be illustrated. A thorough, image-rich review of pathology encountered with cranial nerves III, IV, and VI will be shown, emphasizing key findings radiologists should include in their report in order to better assist referring clinicians. Finally, optimal imaging protocols and potential technical pitfalls will be discussed.

Summary:
Cranial nerve imaging can be challenging for both experienced and novice head and neck imagers. However, following completion of this educational exhibit, the viewer will be able to describe the anatomic course of cranial nerves III, IV, and VI, optimize the imaging protocol based on a patient’s clinical presentation, and develop a practical differential diagnosis.
Facial nerve schwannoma involving multiple segments of facial nerve.

Author(s)
Pradeep Goyal, MD
Clinical Fellow
JACKSON MEMORIAL HOSPITAL

Role: Author

Chariff Sidani, MD
Assistant Professor
JACKSON MEMORIAL HOSPITAL

Role: Author

Efrat Saraf-Lavi, MD
ASSOCIATE PROFESSOR
JACKSON MEMORIAL HOSPITAL

Abstract Details
Schwannomas are uncommon in the facial nerve and account for less than 1% of tumors of temporal bone. They can involve one or more than one segment of the facial nerve. The clinical presentations and the imaging appearances of facial nerve schwannomas are influenced by the topographical anatomy of the facial nerve and vary according to the segment(s) they involve. We present a case of facial nerve schwannoma with multiple segment involvement with left facial twitching and profound sensory hearing loss which is stable for last 5 years.
Abstract Details
The intended electronic exhibit is meant to provide the viewer with a basic overview of the development, anatomy, and physiologic processes involved in normal olfactory sensation and processing. There will be emphasis on pathologic cases involving the olfactory pathways - presented in a pictorial case review format - in order to illustrate these concepts further. These cases will also be used to demonstrate various imaging strategies that may be helpful for delineating the desired anatomy and relevant pathologic processes.
Abstract Details

Purpose: Cranial nerve (CN) pathology is challenging and complex to even the most seasoned radiologist. It requires an in-depth understanding of the anatomy and structures associated with each of the cranial nerves. With the advent of Steady state free precession sequences (SSFP), it is now possible to visualize these structures with incredible detail and better diagnose pathologies associated with these structures. In this exhibit, we present the appearance of all 12 cranial nerves on MR imaging in its various pathological along with clinical descriptions of symptoms related to the pathology.

Description: CN 1 neuropathy typical presents with anosmia or hyposmia and could be due to trauma, chronic inflammation, and tumors. CN 2 or Optic nerve neuropathy may present with vision loss. CN 3 or the oculomotor nerve neuropathy may present with ptosis, drooping of the eyelid, and mydriasis. CN 4 or Trochlear nerve neuropathy presents with double vision CN 5 or Trigeminal nerve neuropathy may present with continuous dull pain in the trigeminal area. CN 6 or Abducens nerve neuropathy may present with diplopia. CN 7 or Facial nerve neuropathy may present with unilateral drooping of facial muscles, numbness and unilateral pain. CN 8 or vestibulocochlear nerve neuropathy may present with unilateral hearing loss. CN 9 or Glossopharyngeal nerve neuropathy can present with severe pain at the back of the throat. CN 10 or Vagus nerve neuropathy presents with oropharyngeal symptoms and possible autonomic symptoms. CN 11 or accessory spinal nerve may present as asymmetric neckline with weakness of the trapezius muscle causing drooping shoulder, winged scapula or forward elevation of the shoulder. CN 12 or Hypoglossal nerve neuropathy may present as unilateral atrophy of the tongue musculature.

Summary: Understanding the imaging appearance in various pathological states and anatomical features of all 12 nerves on MR helps us better correlate clinical symptoms of cranial neuropathies with MR findings.
Abstract Details
Purpose:
To review the imaging technique used for the evaluation of swallowing and describe the stages of
swallowing and the imaging findings in videofluoroscopic swallowing studies.

Description:
Swallowing is a complex process. Pharyngeal and laryngeal abnormalities can cause a variety of symptoms, including dysphagia, odynophagia, and globus sensation. The videofluoroscopic swallowing study with barium contrast is the most used exam to evaluate swallowing disorders which are more frequent in newborns and elderly patients with dementia, stroke sequelae or degenerative neurological diseases.

Conclusion:
The videofluoroscopic swallow study is important in the evaluation of swallowing disorders. The radiologist should be able to recognize the normal phases of swallowing and the anatomy of the pharynx and hypopharynx, as well as to differentiate normal variants/artifacts from true abnormalities.
(H&E_02) An Unusual Appearing Retropharyngeal Mixed Vascular Malformation Causing Dysphagia With Radiologic-Pathologic Correlation

Author(s)
Jared T. Verdoorn, MD
Neuroradiologist
Mayo Clinic

Role: Author
Jorge Torres-Mora, MD
Pathologist
Mayo Clinic

Role: Author
Joaquin J. Garcia, MD
Pathologist
Mayo Clinic

Role: Author
David R. DeLone, MD
Neuroradiologist
Mayo Clinic

Abstract Details
Purpose: To review a case of an unusual appearing retropharyngeal mixed vascular malformation as a rare cause of dysphagia

Description: A 38-year-old female presented to our institution with a several month history of progressive dysphagia to solids. She noted having to chew her food more and drink more liquids to help her swallow. She also had mild associated throat discomfort with swallowing, a globus sensation, and mild dysphonia with a change in voice that she characterized as a “hot potato voice.” She had no history of smoking and drank approximately one alcoholic beverage per day. There was no history of weight loss or malignancy. The patient was otherwise healthy with remainder of history non-contributory.

Physical examination demonstrated no palpable adenopathy or mass in the neck. The oral cavity was normal. With depression of the tongue, the superior aspect of a retropharyngeal mass was noted. Flexible nasopharyngoscopy demonstrated an approximately 3 cm submucosal retropharyngeal mass extending from the post-cricoid region inferiorly to near the esophageal inlet (see attached image). It appeared well circumscribed with no overlying mucosal abnormality. The larynx and vocal cords were normal.

Imaging was obtained including CT and MRI of the neck with IV contrast and CT angiogram (see attached images). The CT demonstrated a biconvex, vertically elongated, homogeneously low-attenuation mass in the retropharyngeal space extending from the C2-C5 level with faint enhancement and no internal calcification. The MRI revealed a homogeneously T1 hypointense and markedly T2
hyperintense, heterogeneously enhancing mass without significant internal flow voids. The CT angiogram demonstrated a small focus of arterial enhancement in the central aspect of the mass without clear evidence of an arterial feeder, nidus, or early draining veins. An ultrasound was also performed that showed the mass to be hypoechoic with few internal echoes but no detectable Doppler flow (see attached images). Imaging studies demonstrated no adenopathy, no adjacent osseous abnormality, and lack of continuity of the mass with the thyroid gland.

Differential diagnosis based on imaging findings included schwannoma, venous/venolymphatic malformation/other atypical vascular malformation, fibromyxoma, low-grade sarcoma, or less likely lymphoma.

An outside FNA was non-diagnostic with only blood seen. Given the patient’s symptoms and indeterminate imaging findings, the mass was completely resected with pathology demonstrating a mixed vascular malformation with predominantly lymphatic malformation but also a small area of arteriovenous malformation.

The patient did well postoperatively with essentially complete resolution of her dysphagia and dysphonia and no evidence of recurrence at 6-month follow-up.

Summary: We present a case of an unusual appearing retropharyngeal mixed vascular malformation with lymphatic malformation and arteriovenous malformation components, including its associated clinical presentation, physical examination findings, radiologic-pathologic correlation, and treatment.
Obstructive sleep apnoea (OSA) is a sleep-related breathing disorder characterised by repetitive obstruction of the upper airway during sleep. The disruption that results has a profound impact on a patient's quality-of-life. In addition, the prolonged and repeated oxygen desaturations that occur have been shown to increase cardiovascular, stroke morbidity and mortality significantly.

Surgical reconstructive surgery of the upper airway is an option for patients that fail continuous positive airway pressure therapy. Collapse of the airway is usually multilevel and collapse at the hypopharyngeal level is a challenging area to address with no ideal surgery identified at the moment.

The hyoid bone in the neck provides attachment of the pharyngeal constrictors that form the luminal/lateral walls of the airway at the hypopharynx. It is hypothesized that hyoid expansion with additional hyomandibular suspension can potentially increase the dimensions of the upper airway at the hypopharyngeal level.

Objectives:

To document the effect of hyoid expansion using titanium plate and screw with hyomandibular suspension on hypopharyngeal airway dimensions.
Anatomical feasibility study performed in a dissection laboratory using 10 human cadaver heads.

Intervention Method:

The hyoid bone is tri-fractured. The expanded hyoid is then suspended to the mandible. CT scans will be performed on the cadavers to measure the airway dimensions before and after the procedure.

Results:

This procedure resulted in statistically significant increase in airway dimensions at the level of the hypopharynx in all 10 human cadaver heads. The mean area of the airway at the level of the hyoid increased from 999.3±193.0 mm$^2$ to 1241.4±326.2 mm$^2$. Statistically significant increase in upper airway volume based on 3D reconstruction was also noted. Upper airway volume increased from 6.94±6.26 ml$^3$ to 13.58±8.29ml$^3$.

Conclusion:

The airway dimensions increased with hyoid expansion and hyomandibular suspension in our cadaveric study measured using CT scans. Further studies are needed to see if this technique can be translated to clinical use in live patients.
Sensitivity enhancement of vessel wall MRI with a wireless-powered endo-esophageal detector

Author(s)
Xianchun Zeng, MD
Clinical doctor
Guizhou Province People's Hospital

Role: Author
Mladen Barbic, PhD
Senior Scientist
Howard Hughes Medical Institute

Role: Author
Suresh K. Mukherji, M.D., M.B.A., F.A.C.R.
Chairman of Radiology
Michigan State University

Role: Author
Chunqi Qian, PhD
Assistant Professor
Michigan State University

Abstract Details
Introduction
MRI can be used to image and characterize carotid artery plaques using a body or surface coil. However, such applications are often hindered by limited sensitivity. A potential technique to enhance MR sensitivity is to use a Wireless Amplified NMR Detector (WAND) inserted into the esophagus to image the great vessels of the neck. The intent of this investigation was to present our preliminary results using esophageal WAND for imaging the great vessels of the neck.

Methods
A cylindrical WAND (Fig. 1) was inserted into the esophagus of a ~300 g rat. The rat was anesthetized with isoflurane and secured in the prone position under ventilation. A standard surface coil was placed beneath the rat to receive amplified signals from inside the body (Fig. 2). The detector position inside the esophagus was empirically adjusted for optimal performance near the aortic arch or carotid bifurcation. Transverse slices were first acquired with bright-blood GRE sequences to locate major arteries near the esophagus. Longitudinal slices were subsequently acquired with black-blood GRE sequences to observe the vessel walls in the absence and presence of amplification.

Results
Fig. 3a is the transverse slice acquired immediately above the aortic arch. Figs. 3b and 3c are longitudinal slices acquired along the dashed line in Fig. 3a. For the amplified image in Fig. 3c, vessel walls and fascia structures are clearly visible near aorta’s junctions with the common carotid artery and the subclavian artery. These vessels have an average thickness of 0.4 ± 0.1 mm (n=4) on their walls. The
region of interest (labelled in green) has a 4.4-fold increase in sensitivity compared to that in the unamplified image (Fig. 3b).

Fig. 4a is the transverse slice for carotid arteries and esophagus. Figs. 4b and 4c are longitudinal slices acquired along the dashed line in Fig. 4a. The average thickness of vessel walls is 0.3 ± 0.1 mm (n=4).

Conclusion
The results of our study indicate that endo-esophagus detector integrated with a wirelessly powered amplifier can be used to image the great vessels of the neck. Such detector can potentially be used to sensitively evaluate plaque compositions.
Purpose:
Voice changes are often the earliest clinical sign of glottic pathology, and CT retains a crucial role for assessment of cord pathology beyond what laryngoscopy can see. With knowledge of specific abnormal vocal cord (VC) appearance, lesions can be discovered in the cord itself, in nearby tissues, or localized to a particular region along the vagus/ recurrent laryngeal nerve course. This review will help the reader identify normal anatomy, imaging features of vocal cord paralysis, appearance of vocal cord carcinoma, local invasion, and the mimics to avoid incorrect diagnosis.

Methods:
A case by case review of normal anatomy and various causes of vocal cord pathology will be shown in this exhibit, using CT neck cases collected from our institution's PACS over the past 10 years. The cases will be shown with relevant history/physical examination in an image rich manner, and will focus on key imaging features that aid in correct diagnosis and avoid misdiagnosis in cases of mimics.

Findings/Discussion:
Recognition and assessment of vocal cord pathology on neck CT scans is important for early detection and treatment.

Many cases of vocal cord paralysis are incidentally discovered and the work up reveals a mass lesion causing the vagus or recurrent laryngeal nerve (RLN) paralysis. Familiarity with the imaging appearance of normal vocal cords, signs of VC paralysis such as sail sign, mushroom sign, ipsilateral deviation of the...
VC, and ipsilateral prominence of the pyriform sinus/ventricle helps to make the correct diagnosis and search for the cause. Additional finding of atrophy of pharyngeal constrictors, ballooning of the pharynx and deviation of uvula indicate that the lesion is causing vagus nerve paralysis and is higher up in neck.

The pitfalls of VC paralysis include trauma to the arytenoid cartilage, tumor infiltration and scanning in breath hold position.

VC carcinoma is the most common laryngeal cancer and presents early due to hoarseness and carries a much better prognosis due to early treatment. Imaging plays a crucial role in staging and detecting otherwise hidden subglottic extension, paraglottic spread, laryngeal cartilage invasion, and extralaryngeal spread along the Broyle's ligament.

Rarely thickening and asymmetry of the VC may be due to inflammatory conditions and polyps rather than cancer.

The radiologist's assessment will help the surgeon to determine the need for laser surgery, partial laryngectomy, total laryngectomy, or further workup, which greatly impacts the patient's life. Furthermore, proper assessment of known disease and post-treatment appearances on CT will greatly affect a clinician's decision for future treatment. With many unique features and mimics of mass and paralysis, a thorough radiologist can interpret specific findings to aid the clinician in a more accurate treatment plan.

Summary/Conclusion:

Neck CT is an excellent modality for initial (and sometimes incidental) detection of vocal cord pathology. When an abnormality is recognized, the clinician’s attention is better directed to the cords, adjacent tissue, and innervating nerve course to find a lesion that may otherwise be overlooked. Armed with knowledge of vocal cord imaging characteristics, radiologists can boost their confidence in an often subtle diagnosis.
Abstract Details
“Hoarsing” around: An anatomic and pathologic review of vocal cord paralysis.

Purpose:
With a complex pathway of innervation, vocal cord paralysis (VCP) can arise from a diverse variety of etiologies. It is essential for radiologists to be familiar with the anatomy involved in cases of VCP, both in preparation of the appropriate exam, and in interpretation of the study.

Approach/Methods:
- Review relevant anatomy regarded vocal cord paralysis.
- Introduce our typical imaging workup for VCP.
- Illustrate radiographic findings of VCP.
- Present pathology throughout the pathway of laryngeal innervation.
Findings/Discussions:
Innervated by the parent vagus nerve, VCP can be caused by lesions in varied locations, including the brainstem, skull base, carotid space, visceral space, and mediastinum. As such, any imaging studies performed for evaluation of VCP should adequately assess each of these locations. Frequently asymptomatic, recognition of features of paresis on routine imaging is also expected. Although damage to the vagus nerve or its recurrent laryngeal nerve branch represent the most common etiologies of VCP, one should be knowledgeable of paresis caused by pathology affecting the external branch of the superior laryngeal nerve, and of anatomic variation altering the typical course of these nerves (such as in the case of aberrant left subclavian artery). Categorized by location (brainstem, skull base, carotid space, visceral space, and mediastinum), we present a variety of pathologic conditions that resulted in VCP.

Summary/Conclusions:
Vocal cord paralysis can result from many different pathologies. It is important for the radiologist to recognize imaging features of VCP, and be familiar with the anatomical course of the vagus nerve and its branches to accurately identify the site of pathology.
PURPOSE: A variety of non-squamous cell neoplasms, both benign and malignant, may affect the larynx. These rare laryngeal tumors are often concealed by overlying intact mucosa, making diagnosis with endoscopy alone difficult. Therefore, cross-sectional imaging plays a critical role in both initial diagnosis and delineation of the extent of submucosal tumor spread. The purpose of this exhibit is to discuss the many imaging manifestations of rare, atypical laryngeal neoplasms, thus raising the radiologist’s awareness of these uncommon tumors and thereby broadening their differential diagnosis. Additionally, we will review the embryology and normal cross-sectional anatomy of the larynx, in which a thorough comprehension is vital in order to characterize these neoplasms preoperatively.

DESCRIPTION: Utilizing original illustrations and 3-D reconstructions, the anatomy and embryogenesis of the larynx will be reviewed, emphasizing key anatomic landmarks of which are crucial to examine when characterizing laryngeal neoplasms. Subsequently, we will present a plethora of uncommon laryngeal neoplasms, utilizing computed tomography (CT) and magnetic resonance imaging (MRI), many with histologic correlation. In supplement to a detailed review of each entity’s typical imaging findings, a focus will be placed on the additional factors relevant to pretreatment or preoperative planning. These rare neoplasms include, but are not limited to: laryngeal chondrogenic tumor, lipoma, leiomyoma, spindle cell sarcoma, schwannoma, myoepithelioma, hemangioma, metastases, laryngocele with concurrent neoplasm, minor salivary gland tumors and tumor mimics, such as amyloidosis.
SUMMARY: Non-squamous cell carcinoma neoplasms of the larynx are rare. However, a thorough review of these atypical lesions and their imaging characteristics will aid in their recognition and accurate detection. As the vast majority of tumors within the larynx are squamous cell carcinomas, prospective characterization of these infrequent tumors can often drastically impact both prognosis and therapeutic management.
(LA_04) Head and Neck Cancer: Crucial Magnetic Resonance Imaging (MRI) anatomy for accurate tumor staging

Author(s)
Gloria J. Guzman Perez-Carrillo, MD, MSc
Clinical Instructor / Research Fellow
Washington University in St. Louis

Abstract Details
Purpose: To provide an educational exhibit illustrating the crucial head and neck anatomy in magnetic resonance imaging (MRI) used in the correct local staging of head and neck cancers. The approach is based on anatomic localization with an emphasis on the anatomy of the oral cavity, nasal sinuses, nasopharynx, oropharynx, hypopharynx, larynx, nodal levels, deep cervical spaces, fascial planes. Use of diffusion weighted images (DWI) to identify possible regions of subtle tumor that need more meticulous characterization and evaluation will be discussed. Histopathological correlation is provided for select cases.

Material and Methods: Retrospective case review of a broad range of pathologically proven cases of head and neck neoplasms accumulated from 2000-2012 and 2014-2016 at a tertiary referral university medical center. These are organized by location of the primary neoplasm and pertinent anatomy for the local staging. High quality anatomical and DWI images are used to illustrate the findings. Some of the cases will be accompanied by histopathological correlation.

Results: The viewer of this exhibit will gain or refresh information about critical MRI anatomy for the local staging of head and neck cancers useful in clinical practice and in preparation for certifying examinations. The images provided aid in the recognition of critical anatomical structures that must be thoroughly evaluated and categorized in order to arrive at the correct local staging.

Conclusions: Staging of head and neck can present a diagnostic challenge. Critical anatomy that needs to be recognized and evaluated for the correct staging of these tumors is fundamental to optimize patient care and outcome.
Abstract Details
Purpose:
The purpose of this exhibit will be to discuss the causes, imaging manifestations, and treatment of traumatic laryngeal injury. This exhibit will:

1. Introduce normal laryngeal embryology and anatomy.
2. Detail the mechanisms and management of traumatic and iatrogenic laryngeal injury.
3. Describe imaging findings associated with the laryngeal injury according to the Schaefer-Fuhrman classification system.
4. Describe a systematic approach to analyzing laryngeal injury to better assess for surgical intervention, according to stability/instability or airway compromise.
Laryngeal trauma is rare, but the associated complications and craniofacial injuries are serious and if left undiagnosed carry significant morbidity and mortality. Often, the imaging manifestations of laryngeal trauma are subtle, or sometimes there may be significant soft tissue emphysema related to a through and through airway defect. However, the site of injury may be masked in an intubated polytrauma patient. The prompt recognition of laryngeal injuries in blunt and penetrating settings is important in guiding medical and surgical management as well as for reducing morbidity associated with these injuries.

The Schaefer-Fuhrman classification system is used to classify laryngeal traumatic injuries from grade I to V ranging from small hematomas, those with increasingly complex cartilage fractures to total laryngotracheal separation with grade V injuries. It is important for radiologists, both within and outside trauma centers, to scrutinize the larynx and recognize patterns of injury requiring additional urgent and emergent therapy.

Summary:

Laryngeal injuries range from minor mucosal damage to severe, life-threatening airway compromise as a result of a complex range of mechanisms. It is vital to appropriately triage, diagnose, and classify traumatic laryngeal injuries to aid in the expedient treatment of these injuries and decrease morbidity and mortality. It is important to understand to role of imaging in the management of laryngeal injuries.
Abstract Details
Purpose: Laryngeal trauma is a rare but potentially life threatening condition. Prompt diagnosis is important in avoiding early complications including death but also long term problems including difficulty breathing, talking and swallowing. CT is usually the initial choice for imaging to evaluate a trauma patient for possible injury of the larynx because it is quick, non-invasive and readily available. Symptoms of the patient do not always correlate with the extent of injury, thus imaging may play a crucial role in determining existence of injury in unexpected cases. In addition radiologists must be aware of important findings associated with more significant cases of laryngeal trauma because they may help guide management.

Description: This exhibit first reviews different types of laryngeal trauma including external blunt (such as motor vehicle accidents and strangulation), external penetrating (such as stabbing and gun shot wounds) and internal blunt (endotracheal intubation) and reviews some of the presentations of these different scenarios. The complex anatomy of the larynx is reviewed because detailed knowledge of the individual components is crucial in being able to correctly diagnose acute injuries. Injuries may consist of fractures but also include soft tissue injuries of the ligaments and hematomas. The exhibit will then review the use of CT imaging of the neck, namely MDCT, which enables the radiologist to view the larynx in 3 planes. In addition, use of special reconstructed 3-D images, which can be constructed for both determining extent of injury but also helping in pre-surgical planning. Evaluation of not only the cartilaginous structures but also the mucosal and submucosal soft tissues is stressed because soft tissue manifestations may be the first clue to cases with subtle injuries. Furthermore the exhibit will also introduce common pitfalls involved in evaluating for potential laryngeal injuries such as differences in ossification associated with patient age and gender.

Summary: Laryngeal trauma is an uncommon injury but it is crucial that prompt diagnosis be made in order that both acute and delayed complications be avoided. Radiologists need to be able to detect trauma involving the larynx on CT scans obtained in the emergent setting. CT scans play an important role in both suggesting the diagnosis but also determining the extent of injury which determines management. Special 3-D reconstructed images can also be created to assist both the radiologist and the surgeon.
Abstract Details
Purpose: Cervical adenopathy is a very common clinical condition. The most common etiologies are inflammatory/infectious processes and metastatic disease. The purpose of this exhibit is to demonstrate CT and MR imaging features of a variety of unusual causes of cervical adenopathy.

Description: CT and MR examinations of unusual neoplastic, infectious, and inflammatory causes of cervical adenopathy are reviewed. Entities include Kimura disease, Kikuchi disease, Castleman disease, sarcoidosis, mononucleosis, TB, HIV, and metastatic thyroid cancer. Characteristics such as necrosis, density, and calcification are discussed. Most pathologic adenopathy has a nonspecific imaging appearance. In select pathological entities, the differential diagnosis can be narrowed, and in a few entities, a specific diagnosis can be made based on imaging appearance.

Summary: Imaging features of unusual causes of cervical adenopathy are illustrated with the goal of forming a limited differential diagnosis and making a specific diagnosis in select entities.
The Many and Changing Faces of Lymphoma in the Head and Neck

Author(s)
Dejan Samardzic, MD
Radiology Resident
Penn State Hershey Medical Center

Role: Author
Kristen L. Baugnon, MD
Neuroradiology Assistant Professor
Emory University

Abstract Details
Purpose: Non-Hodgkin lymphoma (NHL) is a lymphoreticular systemic malignancy which can have varied manifestations in the head and neck, and can mimic many other entities, including infection, inflammatory processes, and other neoplasms. Multiple subtypes exist, with the majority being B-cell origin tumors. In the immunocompromised patient, lymphoma can be associated with underlying viruses such as Epstein-Barr virus and can have a different and more aggressive imaging appearance. Being aware of the different manifestations of lymphoma is important to avoid diagnostic errors and can help with planning for biopsy, as different mediums for specimen preservation or different core biopsy techniques may be required. The purpose of this exhibit is to review the pathophysiology and types of lymphomas, the mechanism of viral mediated lymphomas in the immunocompromised setting, and their representative imaging appearances in the head and neck.

Description: NHL in the head and neck manifests itself in the nodal, extra-nodal lymphatic (Waldeyer's ring: i.e. tonsils & adenoids), and extra-nodal extralymphatic (i.e. orbit, sinuses, aerodigestive tract, salivary and thyroid) forms. These disease locations, along with the clinical symptoms, factor into the modified Ann Arbor staging system used for clinical staging, treatment, and prognosis. This exhibit will review the different imaging appearances of the common nodal and non-nodal sites of lymphomatous involvement on both CT and MRI with emphasis on differential diagnoses and clinical staging. Imaging differences between immunocompetent and immunocompromised cases of NHL will be highlighted.

Summary: This electronic exhibit will highlight the CT and MR imaging appearance of the different manifestations of NHL in the head and neck. Keeping NHL in the differential is important as it can minimize diagnostic errors and aid in obtaining diagnostic biopsy results.
Head and neck cancer is associated with a high incidence of uncontrollable cervical lymph node metastasis - the most important prognostic factor for survival. The American Joint Committee on Cancer has adopted an imaging-based classification of nodal levels used for initial staging or re-staging of disease. However, these guidelines may not fully address all nodal regions and some of the anatomic descriptions can be ambiguous. During treatment, the lymph node drainage pathways may change due to post-treatment anatomical modifications. Radiologists should recognize in their daily practice neck node anatomy based on lymphatic chains and drainage pathways as well as common neck nodes such as levels I-IV.

The purpose of this exhibit is to review the lymphatic chains of the head and neck, including current imaging-based classification, and discuss other lymph nodes that are not included in the TNM atlas; for instance, the prevertebral compartment group, the bucco-facial group, the parotid group, and posterior skull group.

< Description/Table of contents >
1. The clinical implications of lymph node metastasis
2. Review of cervical lymph node metastasis
   • Lymphatic drainage system based on Rouvière classification
   • Image-based classification of head and neck cancer staging
   • Proposed consensus guidelines by the radiation oncology group (DAHANCA, EORTC, HKNPCSG, NCIC CTG, NCRI, RTOG, TROG) in 2013.

3. Lymph node metastasis in patients with an overview during multidisciplinary management

The management of lymph node metastases requires multifaceted treatment strategies consisting of surgery, radiation therapy, and chemotherapy. The most common and important node levels are the jugular lymphatic chain (level II-IV). However, in the setting of post-operative and/or post-radiation changes, the lymph node drainage system may be altered due to the anatomical modifications resulting from structure ablation during the neck dissection procedure. In addition, the delineation of the nodal levels may be more difficult due to inflammation and edematous nature of the post-operative tissues in the neck.

We will discuss all lymph nodes, including those nodal compartments that have not previously been extensively considered; including those within the lower neck (e.g. supraclavicular nodes), the prevertebral compartment group (e.g. retropharyngeal and post-styloid), the bucco-facial group, the parotid group, the posterior skull group (e.g. retroauricular and occipital nodes), and some specific lymph nodes such as lingual node. Peculiarities pertaining to the advanced node-positive and the post-operative clinical scenarios will also be discussed. Detailed knowledge of cervical lymph nodes is essential for the treatment planning and surveillance of head and neck cancer patients.
The Missing Link: Cervical and Dural Lymphatics are Vital, Unappreciated Elements of the Brain Lymphatic Pathway

Author(s)
Wende N. Gibbs, MD
Assistant Professor of Neuroradiology
University of Southern California, Keck School of Medicine

Role: Author
John L. Go, MD
Assistant Professor of Neuroradiology
University of Southern California, Keck School of Medicine

Role: Author
Meng Law, MBBS, FRACR
Professor of Radiology
University of Southern California, Keck School of Medicine

Abstract Details
Purpose: The role of glymphatic system dysfunction in neurodegenerative and immune-mediated disease is currently the subject of intense interest and active research. The blood brain barrier, perfusion, compliance, and fluid exchange have been the primary focus study. Less familiar is the vital role of head and neck structures, such as the cervical lymph nodes, cranial nerve sheaths, and dural lymphatic vessels in the lymphatic drainage system of the brain. This review of the brain lymphatic pathways will provide an overview of the most current literature and discoveries concerning the intracranial glymphatic system, the extracranial components of the system, and the vital, recently discovered links connecting the two.

Description: The learning objectives of this review are as follows:
(1) Provide an overview of the glymphatic system, and the suspected role of glymphatic dysfunction in a variety of CNS diseases.
(2) Describe the three purported pathways of CSF and interstitial solutes: dural arachnoid granulations, perineural sheaths, and recently discovered dura-associated lymphatic vessels.
(3) Analyze the role of cervical lymphatics and their afferent supply from the sinus-associated lymphatic vessels in CNS immune surveillance by peripheral immune cells.
(4) Consider implications for patients with disruptions of these head and neck pathways, specifically malignancy or treatment with surgery and radiation.

Summary: The lymphatic system performs essential physiological functions for protein homeostasis and immune surveillance. Recent research has challenged the long-standing dogma that the CNS lacks a lymphatic system. While the intracranial glymphatic system has monopolized attention in this area, the role of connections to the extracranial compartment is only recently attracting interest. Cervical lymph nodes and
afferent connections from dural lymphatic vessels play a key role in this system, and disruption of these components, in the setting of cancer or cancer treatment, may have unintended upstream consequences.

(N&O_01) Oculopharyngeal Muscular Dystrophy: Head and Neck Manifestations

Abstract Details
Purpose:
1) To familiarize the radiologist with imaging manifestations in oculopharyngeal muscular dystrophy (OPMD).
2) To suggest a role for imaging in OPMD diagnosis.
3) To review the major differential diagnosis for fatty infiltration of extraocular muscles.
4) To review the major differential diagnosis for fatty infiltration of the tongue.

Description:
A case report of a patient with a biopsy proven diagnosis of OPMD will be presented, describing fluoroscopy and CT manifestations in the head and neck, and discussing differential diagnostic considerations and potential implications in OPMD diagnosis.

Summary:
OPMD is a rare inherited myopathy primarily characterized by progressive ptosis, dysphagia, and proximal muscle weakness. The genetics of OPMD have been thoroughly investigated in the literature, leading to molecular genetic testing being the current gold standard for diagnosis. Imaging manifestations of the disease have been described in the literature as a variable degree of fatty infiltration of many abdominal and pelvic muscles. However, published reports regarding head and neck manifestations of the disease are limited and/or outdated.

This case report will familiarize the radiologist with OPMD findings in the head and neck region on CT and video fluoroscopic swallow examinations, which consist of symmetric atrophy and/or fatty infiltration of selected muscles with preferential involvement of the intrinsic and extrinsic tongue muscles as well as
the extraocular musculature. Differential diagnostic considerations will be presented including various causes of denervation atrophy of the tongue and posterior pharyngeal wall as well as thyroid orbitopathy causing fatty infiltration of the extraocular muscles. Differences in imaging findings between these disease entities and OPMD will be emphasized.
A hard act to swallow - Staging of Oropharyngeal cancer

Authors:
Jonathan Weisiger, M.D.
Kaitlin Eng, M.D.
Ian P. Mills, M.D.
Amit Mahajan, M.D.

Purpose: Review staging of oropharyngeal cancer.

Materials and methods: A single institution retrospective review was performed for CT and MRI findings and staging of oropharyngeal cancer.

Description:
Precise staging of oropharyngeal cancer is essential for guiding management and optimizing patient care. Cross sectional imaging plays a fundamental role in surgical management by defining resectable and nonresectable lesions, as well as nodal spread. Through a case based approach, we will review basic anatomy and relevant landmarks that are clinically pertinent for accurate staging of oropharyngeal cancer, as per current TNM staging classification.
Summary:
This educational exhibit will provide basic knowledge to accurately stage oropharyngeal cancer.
Prevertebral ganglion cyst masquerading as necrotic retropharyngeal adenopathy – Review of prevertebral space anatomy and pathology

Author(s)
Evan B. Young, MD
Resident Physician
Geisinger Medical Center

Role: Author
Shamsher S. Dalal, MD
Interventional Neuroradiologist
Geisinger Medical Center

Abstract Details
Purpose: Cystic masses of the prevertebral space are a potential localization pitfall and frequently misdiagnosed. We describe a rare cystic mass of the prevertebral component of the perivertebral space with associated differential diagnosis considerations and imaging recommendations.
Description: Our patient is a 50 year old woman with a history of papillary thyroid carcinoma who underwent routine surveillance thyroid ultrasound. This demonstrated questionable abnormalities in the surgical bed, which prompted further characterization with CT scan of the neck. CT revealed no paratracheal pathology; however, an incidental, thick-rimmed, ~2 cm cystic lesion was identified. This mass was incorrectly localized the retropharyngeal space. Based on these findings, transfacial CT-guided fine needle aspiration biopsy was performed, which yielded a mucoid, hypocellular, and ultimately non-diagnostic specimen. MRI was then performed for further characterization, correctly localizing the collection to the perivertebral space rather than the retropharyngeal space. Findings included fluid signal collection with fine internal septations in the lateral prevertebral component of the perivertebral space without abnormal enhancement. Imaging characteristics and aspiration findings favored a diagnosis of cervical prevertebral synovial/ganglion cyst, a rare entity.
Discussion: The perivertebral space is completely circumscribed by the deep layer of the deep cervical fascia, and is divided into two components: prevertebral and paraspinal. The prevertebral component contains the longus colli/capitus and scalene muscles, the brachial plexus nerve roots, and the vertebral vessels. The deep layer is strong and tends to exclude extrinsic pathology. Potential pathology is limited to the relative paucity of structures contained within the space. The differential diagnoses for a prevertebral space cystic lesion include abscess, necrotic adenopathy, cystic nerve sheath tumor of the brachial plexus, nerve sleeve cyst or venolymphatic malformations. Synovial/ganglion cysts, although rare, should also be considered.
These entities can be more confidently diagnosed with MRI rather than CT, with superior soft tissue contrast and multiple sequences. CT is readily available, inexpensive and generally accepted as the first line imaging tool of the head and neck. However, as our case illustrates, the neuroradiologist should be aware of the potential for lesion mislocalization and mischaracterization when using this modality alone.
(N&O_04) Cervical internal carotid artery pseudoaneurysm complicating malignant external otitis

Author(s)
David R. Leake, MD
Neuroradiologist
Austin Radiological Association

Abstract Details
The purpose of this case report is to describe a carotid pseudoaneurysm complicating necrotizing external otitis. The patient is a 66 year old male with poorly controlled type II diabetes. He is a poor historian from Mexico. He describes a six month subacute course of progressive symptoms including headache, right hearing loss, weight loss, right vision loss, right facial palsy, and right neck pain. Initial CT Head and CT Cervical Spine demonstrated lytic changes of right orbit apex, right clivus, right temporal bone, and pathologic fracture of base of the odontoid. There was opacification of bilateral middle ears and mastoids. There was associated right orbit apex, parasellar, paracival, paratemporal bone extra axial soft tissue mass. In addition there was right nasopharyngeal mass and upper cervical prevertebral soft tissue mass. Subsequent CTA Neck exam demonstrated right internal carotid artery aneurysm. Biopsy of orbital apex was negative for tumor. Tissue cultures were positive for pseudomonas infection compatible with diagnosis of necrotizing external otitis. The patient had an uneventful recovery following IV antibiotics and treatment of pseudoaneurysm with a covered stent. In summary, our case describes an internal carotid artery pseudoaneurysm complicating necrotizing external otitis. It would be helpful for the Head and Neck Radiologist to be aware of the imaging findings of this rare entity in order to expedite diagnosis and treatment.

(O&V_01) Primary Ewing Sarcoma of the Medial Orbit

Author(s)
Matthew Spotnitz, MD, MS, MPH
Radiology Resident
Penn State Milton S Hershey Medical Center

Role: Author
Henry Crist, M.D.
Associate Professor
Division of Anatomic Pathology

Role: Author
T. Thomas Zacharia, MD
Staff Physician
Diagnostic Radiology and Neuroradiology

Abstract Details
Case: Primary Ewing Sarcoma of the Medial Orbit

Discussion: Ewing Sarcoma is the second most common primary malignant bone tumor of childhood. It is one neoplasm in a family of primitive neuroectodermal tumors (pNETs) that result from a common cytogenetic translocation t(11;22)(q24;q12). Maxillofacial involvement of Ewing Sarcoma occurs in approximately 1-7% of cases, and fewer than 20 cases of primary intraorbital Ewing Sarcoma have been reported.

The presenting symptoms of Ewing Sarcoma can include proptosis, periorbital edema, impaired visual acuity and pathological fracture. A history of a mass that is rapidly growing, firm, tender and immobile is concerning for a neoplasm. On CT, Ewing Sarcoma presents as a mass with both osseous and soft tissue components and can be associated with an aggressive periosteal reaction. The soft tissue component can be heterogeneous, owing to internal tumor necrosis.

MRI is the best imaging modality to characterize Ewing Sarcoma. The mass is hypointense on T1 and hyperintense on T2 relative to muscle, which allows for accurate evaluation of invasion into bone marrow and adjacent soft tissues. The most common origin site of a primary intraorbital Ewing Sarcoma is the superolateral or lateral orbit, followed by the medial orbit. The therapy for an intraorbital Ewing Sarcoma is a combination of chemotherapy, surgery and radiotherapy. The median survival for a patient with Ewing Sarcoma is 17 months.

The clinical presentation and imaging characteristics of Ewing Sarcoma overlap closely with Rhabdomyosarcoma. Additionally, Osteosarcoma can recur in the orbit following radiotherapy. For a patient younger than 4 years old, metastatic Rhabdomyosarcoma is in the differential.
Abstract Details

PURPOSE-
Review the radiology of enophthalmos.

DESCRIPTION-
1. While enophthalmos is a less frequently encountered imaging finding than exophthalmos, there is a similarly wide differential diagnosis.
2. Etiologies can be broadly classified into those that alter the bony orbital contour, and those that affect the soft tissue contents.
3. Orbital wall blow-out fractures represent a frequently encountered cause of enophthalmos identified on imaging studies.

OUTLINE-
- Review of orbital anatomy
- Definition of enophthalmos: clinical and radiologic
- Differential diagnosis (representative entities in parentheses):
  1. Abnormalities of the bony orbit
     a. Trauma (orbital wall fractures)
     b. Sinonasal pathology (maxillary hypoplasia, silent sinus syndrome)
     c. Developmental (NF1, Parry-Romberg syndrome)
     d. Iatrogenic (maxillectomy)
     e. Misc (silent brain syndrome)
  2. Abnormalities of the orbital contents
     a. Neoplastic (scirrhous breast ca)
     b. Developmental (microphthalmia, Duane’s syndrome, Parry-Romberg syndrome)
     c. Rheumatologic (Marfan)
     d. Autoimmune (linear scleroderma)
     e. Pseudoenophthalmos (microphthalmia, ptosis bulbi, contralateral exophthalmos)
     f. Misc (anorexia, senile enophthalmos, radiation)
Abstract Details
Purpose: Hallmarks of orbital apex syndrome (OAS) are visual loss from optic neuropathy and ophthalmoplegia involving multiple cranial nerves.

The terms superior orbital fissure (SOF), orbital apex (OA), and cavernous sinus (CS) have been used to anatomically define and localize the disease process. The OA, SOF, and CS are contiguous spaces and share a common differential of pathologic etiologies.

The purpose of this educational exhibit is to review the anatomy of the orbital apex, presenting signs and symptoms of OAS. Via a pictorial discussion, common differential etiologies affecting the orbital apex will be enumerated.

Methods: Diagnostic imaging with MRI using thin section, fat suppression technique is essential to delineating the extent of disease, narrowing the differential diagnosis, and identifying sites for potential biopsy. Where complementary, thin section CT images will be presented.

Systemic diseases including infection, neoplasm, and autoimmune disorders are reviewed. Specifically, fungal, neoplastic, orbital pseudotumor, thyroid orbitopathy involving the orbital apex will be depicted.

Discussion: Orbital apex syndrome (OAS) results from damage to the oculomotor nerve (III), trochlear nerve (IV), abducens nerve (VI) and ophthalmic nerve (V1) in association with optic nerve dysfunction (CNII).

The initial presentation of OAS is usually visual loss and ophthalmoplegia. Periorbital pain or facial pain reflects involvement of the ophthalmic or maxillary branch of the trigeminal nerve. The absence of pain
Optic nerve dysfunction is assessed by measurement of visual acuity and testing for the presence of an afferent pupillary defect. Diplopia can also be the presenting symptom.

Conclusion: Orbital apex syndrome represents a heterogeneous group of disorders that can result from a myriad of etiologies. We have provided a structured approach to evaluating the orbital apex to add value in the management of patients where prompt diagnosis is imperative.
(O&V_04) Spectrum of MR and CT imaging in thyroid associated ophtalmopathy

Author(s)
Geoiphy G. Pulickal, MD, FRCR
Associate Consultant
Alexandra Health, Singapore

Role: Author
Ashish Chawla, MD, ABR
Consultant
Alexandra Health

Abstract Details
Purpose
To review the Computer Tomography (CT) and Magnetic Resonance (MR) imaging findings of thyroid opthalmopathy across the spectrum of mild to severe disease.

Description
Thyroid related ophtalmopathy is the most common cause of proptosis in adults worldwide, usually due to underlying Grave’s disease. CT imaging is usually performed as a baseline study, subsequent follow up with MR imaging to reduce radiation and evaluate complications if they arise.

The hallmark of thyroid opthalmopathy is hypetrophy of the extra-ocular muscle bellies sparing the tendinous insertions. Step wise involvement commencing with the inferior rectus muscle and then the medial, superior, lateral recti and finally the inferior oblique. Findings are usually bilateral and symmetrical; with signs of intra- orbital mass effect in advanced cases. It needs to be differentiated from orbital pseudotumour, sarcoidosis and lymphoproliferative disorders.

Summary
The review the spectrum of imaging findings in thyroid associated opthalmopathy in CT and MR modalities.
A pilomatricoma is relatively uncommon benign neoplasm arising from the skin adnexa. This neoplasm most commonly occurs in the head and neck region during the first two decades of life.

Our objective is to characterize the radiologic appearance of an upper eyelid pilomatricoma on MR and to correlate the imaging findings with the clinical, surgical, and histopathologic features.

In this case of an upper eyelid pilomatricoma, the patient presented with an expanding upper eyelid mass.

On MR, there is well-circumscribed, subcutaneous mass involving the upper eyelid. The mass is predominately hypointense with patchy areas increased signal on T2 weighted pulse sequences. Contrast enhanced T1 weighted images patchy and reticular internal enhancement. There is a surrounding increase in T2 signal and enhancement corresponding to peritumoral inflammatory changes.

After surgical resection, histopathological analysis demonstrates characteristic keratinaceous cells without nuclei, “ghost cells”.
The magnetic resonance imaging features of a case of an upper eyelid pilomatricoma are well demonstrated with good clinical, surgical, and histopathocical correlation.
Abstract Details

Purpose
Immunoglobulin G4 (IgG4) related disease is an idiopathic, systemic fibro-inflammatory disorder characterized by IgG4 positive lymphocytic infiltrative lesions with common involvement of the head and neck. This is a rare, and likely under recognized, disease entity that links many conditions once regarded as isolated single organ disorders such as autoimmune pancreatitis and inflammatory pseudotumor. This abstract reviews the clinical features and imaging findings of head and neck IgG4 related disease using multimodality imaging examples from our institution.

Material and Methods
We performed a retrospective chart review of two cases of IgG4 related disease with involvement of the head and neck from our institution. We focused on the clinical features and imaging findings using multimodality imaging, including US, CT, MR and FDG-18 PET CT. Our findings were then correlated with current literature.

Results
Our two patients, one female and one male, were diagnosed at ages 32 and 41 respectively. The gender distribution of IgG4 related disease in the head and neck in the literature mirrors our findings with a 1:1 male to female ratio. Our patients presented with superior neck swelling and eyelid ptosis. The presentation was subacute with symptoms present for 12-18 months.

Multi-organ disease was seen in both patients with involvement of the submandibular, parotid and lacrimal glands. We saw an example of symmetric bilateral disease and an example of unilateral disease. As observed in our patients, the most commonly involved sites in IgG4 related disease in the head and neck is the lacrimal and salivary glands. The constellation of lacrimal, parotid and submandibular gland enlargement was formerly known as “Mikulicz disease”. Isolated involvement of the submandibular glands was known as “Küttner’s tumor.”

CT imaging demonstrated smooth, homogenous enhancement and enlargement of the involved organ. T1 isointense signal to skeletal muscle with homogenous enhancement following contrast administration was seen on MR. T2 weighted imaging demonstrated low signal intensity of the lesions secondary to increased cellularity and fibrosis. Involved organ sites were intensely FDG avid and PET/CT was helpful in delineating additional subclinical sites of disease. Ultrasound demonstrated changes consistent with
inflammation of the submandibular gland with heterogeneous echotexture and increased vascularity.

Diagnosis was made by surgical pathology demonstrating sclerosing inflammation with IgG4 plasma cell infiltration. Histologic tissue confirmation is gold standard for diagnosis and allows differentiation from malignancy and other inflammatory conditions. Both patients demonstrated response to steroid and immunotherapy, a hallmark of this disease, with a typical relapsing and remitting course.

Summary
IgG4 related disease is an increasingly recognized immune-mediated condition with frequent involvement of the head and neck. This condition can mimic a wide variety of inflammatory and malignant conditions. Familiarity with the typical clinical and imaging features allows for early and accurate diagnosis which is crucial in this treatable condition.
Abstract Details
Purpose: To evaluate the rarely occurring tumor, orbital paraganglioma, with dynamic contrast-enhanced magnetic resonance imaging (DCE MRI) using a time-signal intensity curve (TIC) and positive enhancement integral (PEI) images.

Description: Paragangliomas are tumors of the paraganglia that arise from neural crest progenitor cells, which are distributed all over the body. Paragangliomas may be adrenal or extra-adrenal. Extra-adrenal paragangliomas in the head and neck are not common and may be located at the common carotid artery bifurcation, the jugular foramen, along the vagus nerve, and within the middle ear.

The orbit is an extremely unusual site for paragangliomas, and the existence of normal paraganglia in the orbit is not well documented in humans. Some authors suggested that orbital paragangliomas may arise from sustentacular cells or ciliary paraganglia. This tumor is hypervascular and infiltrative in nature, often making surgery for it difficult. More common orbital tumors that may mimic paragangliomas in imaging are meningioma, cavernous hemangioma, and schwannoma.

DCE MRI is a noninvasive imaging technique that can be used to derive quantitative and semiquantitative parameters that reflect the microcirculatory structure and function in imaged tissues. Researchers have investigated this technique in a wide range of oncologic applications, including for head and neck tumors. However, given the rare occurrence of paraganglioma in the orbit, diagnosis of it remains challenging.

We present herein a case of pathologically proven orbital paraganglioma. The patient presented with a longstanding complaint of left orbital proptosis that progressed over the previous 1 year. MRI revealed a 33 x 16-mm ovoid mass in the left superior lateral orbit with associated bone remodeling of the lateral orbital wall. The mass was mildly heterogeneous in signal on T2-weighted images, with prominent vascular flow voids within the tumor. The mass extended into the periorbital soft tissues and superior
eyelid as well as along the subcutaneous soft tissues overlying the zygomatic arch.

DCE MRI demonstrated a hypervascular mass with early, rapid enhancement after gadolinium administration very similar to arterial vascular enhancement. A TIC demonstrated a rapid initial upslope and rapid washout pattern. The semiquantitative parameter based on the TIC revealed high peak enhancement, a high maximum signal enhancement ratio, and a short time to maximum enhancement. These findings were more distinctive for orbital paraganglioma than for other more common hypervascular tumors, such as meningiomas. Using postprocessed PEI images generated from the area under the TIC was very helpful in delineating the tumor margin, as it infiltrated the periorbital soft tissue, eyelid, and subcutaneous soft tissue overlying the zygomatic arch. Postprocessing of DCE MRI was simple and practical in clinical setting.

Summary: Orbital paraganglioma has distinctive DCE MRI characteristics. Using DCE MRI as an adjunct to conventional MRI to assist diagnosis and delineation of tumor margin for orbital paraganglioma is promising. Simple assessment of the TIC, semiquantitative parameters, and postprocessed PEI images should be considered in evaluation of orbital masses found on MRI scans.
There’s Something In My Eye! PET/CT of Adult Orbital Tumors

Author(s)
Simone Montoya, MD
Resident Physician
University of Rochester Medical Center

Role: Author
Savita Puri, MBBS, MPH
Associate Professor
University of Rochester Medical Center

Role: Author
Alok Bhatt, MD
Assistant Professor
University of Rochester Medical Center

Abstract Details
Purpose

In this exhibit, we present the PET/CT findings of a number of orbital tumors seen in the adult population.

Description

Orbital tumors are a heterogeneous group of neoplasms involving the globe, optic nerve, and/or the extraocular orbit. They can represent primary orbital lesions, secondary extension from adjacent structures, or metastatic disease. This is a case-based review showcasing the radiographic appearance of different orbital tumors, highlighting how PET/CT can sometimes be the first modality which finds the lesion. Example lesions include squamous cell carcinoma, lymphoma, leukemia, and metastasis. As knowledge of orbital structures is key in assessment of these lesions, there will be a brief introduction of orbital anatomy preceding the cases.

Summary

Orbital tumors are sometimes first identified on PET/CT, perhaps performed for other reasons. Knowledge of the anatomy of the orbit can help fully characterize the lesion.
Purpose:
The purpose of this exhibit is to review the imaging appearance and clinical findings of non-traumatic orbital emergencies.

Description:
There is an eclectic group of disease processes that involve the orbit with the potential for severe morbidity (such as permanent vision loss) and even mortality. Because of this, a diagnosis of orbital pathology can be frightening and anxiety provoking for both patients and physicians. Early diagnosis of orbital emergencies is crucial so that treatment can be initiated early in order to prevent devastating sequelae.

In this exhibit, non-traumatic orbital emergencies will be categorized and their clinical and imaging manifestations will be discussed in a case-based review format. The orbital emergencies will be categorized as follows:

1. Infection
   a. Postseptal orbital cellulitis
   b. Abscess: Subperiosteal and Intraorbital
   c. Neuretinitis
   d. Invasive fungal sinusitis with extension into the orbit
   e. Differentiating from non-emergent infections such as preseptal cellulitis and dacrocystitis

2. Vascular
a. Ophthalmic vein thrombosis  
b. Carotid-cavernous fistula, both direct and indirect  
c. Cavernous sinus thrombosis

3. Inflammation  
a. Optic neuritis and differentiating acute from chronic optic neuritis  
b. Orbital pseudotumor (idiopathic orbital inflammation)  
c. Thyroid eye disease

4. Orbital manifestations of intracranial neurologic emergencies  
a. Terson syndrome  
b. Cranial nerve palsy from aneurysm and brainstem infarction  
c. Papilledema  
d. Idiopathic intracranial hypertension

Summary:

Familiarity with the clinical presentation and imaging findings of orbital emergencies is imperative as delay in diagnosis and treatment can lead to permanent vision loss and, in some cases, mortality.
Abstract Details
Purpose: To investigate the prevalence of calcified scleral plaques and its relationship to age and IOL insertion.
Materials and methods: Our study assessed prevalence of calcified scleral plaques on CT head imaging done for unrelated indications in patients. A total of 120 patients including matched controls were assessed. The prevalence of scleral plaques, the site of the plaques, bilaterality, relationship to presence or absence of intraocular lens implants were assessed.
Results: Though the etiology of scleral plaques are varied and includes inflammation such as scleritis, lymphoma, dystrophic calcification and hypercalcemic states, the most common cause is senile scleral plaques or Cogan's plaques which are found at the insertion of the medial and lateral recti muscles. Our study revealed that calcified senile scleral plaques were common in patients aged 75 and above. Prevalence in this age group was greater than 60%. The plaques were slightly more prevalent at the insertion of the lateral rectus as compared to the medial rectus. The plaques were common in patients with intraocular lens but these patients were also older.
Conclusion: The study revealed that the most common cause of scleral calcification in asymptomatic patients is senile scleral plaques seen at the insertion of the lateral and medial rectus muscles. This is overwhelmingly more common than any other cause of scleral plaques seen in the eye and is very common in patient's beyond the age of 75.
Compressive Optic Neuropathy from the Normal and Abnormal Internal Carotid Artery

Author(s)
Robert Chen, MD
Consultant Radiologist
Singapore General Hospital

Role: Author
Sharon Tow, Senior Consultant
Senior Consultant Ophthalmologist
Singapore National Eye Center

Abstract Details
The causes of optic neuropathy are myriad, and include demyelinating, inflammatory, ischemic, traumatic, and compressive etiologies. Only 20% of cases will identify a compressive etiology upon the optic nerve as the source of the optic neuropathy. Mass lesions along the course of the optic nerve, including but not limited to meningiomas, hemangiomas, hemangiomas, lymphangiomas, lymphoma, and extraocular muscle enlargement from thyroid eye disease, all have been known to compress the optic nerve, leading to damage to the optic nerve, disc pallor, and subsequent loss of vision.

The internal carotid artery (ICA) is another potential mass lesion that has been rarely described in causing a compressive neuropathy. Neurovascular conflict from the 5th, 6th, and 7th cranial nerves have been well described, but a vascular conflict to the 2nd cranial nerve is less often seen and not often thought of by the radiologist as the source for optic neuropathy.

Aneurysms from the ICA, whether they be fusiform or saccular, can compress the optic nerve. Additionally, a normal appearing nonaneurysmal ICA can compress the optic nerve, leading to optic neuropathy.

In our presentation, we will show several examples (at least 5 cases) of abnormal and normal appearing ICAs that are believed to be the cause of the optic neuropathy. Each of the cases clearly show optic atrophy, the normal or abnormal ICA compressing the optic nerve, and have concordant ophthalmologic findings that suggest the ICA to be the source optic neuropathy. The clinical outcomes of some of these cases will be examined, if and when possible.
Abstract Details
Purpose: To describe the imaging and surgical anatomy of the lower oral cavity spaces and to provide imaging examples of common and uncommon pathologies that occur in this location.
Description: The mylohyoid muscle divides the floor of the oral cavity into two distinct anatomic areas, the sublingual space and the submandibular space. These comprise a small but important area within the oral cavity, and despite their small size are host to a wide array of pathologies including benign and congenital cystic lesions, inflammatory and infectious processes, benign and malignant neoplasms, and vascular lesions. The goal of this educational exhibit is to provide an overview of the relevant radiologic and surgical anatomy of the floor of the oral cavity, the sublingual and submandibular spaces, and to discuss and provide imaging examples of the pathologic processes that occur in these locations.
Summary: The submandibular and sublingual spaces comprise a small but important area within the oral cavity. Familiarity with the pathological processes that occur here will help general radiologists and neuroradiologists appropriately interpret imaging studies performed to evaluate pathologies that occur in this location.
(OC_02) Brush your teeth! Pictorial Review of Common and Uncommon Odontogenic Infections in the Head and Neck

Author(s)
Dmitriy N. Kazimirko, MD
Radiology Resident
University of Mississippi School of Medicine

    Role: Author

Amy B. Farkas, MD
Radiology Resident
University of Mississippi School of Medicine

    Role: Author

E. Patrick. Farley, MD
Assistant Professor, Radiology
University of Mississippi School of Medicine

    Role: Author

Ellen E. Parker, MD
Assistant Professor, Radiology
University of Mississippi School of Medicine

    Role: Author

Abstract Details
Purpose: Odontogenic infections are common in patients at our institution and are a significant cause of morbidity and sometimes mortality. These infections can be localized but can also extend far beyond the oral cavity. This interactive exhibit will familiarize participants with crucial imaging findings and pertinent clinical features of odontogenic infections.

Description: Interactive image-rich case-based review of common and uncommon patterns of odontogenic infection. Cases will be presented as unknowns, with follow-up questions and explanations of key imaging and clinical points. Basic anatomy with emphasis on spaces will be reviewed for each case. The presentation will be optimized for viewing on mobile phones and tablets as well as computer viewing stations.

Summary/Conclusion: Participation in this interactive exhibit will increase the participant's familiarity of and comfort level for interpretation of odontogenic infections on head and neck imaging.
(OC_03) Odontogenic Head and Neck Abscesses: Where they go and how to look for them

Author(s)
June Kim, MD
Assistant Professor
University of Kentucky

Role: Author

Douglas E. Lukins, MD
Assistant Professor
University of Kentucky

Abstract Details

Purpose: To review a range of common and less common locations of dental-related abscesses with CT examples, reported patterns of spread, key associated findings, and other pearls and pitfalls that may aid the radiologist and clinician with diagnosis and treatment planning.

Description: Odontogenic, or dental-related, abscesses in the soft tissues of the head and neck are a frequently encountered cause of facial and neck swelling in the emergent setting. Odontogenic infections have been reported as one of the most common causes for deep neck space infections. Left untreated, these infections can lead to complications and even death. Imaging, primarily with CT, can facilitate diagnosis and treatment planning in suspected and unsuspected cases. With CT examples, this exhibit will summarize common and other locations of dental-related abscesses in the soft tissues of the head and neck; key associated findings such as bone abnormalities; and complications including mediastinal abscess, cutaneous fistula, and others.

Summary: Dental related abscesses can be a diagnostic consideration in a patient presenting with facial swelling and being aware of the varied locations and associated findings seen on CT may facilitate diagnosis and treatment.
(OC_04) Case Report: Floor of Mouth Schwannoma

Author(s)
Sameer Sandhu, MD
Radiology Resident
Christiana Care Health System

Role: Author

Boris Reznikov, MD
Staff Radiologist
Christiana Care Health System

Role: Author

Robert Witt, MD
Otolaryngologist
Christiana Care Health System

Abstract Details
Purpose:
We will describe a case report of a young woman who presented with a left sided neck mass. Imaging revealed a floor of mouth lesion. Transoral resection was performed revealing a benign schwannoma. We will describe the imaging and pathologic features of this lesion, as well as a brief review of the literature, and discuss relevant differential diagnoses.

Description:
A 23 year old woman with no significant past medical history presented with a one month history of a left sided neck mass in the submandibular region. The patient denied fever, chills, night sweats, dysphagia, stridor, and hoarseness. Clinical exam revealed a firm, non tender mass in the left floor of mouth with intact overlying mucosa, without lymphadenopathy.

Initial noncontrast CT revealed a 3.5 cm well circumscribed low density mass measuring approximately 40 Hounsefild units, in the left floor of mouth. There was no mass effect on the oropharyngeal airway including vallecula. There were no signs of inflammation and no lymphadenopathy. At this point, differential considerations included ranula or sialocele, dermoid or epidermoid cyst, lymphatic or vascular malformation, salivary gland neoplasm, peripheral nerve sheath neoplasm, and less likely squamous cell carcinoma, sublingual gland carcinoma, lingual thyroid, and abscess. Subsequent MRI demonstrated a well circumscribed 3.6 cm mass deep to the left myelohyoid muscle, displacing the right genioglossus muscle laterally. The mass was slightly hyperintense to muscle on T1 weighted imaging and hyperintense on T2 weighted imaging with areas of cystic degeneration or necrosis. Following contrast administration, there was enhancement of the solid components of the mass and no enhancement of the central regions of cystic degeneration or necrosis.
Transoral surgery was performed with removal of the sublingual gland as well as the floor of mouth mass which was separate from the lingual nerve and the sublingual and submandibular (Wharton's) ducts. The mass appeared tan and had a rubbery consistency. Pathology revealed a bland spindle cell neoplasm with no evidence of mitotic activity or significant nuclear pleomorphism. There was no hemorrhage or necrosis. There were varying degrees of cellularity and areas consistent with Verocay bodies. Immunohistochemical stain for S100 was positive. Pan-cytokeratin, desmin, and actin stain were negative. The final pathology was consistent with a benign schwannoma. The patient's post operative course was unremarkable.

Schwannomas typically occur in patients between the ages of 30-50 years old, but can occur in age. Approximately 25-50% occur in the head and neck region, however, rarely in the floor of mouth. These tumors strongly express S-100 in most cells in contrast to neurofibromas which demonstrate variable expression. Total resection is usually curative. Malignant transformation is rare.

Summary:
We have described the clinical presentation, imaging features, pathologic features, and differential diagnosis of a rare floor of mouth schwannoma.
(OC_05) Percutaneous Aspiration Of Parapharyngeal and Retropharyngeal abscesses in Children Utilizing CT Guidance; an adjunct to surgical drainage.

Author(s)
Robert A. Koenigsberg, DO, FAOCR
Professor of Radiology
Hahnemann University Hospital - Drexel University College of Medicine

Role: Author

Alyssa Terk, MD
Otolaryngologist
St. Christopher's Hospital for Children

Role: Author

Jimmy Pham, DO
Otolaryngology Resident
Philadelphia College of Osteopathic Medicine

Role: Author

Suruchi Dewoolkar, DO
Diagnostic Radiology Resident
Hahnemann University Hospital - Drexel University College of Medicine

Abstract Details
Purpose: We studied two children, ages 9 months and age 11, one case each of parapharyngeal abscess and retropharyngeal abscess refractory to medical care. Each case was in extremis, with respiratory and cardiac compromise.

Methods: Each case was performed under CT guidance with general anesthesia. Localization was performed with judicious use of contrast material to localize and avoid neurovascular structures. Appropriate 20 gauge needles were utilized to access and aspirate the abscesses.

Results: The 11 year old patient was aspirated via a direct oral approach to the retropharyngeal space whereas the second patient was aspirated via a percutaneous retromandibular – parapharyngeal approach. Both aspirations yielded purulent material with positive cultures, 9 mo. - strep pyogenes and propionibacterium acnes, and 11 year old - strep pyogenes. Both collections were partially drained percutaneously, with only the retropharyngeal abscess required additional surgical intervention.

Conclusions: Percutaneous aspiration of parapharyngeal and retropharyngeal abscesses in children can be a useful adjunct to conventional surgical drainage in life threatening cases of head and neck infections, and can be curative when performed in conjunction with appropriate antibiotic regimens.
Spectrum of Head and Neck Sarcomas: A Pictorial Review

Author(s)
Kunal P. Patel, MD
Radiology Resident
Oakland University William Beaumont School of Medicine

Jeffrey Wilseck, DO, FAOCR
Assistant Professor of Radiology
Oakland University William Beaumont School of Medicine

Abstract Details
Purpose: Sarcomas are rare malignant neoplasms originating from mesodermal tissues. These tumors comprise less than 1% of all malignancies of which only 5-15% occur in the head and neck. Radiographic diagnosis of a specific sarcoma is often difficult because tumors in this class frequently demonstrate similar imaging features. Nonetheless, differentiation of these tumors is important because prognosis and therapeutic strategy differ according to the specific pathology. Radiologists who interpret these imaging studies should be familiar with the types of soft tissue and bone sarcomas that can occur in the head and neck as well as specific imaging features that may suggest a particular diagnosis. The aim of this exhibit is to review the spectrum of head and neck sarcomas in an effort to help the radiologist provide a narrow and accurate differential diagnosis when faced with these types of lesions.

Description: Imaging plays an essential role in the evaluation of head and neck sarcomas in many ways: to help make the correct diagnosis, to assess tumor size and relation to adjacent structures, and to evaluate for local and/or distant spread. While MR is the best imaging modality for evaluating the degree of soft tissue involvement and composition of these tumors, CT is often helpful to evaluate for the presence and extent of bony involvement as well as soft tissue calcification. The information obtained from both CT and MR is complementary and both studies are often required in the evaluation of these tumors. Occasionally, imaging findings can suggest the correct diagnosis, however definitive diagnosis typically requires histologic sampling. We provide several original histologically proven case examples of sarcomas involving the head and neck. We detail the typical clinical presentation, epidemiology, CT and MR imaging findings, prognosis, and treatment strategies for a wide spectrum of head and neck sarcomas. Important clinical and imaging pearls which may help the radiologist include or exclude specific entities from their differential diagnosis will be discussed.

Summary: While sarcomas of the head and neck are rare tumors, their accurate diagnosis is extremely important in determining prognosis and guiding treatment. In general, sarcomas of the head and neck have a poorer prognosis than sarcomas located elsewhere in the body. Head and neck sarcomas often affect critical structural areas that can result in morbidity and mortality if they are not diagnosed and managed appropriately and in a timely fashion. Complete surgical removal of the tumor is extremely important to having the best prognosis possible. Therefore, it is vital for the radiologist not only to recognize these tumors and provide an appropriate differential diagnosis but also to provide the clinician
with detailed information regarding the location and extent of these tumors.
Abstract Details

Purpose:
Head and neck (H&N) surgical reconstruction is complex, and postoperative imaging may prove challenging for the interpreting radiologist. Free flaps are often used to reconstruct orbital, sinus, deep face, and cervical defects. An understanding of free flaps is crucial for the H&N radiologist, and facilitates providing accurate, useful imaging reports. Differentiation of the normal flap appearance from recurrent tumor can only happen when the flap anatomy is understood.
The goal of this case based exhibit is to provide a comprehensive review of H&N free flap reconstructions using cross sectional imaging, original diagrams, and intraoperative photographs.

Description:
Complex reconstruction techniques are utilized to close surgical defects following H&N tumor extirpation. These repairs consist of transposed tissues that fulfill multiple purposes – improved wound healing, function, and cosmesis. Prior to surgery, the flap source and role are planned.

Reconstructive flaps can be categorized as local, pedicle, and free flaps. H&N free flap reconstructions, the focus of this exhibit, involve the transfer and reanastomosis of autologous vascularized free tissue into the head and neck to allow closure of surgical defects. Free flaps are categorized by both their tissue constituents (i.e. skin, muscle, fascia, or bone) and anatomic origin (i.e. lattisimus dorsi muscle or myocutaneous, anterolateral thigh fasciocutaneous, radial forearm fasciocutaneous, scapular osteocutaneous, or fibular osteocutaneous).

Each flap has a characteristic appearance, and an understanding of flap anatomy and function aids in imaging analysis. Original anatomic diagrams, operative and post-operative photographs coupled with CT and MR images are the basis of this exhibit.

Summary:
This educational exhibit will review the selection, anatomy, and imaging of a variety of H&N free flaps. An understanding of these flaps is essential to recognize flap complications and to accurately differentiate postoperative changes from tumor recurrence.
(OT_03) Imaging Findings of Head and Neck Infections: Patterns of Involvement and Pathways of Spread

Author(s)
Daniel Ginat, MD, MS
radiology
university of chiago

Abstract Details
Purpose: The imaging findings of complicated head and neck infectious processes are reviewed, with an emphasis on patterns of involvement and pathways of spread.
Description: The imaging features of the follows conditions will be reviewed and discussed based on anatomical regions: oral cavity (odontogenic infections and associated complications, such as Ludwig's angina and orbital infection, infected osteonecrosis, as well as infection-induced neoplasms), paranasal sinuses (invasive fungal sinusitis, acute pyogenic sinusitis and complications, such as orbital and intracranial abscess, including Pott's puffy tumor, mucopyocele, and skull base osteomyelitis, as well as concurrent cancer and fungus balls), ear and temporal bone (necrotizing otitis externa, acute coalesching mastoiditis, and Bezold's abscess), pharyngeal mucosal, visceral and retropharyngeal spaces (Lemierre's syndrome, peritonsillar and retropharyngeal abscesses with complications, recurrent suppurative thyroiditis related to branchial apparatus anomalies, complications of ingested foreign bodies and anastomotic leaks), lymph node and skin (mycobacterial infections and cat scratch disease, for example).
Summary: Diagnostic imaging, particularly CT and MRI, plays an important role is assessing the extent of involvement by head and neck infections. Familiarity with typical routes of spread for infection helps identify potential complications. It is important to search for the potential source of complex head and neck infections, such as underlying odontogenic problems or underlying tumors and congenital lesions.
(OT_04) Rare case of stellate ganglion schwannoma presenting with Horner’s syndrome.

Author(s)
Melissa M. Chen, MD
Fellow
The University of Texas MD Anderson Cancer Center

Role: Author
Lawrence E. Ginsberg, MD
Professor
The University of Texas MD Anderson Cancer Center

Abstract Details
Purpose
- To review the anatomy of the stellate ganglion and important anatomic landmarks in localizing tumors to the stellate ganglion.
- To review the clinical pathophysiology of Horner’s syndrome.
- To discuss a case of histologically proven stellate ganglion schwannoma in a patient who presents with Horner’s syndrome and history of breast cancer.

Description:
The stellate ganglion forms from the fusion of the inferior cervical and first thoracic sympathetic ganglions, which occurs in 80% of the population. The ganglion is typically located at the level of the C7 vertebral body, anterior to the transverse process of C7, superior to the first rib and posterior to the vertebral artery. It supplies sympathetic innervation to the face, neck and arm. The differential for tumors arising from or compressing the stellate ganglion is narrow and includes schwannoma, neuroblastoma in a child, and a pancoast tumor, related to extrinsic compression.

Conclusion:
Understanding the clinical pathophysiology of Horner’s syndrome can help to localize a tumor or mass in the appropriate location. Recognizing that a neoplasm might be arising from the stellate ganglion, the radiologist can provide a more specific differential diagnosis.
Abstract Details
Purpose: The goal of this exhibit is to review the spectrum of cystic lesions that can occur in the neck soft tissues based on anatomical distribution and to provide insights into the optimal imaging modality selection and clues for distinguishing benign and malignant entities.

Description: The following topics will be reviewed:
* Oral cavity region: Ranula, Dermoid/Epidermoid/Teratoma, Abscess
* Midline region: Thyroglossal duct cyst, suppurative thyroiditis, Thyroid cystic nodules and neoplasms, Cystic parathyroid adenomas, Laryngocele, Neurenteric cyst, Thymic cyst
* Parotid region: First branchial cleft cysts, Warthin’s tumor, Sjogren syndrome, Benign lymphoepithelial lesions
* Cervical chain region: Metastatic and suppurative lymphadenopathy, second branchial cleft cysts, Cystic schwannomas
* Posterior triangle region: Lymphangioma, Cystic metastatic lymphadenopathy, Tuberculous and other atypical lymphadenitis

Summary: The precise anatomical location and imaging appearances are important for the accurate diagnosis and formulating the differential diagnoses of cystic lesions in the neck. In the majority of cases, ultrasound and/or needle aspiration is adequate for pre-treatment assessment. For large, deep, or complex lesions assessment with MRI and/or CT provides useful supplementary information. Radiologists should be aware of the imaging findings of cystic neck lesions in order to formulate and effective differential diagnosis and help in guide appropriate management.
Abstract Details
Purpose: Interpretation of soft tissue neck CT performed on an emergency basis can be daunting for novice residents on call. As imaging is often the first step in patient evaluation (often with little or no other clinical information available), and many emergency department providers rely on imaging to guide patient management, it is crucial that radiology residents be able to interpret and communicate findings rapidly and accurately. This interactive exhibit will familiarize residents with crucial imaging findings and pertinent clinical features of not-to-miss diagnoses on soft tissue neck CT ordered from the ER at a busy tertiary medical center.

Description: Interactive image-rich case-based review of common and uncommon soft tissue neck CT diagnoses encountered on call from the emergency department at a busy tertiary medical center. The case mix will mirror that of a real ER: in addition to coverage of acute infectious/inflammatory processes and trauma, the exhibit will include other processes not typically considered "emergent" but which also present in the ER for various reasons. Cases will be presented as unknowns, with follow-up questions and explanations of key imaging and clinical points. Basic anatomy with emphasis on spaces will be reviewed for each case. The presentation will be optimized for viewing on mobile phones and tablets as well as computer viewing stations.

Summary/Conclusion: Participation in this interactive exhibit will increase residents' familiarity of and comfort level for rapid and accurate interpretation and communication of critical diagnoses encountered on soft tissue neck CT performed on an emergent basis.
Abstract Details
Purpose:
Bone lesions of sternoclavicular joint (SCJ) are occasionally seen. In this study, we presented three unusual cases of SCJ lesions. The imaging findings and clinical features of each case were discussed. Apparent bone invasion from soft tissue malignancies, such as skin cancer, thyroid cancer and lymphadenopathy, were excluded.
Patients and Methods:
Patient 1, 20-year-old man with no symptom was pointed out the lesion of right sternoclavicular joint and left pleural thickening at medical check-up.
Patient 2, 89-year-old man, with prostatic cancer, was revealed the enlargement bilateral clavicular heads.
Patient 3, 76-year-old man complained upper chest wall swelling with tenderness. He has previous
history of prostate tic cancer. 
CT scans were examined on 64 multidetector-row CT; Toshiba or Hitachi.
Results:
In patient 1, mass lesion eroding SCJ, expanding to the anterior mediastinum was revealed on whole body CT check-up (Fig1, left). CT demonstrated pleuritis on bilateral lung base (Fig1, right). The patient was completely asymptomatic. We suspected tuberculosis and inspected his sputum smear and PCR, subsequently examined pleural effusion, bronchoalveolar lavage (BAL) and bone aspiration of SCJ, however, all these results were negative. Positron- emission CT (PET-CT) was undergone with the result of highly malignant lesion of SCJ and the lung with peritoneal involvement. 
Patient 2 and 3 had suffered prostatic cancer. CT was performed for screening bone metastases and revealed SCJ abnormalities with hyperostosis in patient 2 (Fig2, left and middle) and as destructive mass in patient 3 (Fig3, left). Both did not seem to be the sclerosing metastases from prostate cancer. 
Discussion:
In patient 1, despite of the result of PET-CT we focused on his asymptomatic peritonitis and examined him with colonoscopy resulted in intestinal tuberculosis. Three weeks later, the culture test revealed tubercle bacilli in bone aspiration specimen. As known as “cold abscess”, bone destruction by tuberculosis can be asymptomatic seen in our patient 1. The difficulty to confirm the tuberculosis has also noted.
Symmetric enlargement of SCJ with mild tenderness but no resting pain of patient 2 gave rise to the questionable diagnosis of SAPHO syndrome, which is a chronic disorder that involves the skin, bone, and joints. SAPHO is an acronym for the combination of synovitis, acne, pustulosis, hyperostosis, and osteitis. Pustulosis vulgaris seen in the knee skin of patient 2 (Fig2,right) was confirmed to be compatible with psoriasis pustulosis psoriasis by a dermatologist.
CT showed lytic/destructive lesion of SCJ in patient 3 and sclerosing bone metastases was thought not likely. Right lung nodule attaching the pleura was noticed (Fig3,right) and lung cancer was diagnosed. Since the SCJ lesion was not painful , considering his age and suffering prostatic cancer, the patient had decided to take no further examination and treatment. Bone metastases are usually harmful, however, could be painless like our patient 3, and need to be careful to evaluate bony destruction inpatients.
(OT_08) Posttraumatic Arteriovenous Malformation of the Neck: B-Mode Sonography, Color Doppler Sonography and MRI Findings

Author(s)
Hasan Yerli, MD
Associate Professor of Radiology
Baskent University Zubeyde Hanim Practice and Research Center, Department of Radiology

Role: Author
Esin Gezmiş, MD
Instructor of Radiology
Associate Professor of Radiology, Baskent University Zubeyde Hanim Practice and Research Center, Department of Radiology

Role: Author
A.Muhtesem Agildere, MD
Professor of Radiology
Baskent University Zubeyde Hanim Practice and Research Center, Department of Radiology

Abstract Details
Purpose: Imaging findings that are related with posttraumatic arteriovenous malformation (AVM) of the neck are little known in the literature. We present the findings of B-Mode sonography, color Doppler Sonography and magnetic resonance imaging (MRI) of the posttraumatic AVM localized in the neck region.

Material and methods: A 31-year-old woman was admitted to the department of radiology for the evaluation of a mass in her right neck. After the physical examination, B-mode sonography, color Doppler sonography and MRI were performed. After surgical excision, diagnosis is confirmed by histopathology.

Results: The physical examination revealed a non-tender mass. In her history, there was enlarging and shrinking mass in the her right neck region. A heterogeneous solid soft-tissue mass with regular contours located in the midjuguler region having dimensions of 4.5 x 4.5 centimeters was determined in the B-mode sonography. The mass had central vascularity in the color Doppler examination. In the MRI examination, the mass with a central haemorrhagic component was heterogenous iso-intense with the muscle in T1-weighted images. Postcontrast images showed peripheral enhancing of the mass and its feeding artery and drainage vein. It had multilobulated contour and heterogeneous hyperintense with the muscle in T2-weighted images. The histopathologic examination showed thin and thick-walled arterial channels with adjacent venous channels.

Conclusion: Posttraumatic AVM that appears as a rare condition should be kept in mind in the patients having trauma history for the differential diagnosis of neck masses. The presence of central vascularity in the color Doppler and the determination of haemorrhagic component, the feeding artery and drainage
vein on MRI may be the important findings supporting the diagnosis for AVM of the neck.
Diagnostic dilemma of fat containing masses of the neck

Author(s)
Jens O. Heidenreich, MD
Associate Professor
Dept. of Radiology, Dalhousie University

Abstract Details
Purpose: This educational exhibit will be discussing imaging characteristics of various types of fat containing lesions including lipomas, atypical lipomas, dermoids, well differentiated liposarcomas, myxoid and dedifferentiated liposarcomas, as well as non-lipomatous lesions resembling liposarcomas like teratomas, sarcomas or extraosseous chordomas. There will be examples of non-tumorous fat-containing lesions related to fatty atrophy of muscle or atrophic graft tissue, which can mimic lipomas unless viewed within the appropriate clinical context.

Description: Lipomatous tumours are common lesions accounting for approximately 50% of soft tissue tumors. 15% of lipomas and about 5% of like us of cours and about 5% of liposarcomas occur in the head and neck region. While lipomas are benign tumours with hardly any tendency for malignant transformation, their potential trans-spatial appearance and internal architecture make them indistinguishable from well differentiated malignant tumors like liposarcomas. The majority of lipomas are well circumscribed with homogeneous fat tissue, displace adjacent soft tissue structures and can be separated from surrounding tissue by a thin walled surrounding capsule. However, approximately 10% of lipomas have non-fatty septa and nodules as soft tissue components which makes characterization far more complex. Contrast enhancement on either computer tomography or magnetic resonance imaging is suspicious for a malignant well differentiated liposarcoma. Liposarcomas, depending on their degree of pathological differentiation, have a decreasing percentage of fat tissue within the underlying lesion. Well differentiated liposarcomas have over 80% fat tissue, septations comprised of bands of collagen, nodular or globular areas, and may present with presence of calcific deposits. Pathologically they contain enlarged adipocytes, atypical hyperchromatic cells, and lipoblasts. Enhancing nodules and septations thicker than 2 mm are suspicious for liposarcomas, non-fatty components are hot on FDG-PET. De-differentiated liposarcomas, are inhomogenous lesions with increasing percentage of solid components with only small irregular shaped fatty speckles up to almost entirely solid lesions. It may be impossible to recognize fatty components on CT or MRI making these lesions indistinguishable from other soft tissue tumors like teratomas, chordomas or sarcomas. Enhancements is irregular and limited to solid components. Lesion location may be helpful in differentiating. Lipomas and Liposarcomas of the head and neck are most commonly found in posterior or later neck spaces. Chordomas are more likely to be located within the clivus or the sacrum, with extraosseous or spinal manifestations less likely. Extracranial dermoids of the head and neck have a preponderance for the oral cavity. Also, diffusion weighted imaging and made demonstrate increased signal with suppression on apparent diffusion coefficient maps.

Summary: Reliably, none of the available imaging technologies are able to differentiate benign from malignant lipomatous masses in the neck. Presence of enhancement and any internal architecture, even with septations of less than 2 mm, should raise concern for a malignant rather than benign lesion and be
clearly communicated to the clinical partner. Wide surgical excision followed by radiation and chemotherapy poses a relatively low risk in lieu of a 50%-90% 5-year survival rate.
Purpose: Venous aneurysm of neck is an uncommon clinical entity and external juguler vein aneurysm are very rare. We present the findings of B-mode sonography, color Doppler sonography and magnetic resonance imaging (MRI) of external juguler vein aneurysm localized in the right supraclavicular region.

Material and methods: A 47-year-old woman was admitted to the department of radiology for the evaluation of a mass in her right neck. After the physical examination, B-mode sonography, color Doppler sonography and MRI were performed.

Results: The physical examination revealed a non-tender mass. In her history, there was a stable mass in the her right neck region. A homogeneous hypoechoic, uncertain soft-tissue lesion with regular contours located in the right supraclavicular region having dimensions of 3 x 2.9 centimeters was determined in the B-mode sonography. The mass had a slow internal vascularity and aliasing in the color Doppler examination and spectral Doppler examination showed venous type flow. MRI confirmed external juguler vein aneurysm located nearing the subclavian vein. Postcontrast images showed the presence of an enhancing round-shaped homogeneous saccular lesion at lateral wall of the external juguler vein. The patient rejected surgical operation. Follow-up sonography was suggested.

Conclusion: External juguler vein aneurysm that appears as a rare condition should be kept in mind in the patients having supraclavicular mass for the differential diagnosis of neck masses. Sonographic findings can be unclear and MRI presents the important findings confirming the diagnosis for external juguler vein aneurysm.

Key Words: Ultrasonography; aneurysm; external juguler vein; Color Doppler; Magnetic resonance
Purpose: More than 70% of patients are affected by lymphedema (LE) after treatment of head and neck...
cancer (HNC). LE is associated with increased symptom burden, decreased function, and decreased quality of life. Objective assessment of the CT imaging for LE is not routine because of a lack of recognition of the significance of the findings, and a lack of objective evaluation methods. We have developed a measurement tool in an attempt to easily quantify CT changes of lymphedema.

Approach/Methods: We evaluated the baseline and post-treatment CT images from 82 patients with HNC, and chose representative images to emphasize key findings. Conventional axial and reformatted sagittal CT images are used to grade LE using this measurement tool. Fat stranding is assessed in 5 locations on the axial images (at the level of the superior thyroid cartilage), and submandibular space fat on the sagittal images. Sagittal images are also used to measure epiglottis thickness as well as prevertebral soft tissue thickness, as surrogates of diffuse pharyngeal and laryngeal submucosal edema.

Findings/Discussion: Fat stranding is graded 0-1-2, after the method of Mukherji et al (Radiology 1994;193:141-48). The epiglottis width is measured 8 mm from the posterior superior extent (Figure). Prevertebral soft tissue thickness is measured at the C3 level. Prior surgery or tumor may prevent assessment at specific locations. Pitfalls of grading are presented, including the use of CT-PET and radiation localization CT images, changes in patient positioning over time, and changes in anatomy after treatment.

Summary/Conclusion: Lymphedema is an under-recognized, under-reported, and usual imaging finding after HNC treatment, which can be quantified objectively, using a simple approach and standard CT images.
(OT_12) Sarcoidosis involving the Head and Neck: A comprehensive case-based review

Author(s)
Jason R. Jones, MD
Radiology Resident
Yale-New Haven Hospital - Department of Diagnostic Radiology and Biomedical Imaging; Yale School of Medicine
Role: Author

Kenedy Foryoung, MD
Radiology Resident
Yale-New Haven Hospital; Yale School of Medicine - Department of Radiology and Biomedical Imaging
Role: Author

David Durand, MD
Radiology Resident
Yale-New Haven Hospital; Yale School of Medicine - Department of Radiology and Biomedical Imaging
Role: Author

Ajay Malhotra, MD
Assistant Professor of Radiology and Biomedical Imaging
Yale-New Haven Hospital; Yale School of Medicine - Department of Radiology and Biomedical Imaging
Role: Author

Abstract Details
Sarcoidosis involving the Head and Neck: A comprehensive case-based review
Jason R. Jones, MD, Kenedy Foryoung, MD, David Durand, MD, and Ajay Malhotra, MD
Yale University School of Medicine, Department of Radiology and Biomedical Imaging

Teaching Points:
- Discuss guidelines and criteria for diagnosing Neurosarcoidosis.
- Review the various clinical manifestations and imaging findings of Sarcoidosis in the head and neck, based on anatomical sites involved. Examples from our institution will be used.
- Discuss the common pitfalls in making the diagnosis of Neurosarcoidosis.

Table of Contents/Outline-
1. Neurosarcoidosis can occur in the presence of systemic disease or as an isolated entity. It is sometimes described as a disease of exclusion. The diagnosis is especially challenging as the imaging findings can overlap with other disease entities in the head and neck.
2. The guidelines and proposed criteria for establishing this diagnosis will be reviewed.
3. Illustrative cases from our institution with varied presentation and sites of involvement will be reviewed as
well as their imaging findings. This will include:

a. Skull Base
b. Cranial Nerves
c. The meninges
d. Sino-nasal
e. Laryngeal
f. Sellar involvement
g. Orbits-ocular, lacrimal gland, extraocular muscles, optic sheath
h. Salivary glands
i. Otologic

4. Examples demonstrating the pitfalls in making the diagnosis will be highlighted.
Abstract Details
Purpose:
1. Identify common imaging findings of complications associated with acute and chronic substance abuse.
2. Discuss the associated differential diagnostic considerations for findings associated with substance abuse.

Description of Content/Outline:

1. Introduction:
The introductory portion of the exhibit will establish the current epidemic of substance abuse in the United States, the current burden on the health-care industry, and the role of radiologists in identification and treatment of patients suffering from complications related to substance abuse. The common complications of substance abuse will be sub-divided into categories of infectious, inflammatory and ischemic, and traumatic findings for subsequent discussion. Each of the sections will provide differential diagnostic considerations, where appropriate.

2. Infectious
This section will review the common sources of infection for patients suffering from complications related
to substance abuse. The category of infectious complications will be further sub-divided into sections related to acute infectious complications (e.g. abscess, septic thrombophlebitis, septic embolic disease, and osteomyelitis) and complications related to chronic infectious processes (e.g. HIV complications, chronic/resolved osteomyelitis).

3. Inflammatory/Ischemic
Following a review of infectious complications related to substance abuse, the viewer will be presented with a review of inflammatory and ischemic sequelae of substance abuse including common locations of myositis, infarct/anoxic brain injury, and nasal septal perforation.

4. Trauma
Finally, the viewer will be presented with a brief review of common traumatic injuries identified at our institution in association with substance abuse, ranging from retained foreign bodies to common fracture patterns.

Summary:
The growing epidemic of substance abuse is increasingly being recognized as a major contributor to healthcare resource use, particularly in the northeast United States. The reviewer will be presented with common complications related to substance abuse that may be identified on head and neck imaging studies, appropriate differential diagnostic considerations, and a discussion of the role of the radiologist in the care of this growing patient population.
Cystic Pontine and Cerebellar Mass Secondary to Perineural Tumor Spread of High-Grade, Infiltrating Mucoepidermoid Carcinoma

Author(s)
Kyle T. Golden, D.O.
Radiology resident
Westchester Medical Center

Role: Author

Hasit Mehta, MD
Attending physician
Westchester Medical Center - New York Medical College

Role: Author

Jennifer Ronecker, M.D.
Resident- Neurosurgery
Westchester Medical Center

Role: Author

Raj Murali, M.D.
Attending Physician
Westchester Medical Center

Role: Author

Shalabh Bobra, MD
Attending physician
Westchester Medical Center - New York Medical College

Abstract Details

Cystic Pontine and Cerebellar Mass Secondary to Perineural Tumor Spread of High-Grade, Infiltrating Mucoepidermoid Carcinoma

Purpose:
The purpose of this exhibit is to showcase a rare presentation of Mucoepidermoid Carcinoma with perineural tumor spread resulting in a cystic pontine and cerebellar mass.

Description:
A 66 year-old male previously diagnosed with Bell's palsy presents with approximately two years of left-sided facial weakness and pain. The patient also reports that he has experienced blurred vision for the past six months, as well as gait instability and vertigo for the past week. He is a retired school custodian and current...
every day smoker. His past medical history is remarkable for hyperlipidemia and for having suffered a TIA approximately 10 years prior. Physical examination is notable for left-sided facial droop, incomplete closure of the left eye, decreased sensation to touch with pain in the V1 and V2 trigeminal nerve distributions, fullness of the left parotid gland, left greater than right dysmetria, and 4/5 strength in the left upper and lower extremities.

A non-contrast head CT performed at an outside hospital demonstrates a low-density mass within the left pons and left middle cerebellar peduncle. An MRI of the brain with and without contrast is subsequently performed, and reveals a large, irregular, invasive mass lesion within the superficial and deep lobes of the left parotid gland with direct extension into the infratemporal fossa and masticator space. The tumor also demonstrates ipsilateral perineural extension along the V3 branch of the trigeminal nerve within foramen ovale, and along the trigeminal ganglion within Meckel’s cave. Infiltrative tumor involvement also extends along the V2 branch of the left trigeminal nerve. Additionally, tumor extension is present along the intracranial segment of the left trigeminal nerve with a cystic, peripherally enhancing, intraparenchymal mass within the left lateral pons and left middle cerebellar peduncle. Finally, infiltrating tumor extends from the left parotid gland cephalad to the left stylomastoid foramen, to involve the mastoid segment, tympanic segment, and anterior genu of the left facial nerve (CN VII). A non-contrast CT of the temporal bones is then performed for pre-operative planning, and demonstrates erosive widening of the left foramen ovale and an enlarged left facial nerve canal.

The case will be presented with images from the non-contrast CT of the head, the pre- and post- contrast MRI of the brain, and the non-contrast CT of the temporal bones. Histopathologic correlation and intraoperative neurosurgical images will also be provided.

Summary:
Mucoepidermoid carcinoma is known to exhibit perineural tumor spread. However, an extensive literature search reveals no previously reported cases of Mucoepidermoid Carcinoma with perineural tumor spread resulting in a cystic, intracranial, parenchymal mass. The exhibit will showcase this rare presentation of Mucoepidermoid Carcinoma. It will be presented using images from a non-contrast CT of the head, a pre- and post- contrast MRI of the brain, and a non-contrast CT of the temporal bones. Histopathologic correlation and intraoperative neurosurgical images will also be provided.
Abstract Details

Purpose:
To review the anatomy of the carotid space and imaging findings of common lesions found therein.

Description:
We will cover the anatomy of the carotid space, namely the vascular and neural contents, their relationship to one another, and how that informs our approach to creating a differential diagnosis for carotid space lesions. In addition to the intrinsic imaging findings of common lesions, we will discuss recognizing patterns of vessel displacement to help pinpoint the structure from which a lesion arises. Specific pathologies to be covered include paragangliomas such as carotid body tumor, glomus vagale, and sympathetic paraganglioma, nerve sheath tumors including schwannoma, and others.

Summary:
The carotid space is an important anatomic landmark in head and neck imaging, giving rise to a variety of lesions. Our presentation will help radiologists more accurately narrow their differential diagnosis based on imaging findings of common carotid space lesions and their associated patterns of mass effect.
The use of eponyms is common in medicine. Radiology has accepted the use of different eponyms to describe a variety of pathologies and imaging findings. However, most radiologists do not know the origins of them and are relegated to memorizing long lists.

The intent of this exhibit is to describe the origin of various disorders associated with a common eponym. The exhibit will review the origin and author’s original articles and scenarios that led to these initial discoveries.

This approach is beneficial for educating residents, fellows and medicine students as it is easier to remember different diseases by understanding origins as opposed to just memorizing lists. Some of the diseases and topographic regions that will be discussed are:

Various pathologies involving Rossmuller's fossa.
Bell's palsy.
Various pathology involving Dorello's canal.
Bichat's fat pad hernia.
Pirogov's, Beclard's and Farabeuf's triangles.
Mondini's Malformation.
Sialoadenitis of the submandibular gland due to Wharton's duct sialolith.
Pathology of Stenon's duct.
Critical Head and Neck Diagnoses for the On Call Resident

Author(s)
Eric J. Hartman, MD
Resident
University of Wisconsin - Madison

Role: Author

Tabassum Kennedy, MD
Assistant Professor
University of Wisconsin School of Medicine and Public Health

Role: Author

Gregory Avey, MD
Assistant Professor
University of Wisconsin School of Medicine and Public Health

Abstract Details
Purpose: To educate junior radiology residents regarding critical head and neck diagnoses prior to taking call.

Approach/Discussion: This exhibit will display head and neck diagnoses which are important for residents to identify on call. Adult and pediatric diagnoses will be included with a focus on infectious, traumatic, and vascular pathologies which require clinical intervention, along with their more benign mimics. The exhibit will showcase multiple high resolution images with classic imaging findings. Text will accompany the images to make key points and provide selected references. Original artwork and diagrams will be included.

Summary: Understanding characteristic imaging findings of emergent head and neck diagnoses will enable residents to effectively interpret imaging and appropriately triage treatment in these critically ill patients.
(OT_18) Myofibrosarcoma of the neck presenting as a vascular thrombosis

Author(s)
Ryan Bou Said, MD
Resident
OUHSC

Role: Author
Michelle D. Williams, MD
Associate Professor
The University of Texas MD Anderson Cancer Center

Role: Author
Beth S. Edeiken-Monroe, MD
Professor
The University of Texas MD Anderson Cancer Center

Role: Author
Bruno D. Fornage, MD
Professor
The University of Texas MD Anderson Cancer Center

Role: Author
Erich M. Sturgis, MD
Professor
The University of Texas MD Anderson Cancer Center

Role: Author
J. Matthew Debnam, MD
Associate Professor
The University of Texas MD Anderson Cancer Center

Abstract Details
Background and Purpose: Myofibrosarcoma is a rare subtype of sarcoma that is derived from myofibroblasts.

Materials and Methods: To review imaging findings of a myofibrosarcoma of the neck that presented as a vascular thrombosis and to review the literature.

Results: A 57 year-old female with a history of papillary thyroid carcinoma that was treated with surgery and radiation presented with a palpable neck mass. On CT the mass was an elongated tubular structure with central hypodensity. The mass mimicked a thrombosed vessel on ultrasound. Repeat ultrasound showed increase in size of a vascular mass. The vessels in the mass excluded a thrombosis. Core biopsy revealed a
grade I/II myofibrosarcoma. Treatment included pre-operative radiation, surgical excision and chemotherapy. Follow-up imaging has shown no evidence of recurrence. Myofibrosarcoma of the neck usually occurs in the middle age with slight male predominance. It has a wide anatomical distribution but shows predilection to the head and neck, especially the oral cavity. Most patients present with a slowly-growing painless mass. On CT, myofibrosarcoma is a solid soft tissue mass that may be associated with bone erosion. On MR, lesions are T1 hypointense, T2 hyperintense and demonstrate homogeneous enhancement. Perineural spread and distant metastasis are uncommon. Histologically, myofibrosarcomas are primarily composed of spindle-shaped cells arranged in fascicles. The tumor cells have small to moderate amounts of ill-defined, mildly eosinophilic cytoplasm and fusiform nuclei with mild nuclear pleomorphism and a low mitotic rate. Immunohistochemically, these tumors are immunopositive for vimentin, SMA, muscle-specific actin, calponin and fibronectin, and rarely immunopositive for desmin. These are immunonegative for laminin, type IV collagen, s-100, EMA, cytokeratin and CD34. Surgery is the mainstay of therapy and may be supplemented by radiation or chemotherapy. Recurrence may be seen in one-third of cases. The mortality rate is >10%.

Conclusion: Myofibrosarcoma has a predilection for the head and neck often involves oral cavity. These lesions are usually T2 hyperintense and demonstrate homogeneous enhancement; osseous destruction may occur, but perineural spread is uncommon. There is a moderate propensity for local recurrence, but a low incidence of distant metastasis. Knowledge of the imaging characteristics of myofibrosarcoma will alert head and neck radiologists to include this rare lesion in the differential diagnosis of head and neck lesions.
PURPOSE:

“Neck mass, evaluate for malignancy” is a common indication for CT and MR examinations of the head and neck. The skin and superficial soft tissues are often overlooked as a potential originating site of the lesion, as the search is frequently dedicated to evaluate for head and neck cancer and associated nodal disease. However, skin and superficial lesions are often encountered and may be a significant source of patient discomfort or cosmetic deformity. Although some pathology is benign or iatrogenic, some lesions may be a harbinger for more ominous processes, including malignancy.

The purpose of this examination will be to review skin and soft tissue lesions of the head and neck. Emphasis will be placed on identifying lesions that require immediate clinical attention and distinguishing these from benign, although sometimes unusual, processes.

DESCRIPTION:

Through a case-based illustrative review, we will discuss the clinical and imaging features of the following processes that can result in “masses” in the head and neck:

1. Benign processes including cosmetic injections/implants, benign neoplasms such as lipoma, vascular or lymphatic malformations, epidermal inclusion cysts, dermoid/epidermoid lesions, and nerve processes such as neurofibromas.
2. Infections/inflammatory processes including cellulitis, abscesses, and cutaneous manifestations of sarcoidosis.
3. Skin cancers including a review of the staging.
4. Other malignant processes such as soft tissue metastases from distant primary sites of malignancy, Sezary syndrome, Kaposi Sarcoma, and angiosarcoma.

SUMMARY:

Multiple processes can affect the skin and soft tissues of the head and neck and result in a visible or palpable deformity. The lesions may be benign or malignant, common or unusual. The role of the radiologist is to identify these lesions as a potential source for the patient's visible, palpable, or cosmetic abnormality. Identifying worrisome processes as an initial presenting feature of more ominous systemic or malignant processes can aid in earlier treatment and improved outcome.
(PE_01) Imaging of Cystic Head and Neck Lesions in Children: A Pictorial Review

Author(s)
Ian P. Mills, MD
Radiology resident - 4th year
Department of Radiology and Biomedical Imaging, Yale-New Haven Hospital

Role: Author
Jonathan R. Weisiger, MD
Resident
Department of Radiology and Biomedical Imaging, Yale School of Medicine

Role: Author
Frank J. Minja, MD
Assistant Professor
Department of Radiology and Biomedical Imaging, Yale School of Medicine

Abstract Details
Purpose:
To review the imaging appearances and differential diagnosis of cystic head and neck lesions in pediatric patients.

Description:
Both congenital and acquired conditions can present as cystic neck masses in pediatric patients. This educational exhibit will review some of these diseases, including branchial cleft cysts, thyroglossal duct cysts, abscesses, lymphangiomas/cystic hygromas, ranulas, and necrotic lymphadenopathy. CT, MRI, and ultrasound images will be presented, and imaging appearance, pathology, and distinguishing features will be discussed.

Summary:
Multiple pediatric disease processes can manifest as cystic lesions in the head and neck. The purpose of this exhibit is to review the imaging appearances and distinguishing features of diseases that can present as cystic lesions in pediatric patients.
(PE_02) Imaging of Pediatric Allergic Conditions and Mimics

Abstract Details

Background/Purpose: Medical imaging plays a fundamental role in the diagnosis and management of patients who present to the pediatric allergy specialist. Children might present with a constellation of chronic, non-specific atopic symptoms, making the clinical diagnosis uncertain without the assistance of imaging. The aim of this review is to discuss the role of imaging in the diagnosis and management of various respiratory and non-respiratory atopic conditions and their mimics as they manifest in the pediatric population.

Educational Goals/Teaching Points:
1. List common, uncommon and rare etiologies for allergy-like symptoms in the pediatric population.
2. Discuss role of imaging in the diagnosis and management of pediatric upper and lower respiratory allergic conditions.
3. Review imaging findings of various infectious, inflammatory, developmental and neoplastic conditions which may cause atopic symptoms (eg. acute and chronic rhinosinusitis, allergic fungal sinusitis, sinonasal polyposis, juvenile nasal angiofibroma, etc.) and highlight pertinent potentially life-threatening complications (eg. orbital cellulitis, subperiosteal abscess, invasive fungal sinusitis, sinus thrombosis).
4. Emphasize the use of imaging to detail potentially life-threatening complications of chronic atopic disease.
5. Describe the normal patterned development of the paranasal sinuses and how various disease processes (eg. chronic rhinosinusitis or cystic fibrosis) are known to affect development.
6. Detail how anatomic variants (eg vascular rings and slings, tracheoesophageal fistulae) may contribute to allergy-like symptoms.

Conclusion: Allergic rhinitis, asthma, chronic cough, and food allergy are among the most common reasons for referral of patients to the pediatric allergist. The symptoms of these conditions are often non-specific. Through the complementary use of radiography, fluoroscopy, computerized tomography (CT), or magnetic resonance (MR) imaging, the radiologist can detect and differentiate various infectious, inflammatory, developmental, or potentially neoplastic conditions which cause these symptoms, as well as alert clinicians to potentially life-threatening disease-related complications. Radiologists may also diagnose unexpected anatomic or congenital variants which may cause atopic-like symptoms.
(PE_03) Imaging Features of Pediatric Idiopathic Intracranial Hypertension

INTRODUCTION

Adult patients with idiopathic intracranial hypertension (IIH) may have characteristic radiographic signs on
magnetic resonance imaging (MRI). These signs have not been extensively evaluated in children. The
purpose of this presentation is to examine the radiographic findings of pediatric IIH in order to
classify the salient features and gain a deeper understanding of disease pathophysiology.

METHODS

Retrospective, case-control study of pediatric patients with and without IIH from the ophthalmology
department at single tertiary care center was performed. Clinical data including demographics, lumbar
puncture results, and ophthalmic findings were obtained. Review of patient MRI/MRV evaluated for
presence of an enlarged perioptic subarachnoid space, posterior globe flattening, protrusion of the optic
nerve head, empty sella turcica, prominent arachnoid granulations, skull base crowding, Chiari I malformation, ventriculomegaly and transverse sinus stenosis. Longitudinal changes in imaging features were also assessed in patients who had imaging performed either prior to diagnosis, or after a period of treatment, and compared with imaging performed at the time of diagnosis.

RESULTS
Neuroimaging and clinical findings of 49 patients with IIH and 30 control patients were evaluated. Compared to controls, IIH patients had significantly larger perioptic subarachnoid space (p < 0.001), and higher incidences of posterior globe flattening (p < 0.001; sensitivity 0.95, specificity 0.66), protrusion of the optic nerve head (p < 0.001; sensitivity 1.0, specificity 0.5), empty sella turcica (p < 0.001; sensitivity 0.89, specificity 0.53) and Chiari I malformation (p = 0.014; sensitivity 1, specificity 0.41). The presence of prominent arachnoid granulations (p=0.459), skull base crowding (p=0.145) and transverse sinus stenosis (p=0.406) did not reach significance. An enlarged perioptic subarachnoid space of > 5.2 mm was highly sensitive for predicting papilledema in pediatric IIH. A subset of patients also demonstrated changes in imaging findings prior to and following treatment highlighting the dynamic nature of the disease and the ability of imaging to depict these changes.

CONCLUSIONS
Several highly sensitive key radiographic findings in pediatric IIH were identified. An enlarged perioptic subarachnoid space and posterior globe flattening on neuroimaging coupled with the clinical symptom of pulsatile tinnitus was highly predictive of pediatric IIH.
Abstract Details
Purpose:
Of head and neck rhabdomyosarcomas, parameningeal subsites have a worse prognosis than non-parameningeal subsites. The radiation treatment of parameningeal tumor subsites, including timing and field, is critically determined by specific imaging features. We review the imaging characteristics of pediatric parameningeal rhabdomyosarcoma that affect clinical management, including the identification of a parameningeal location, intracranial extension, and regional lymphadenopathy.

Description:
Rhabdomyosarcoma is the most common soft tissue sarcoma in the pediatric population, and the most common primary site is the head and neck. Within the head and neck, site of origin is subdivided into parameningeal (which includes the nasopharynx, nasal cavity, paranasal sinuses, middle ear, mastoid, infratemporal fossa, pterygopalatine fossa, and parapharyngeal space) and non-parameningeal (which includes all other sites in the head and neck). Parameningeal sites have a worse prognosis.

Identification of a parameningeal subsite is critical since this affects the staging, prognosis, and management. Patients with parameningeal tumors must have a lumbar puncture and MRI of the brain as part of their workup. Parameningeal tumors are treated with concurrent chemotherapy and radiation, which is targeted to the primary site and involved regional lymph nodes. This differs from other head and neck subsites, where an LP and MRI brain are not required, treatment may include surgical resection, and radiation may be omitted. While identification of involved structures aids the radiation oncologist in outlining the treatment field, for parameningeal subsites it is critically important to identify intracranial extension as specifically defined by involvement of the dura. This key factor not only affects the treatment field but also alters the timing of radiation.
Sentinel lymph node biopsy is not routine in head and neck rhabdomyosarcoma, as it is for extremity sites, and regional lymph nodes are not prophylactically radiated, as they are in other head and neck tumors. Therefore it is important to specifically identify regional lymphadenopathy or even suspicious lymph nodes, as these require biopsy. If positive, these lymph nodes are contoured and included in the radiation field.

We review the potential routes for intracranial extension and regional nodal lymphatic drainage patterns for each parameningeal subsite.

Summary:
Familiarization with and communication of specific imaging features of pediatric parameningeal rhabdomyosarcomas, including subsite of origin, intracranial extension, and regional lymphadenopathy, facilitates expeditious workup and appropriate oncologic management, as these features affect staging, prognosis, management, and radiation timing and dose.
Abstract Details
Purpose: The goal of this exhibit is to review the imaging findings related to craniosynostosis and the effects of surgical reconstruction.

Description: Accurate depiction of the cranial sutures using high-resolution, but low-dose CT, particularly 3D surface renderings, is often important for surgical planning in patient with craniosynostosis. Many operations are complex and involve multiple stages of cranial reconstruction. The following topics will be included in this exhibit:
* Standard clinical and imaging work up for patients with craniosynostosis.
* Types of craniosynostosis, including associated conditions, such as Apert syndrome, Crouzon syndrome, and premature closure of sutures from ventricular shunting.
* Types of surgeries that can be performed to correct craniosynostosis and depict the corresponding expected imaging findings.
* Potential complications of craniosynostosis surgery with imaging correlates.

Summary: Familiarity with the imaging features of the various types of craniosynostosis and surgical techniques is important for patient management.
Disorders of the pediatric temporomandibular joint (TMJ) are varied in etiology with multiple congenital and acquired disorders. The purpose of this exhibit will be to review the anatomy, growth and development of the TMJ, highlight cases of congenital and acquired TMJ pathology and propose an imaging algorithm for congenital disorders of the TMJ. Awareness of TMJ pathology is important as these disorders may result in chronic pain, difficulty with speaking and eating, facial asymmetry and dysmorphism for patients.

Description:
This electronic exhibit will review the growth and development of the TMJ, normal TMJ anatomy with an emphasis on cross-sectional imaging and discuss the imaging techniques available for the assessment of TMJ pathology in children. This exhibit will highlight the various congenital and acquired disorders of the pediatric TMJ using multiple case examples with photographs, radiographs, CT, MR and 3D surface rendered images. Disorders will include hypoplasias/aplasias such as hemifacial microsomia, Treacher Collins Syndrome, branchio-oto-renal syndrome, Pierre Robin sequence as well as disorders leading to large condyles, such as Proteus syndrome and fibrous dysplasia. Acquired disorders of the TMJ including trauma, progressive condylar resorption, inflammatory joint conditions, infection, and soft tissue tumors. Finally, a proposed imaging-based algorithm will be presented as a general guide to assessing congenital disorders of
Summary:

The temporomandibular joint is a complex joint that is responsible for growth and development of the mandible and the facial skeleton. Using multi-modality imaging and case examples, a range of congenital and acquired pathology of the pediatric TMJ will be reviewed.
Abstract Details
Purpose: The purpose of this case report is to present an exceedingly rare case of infantile fibrosarcoma originating within the head and neck region. No case reports were identified in the literature with this specific presentation and our goal is to increase awareness of this diagnosis by briefly discussing the demographics, presentation and associated imaging findings to assist our patients and surgical colleagues.

Description:
Congenital infantile fibrosarcoma is a soft tissue sarcoma mainly involving the lower extremities which usually presents in the first year of life. A subset of cases occur in the head and neck; however, it is exceedingly rare for involvement at the base of the skull and posterior neck. The paucity of data demonstrates a prevalence of < 1% of childhood malignancies in this area. Our case is a 3 year old female with rapid growth of a right posterior neck neck mass noticed at 3 months of age. After initial imaging was acquired and utilized for preoperative planning, the patient was taken to the operating room at 5 months of age for gross total excision. Following the successful procedure from Neurosurgery/Pediatric Surgery, the pathology report ultimately revealed infantile fibrosarcoma.

Initial imaging with MRI revealed a 3.3x4.6x5.2 cm T1 hypointense/T2 hyperintense mass within the right posterior neck extending from the skull base to approximately C4. There was heterogeneous post contrast enhancement of multiple internal septa. Additional imaging with CT/CTA again demonstrated a large right posterior neck mass with no vascular or osseous involvement.

The patient has continued to do well postoperatively in which the last MRI did not reveal disease recurrence or distant metastases.

Summary:
Congenital infantile fibrosarcoma of the head and neck is an exceedingly rare presentation that demonstrates a prevalence of less than 1% of childhood malignancies in this area. The purpose of this case report is to increase awareness of this diagnosis and to briefly discuss demographics, usual presentation and associated imaging findings to assist our patients and surgical colleagues.
(PE_08) Navigating the Pediatric Globe: A Review of Benign and Malignant Pathology

Author(s)
Ian P. Mills, MD
Radiology resident - 4th year
Department of Radiology and Biomedical Imaging, Yale-New Haven Hospital

Role: Author
Jonathan R. Weisiger, MD
Resident
Department of Radiology and Biomedical Imaging, Yale School of Medicine

Role: Author
Frank J. Minja, MD
Assistant Professor
Department of Radiology and Biomedical Imaging, Yale School of Medicine

Abstract Details
Purpose:
To review the imaging appearances and differential diagnosis of lesions of the globe in children.

Description:
Lesions of the globe are most common in pediatric patients, and may represent benign or malignant etiologies. This educational exhibit will review some of these diseases, including retinoblastoma, coloboma, retinopathy of prematurity, persistent hyperplastic primary vitreous (PHPV), and coat disease. Imaging appearance, pathology, and distinguishing features will be discussed.

Summary:
Lesions of the globe are most common in pediatric patients, and it is important to distinguish benign from malignant pathology. The purpose of this exhibit is to review the imaging appearances and distinguishing features of benign and malignant pathology of the pediatric globe.
Abstract Details
Purpose: Evaluation for craniosynostosis is an infrequently encountered entity. The infrequent rate at which this study is performed restricts the radiologist from maintaining familiarity with the systematic approach to interpretation and identification of the most frequently seen pathologies. This multimodality quiz aims to review the important findings seen with craniosynostosis and variants of normal in a quiz like fashion to encourage a structured approach for evaluation and increase retention of imaging pearls.

Materials and methods: The images used in the review were collected from our health system. CT, plain film and MR imaging findings were focused on.

Results: A systematic approach and familiarity with normal and variant anatomy based on age will make the approach to craniosynostosis relatively straightforward. The pathologies reviewed included but were not limited to normal sutural anatomy, timing of fusion of sutures, normal variants, findings associated with early sutural fusion, delayed complications of undetected craniosynostosis.

Conclusion: With familiarity to normal imaging findings, this uncommonly encountered imaging study can be tackled with finesse.
(PE_10) MRI findings in infants with hearing loss and auditory neuropathy spectrum disorder due to thiamine deficiency

Author(s)
Anat Aizer-Dannon, MD
staff radiologist
Schneider Children's Medical Center

Role: Author
Renate Engisch, MD
staff radiologist
Institute of Diagnostic and Interventional Neuroradiology Bern University Hospital

Role: Author
Paul A. Caruso, MD
staff radiologist
Massachusetts Eye and Ear Infirmary, Harvard Medical School

Abstract Details
Purpose
Auditory neuropathy spectrum disorder (ANSD) is a cause of hearing loss thought to relate to a problem in acoustic transmissions along the retrocochlear auditory pathway between the inner ear and the auditory cortex. The key diagnostic features of hearing loss in ANSD are normal cochlear outer hair cell function as reflected by normal otoacoustic emissions (OAEs) or normal cochlear microphonics (CMs) but with abnormal auditory brainstem responses (ABRs).
A group of 11 Israeli children who developed encephalopathy due to nutritional thiamine deficiency has previously been reported. These children later developed moderate to severe hearing loss with features of ANSD and seven of these children underwent MR imaging as part of the diagnostic evaluation. The purpose of the current study is to report the MR findings in these infants and to correlate them with the clinical evaluation and outcome. To our knowledge this is the first report that describes the MR findings in infants with auditory neuropathy spectrum disorder due to thiamine deficiency.

Methods
The clinical records were reviewed for demographics, age at presentation, duration of nutritional thiamine deficiency, findings confirmatory of ANSD, outcome of the hearing loss following treatment with thiamine supplementation, and for neurologic sequelae. The MRIs were reviewed for abnormal findings along the auditory pathway from the external auditory canal to the cerebral cortex. All MRIs included T1 and T2 weighted images. Post gadolinium T1 weighted were available in six patients and DWI in five patients. Four children underwent additional MR imaging following thiamine supplementation.

Results
The study group included 7 infants: five female and two male aged 3-10 months. The age at presentation ranged from 3 to 10 months, and the estimated duration of feeding with the thiamine-deficient formula
ranged from 2 to 5 months. All 7 patients met criteria for ANSD with normal OAEs or CMs and abnormal ABRs. Following thiamine supplementation, five patients improved and two had permanent ANSD. The neurologic sequelae included seizures, ataxia, hemiparesis, and intellectual disability. Along the auditory pathway, abnormal signal on the T2 weighted images was seen in the cochlear nuclei in six patients, in the trapezoid body in four patients, in the lateral lemnisci in four patients, in the inferior colliculi in five patients. Abnormal diminished diffusion was seen in the tectum, brainstem, posterior thalami, and the basal ganglia. After the administration of thiamine, follow up MRI exams available in four patients, showed improvement in the signal abnormality in the brain stem and tectum.

Conclusion:
Our report describes for the first time the MR findings along the auditory pathway in infants with auditory neuropathy spectrum disorder due to nutritional thiamine deficiency.
Fetal Facial Anomalies and Their Associations

Author(s)
Avrum N. Pollock, MD, FRCPC
Pediatric Neuroradiologist
CHOP
Role: Author
Beverly Coleman, MD
Radiologist/Fetal Imager
CHOP
Role: Author
Tamara Feygin, MD
Pediatric Neuroradiologist
CHOP
Role: Author

Abstract Details
Title: Fetal facial anomalies and their associations.
Authors: Pollock, A.N., Coleman, B., Feygin, T.
Background/Purposes: Numerous anomalies of the fetal face may present as an isolated finding or may be associated with an underlying systemic disorder. The purposes of this study include: 1. Description of imaging appearance of facial anomalies in fetuses. 2. Assessment of spectrum and frequency of underlying systemic disorders associated with fetal facial defects.
Methods and Materials: With IRB approval, retrospective search of cases with fetal facial anomalies was performed using keywords "microphthalmia", "coloboma", "cataract", "nasal anomaly", facial cleft", "macroglossia","Fetal". Cases were selected from fetal ultrasound and fetal MR imaging performed at our institution from 2008-2015 for assessment of suspected anomalies on obstetric ultrasound. Available imaging in the selected cases was independently reviewed by 2 neuroradiologists, and 1 senior radiologist, with expertise in prenatal ultrasound.
Results:
Evaluation of MRI/US examinations and patient's charts revealed 50 patients with orbital anomalies, including microphthalmia, vitreous coloboma, cataracts; 89 patients with facial cleft; 4 cases of nasal atresia, and 7 cases of macroglossia. Facial anomalies were diagnosed during work up of suspected fetal central nervous system pathology. The lesions were diagnosed on obstetric ultrasound and fetal MRI. The indications for imaging were hydrocephalus, facial clefts or multiple congenital anomalies (MCA). The gestational age at the time of imaging was between 18 -30 weeks. The vast majority of orbital, nasal and tongue lesions were associated with underlying systemic disorders, while facial defects were equally seen as an isolated finding or as a part of more complex entity. The spectrum of detected congenital disorders comprises known syndromes (PHACES, CHARGE, Walker-Warburg, Aicardi, Trisomy 21 and Wolf-Hirschhorn), Beckwith Wiedemann, and unspecified cases of MCA.
Conclusion:
Detection of fetal facial lesions should prompt a diligent search for associated birth defects. Presence of fetal facial anomalies occasionally may help to narrow a long list of underlying systemic disorders. Precise assessment of associated anomalies is very important in decision making and future planning.
Abstract Details

PURPOSE:
We will highlight the role of imaging in diagnosis and therapy of head/neck vascular anomalies (VA), using a case-based approach with dermatologic and otolaryngologic correlation. The ISSVA (International Society for the Study of Vascular Anomalies) classification will be introduced and utilized as a framework for discussion.

Ideally, VA patients should be evaluated and managed by a multi-disciplinary team of specialists. This
The presentation will focus on the radiologist’s collaborative role in VA workup including: when and why to image, appropriate choice of modality, key neuroimaging features, and stigmata of syndromic disease. Accompanying dermatologic and otolaryngologic color photos will emphasize the complementary roles of imaging and clinical examination.

DESCRIPTION:
ISSVA CLASSIFICATION
- Vascular neoplasms: benign, borderline, malignant
- Vascular malformations: simple (low- vs. high-flow), combined

IMAGING MODALITIES
- US, XR, CT, MR, XA

PART I: TUMORS
- Congenital hemangioma: RICH, NICH, PICH
- Infantile hemangioma: focal vs. segmental, GLUT1+
- Kaposiform hemangioendothelioma, tufted angioma
- Angiosarcoma
Hemangioma syndromes
- PHACES
- Neonatal hemangiomatosis (MLT)

PART II: LOW-FLOW MALFORMATIONS
- Capillary
- Lymphatic: macro- vs. microcystic
- Venous
Low-flow syndromes
- Sturge-Weber
- Lymphangiomatosis
- Macrocephaly-capillary malformation (M-CM)
- Cutis marmorata telangiectactica congenita (CMTC)
- CLAPO
- Gorham-Stout

PART III: HIGH-FLOW MALFORMATIONS
- Arteriovenous malformation
- Arteriovenous fistula
High-flow syndromes
- Wyburn-Mason (CAMS)
- Osler-Weber-Rendu (HHT)
- CM-AVM (RASA1)

OTHER SYNDROMES
- PTEN hamartoma tumor syndromes (PHTS)
- PIK3CA segmental overgrowth syndromes
SUMMARY:
Diagnosis and management of vascular anomalies requires close collaboration between clinicians and radiologists. Physical examination, growth history, and laboratory values will help in the classification of vascular tumor versus vascular malformation. Cross-sectional imaging aids in assessment of lesion composition, margins, deep extent, and potential complications.

Familiarity with the spectrum of head/neck cases will enable neuroradiologists to select the appropriate imaging modality, identify key diagnostic features, and correlate with clinical findings. By establishing the correct diagnosis or differential diagnosis, the radiologist can help guide appropriate management and/or further workup.
Abstract Details
Purpose: To give an overview about MRI of the tempomandibular joint and its use in pediatric patients.

Description: First a review of the anatomy of the tempomandibular joint will be given. Next, indications for MRI of the TMJ joint will be discussed. This will be followed by discussion of the optimal protocol including different sequences and planes used and when IV contrast is needed. There will then be several cases shown to illustrate how MRI is useful with emphasis on pediatric patients particularly with juvenile rheumatoid arthritis.

Summary: This education exhibit will review the anatomy of the TMJ joint, followed by discussion of indications for MRI in pediatric patients and the optimal protocol to use. Cases will be used to illustrate teaching points with emphasis on pediatric patients with Juvenile rheumatoid arthritis.
Abstract Details
Purpose:
There is a wide spectrum of pathology that can affect the salivary glands in the pediatric population which includes congenital, infectious, inflammatory and neoplastic processes. It is also not uncommon to find incidental findings involving the salivary glands on MR imaging of the brain in the pediatric population. The purpose of this educational electronic exhibit is to review various pathologies involving the parotid, submandibular and sublingual spaces in children and to describe the relevant imaging features using different modalities (CT and MRI).

Approach/Methods:
The normal imaging anatomy of the salivary glands will be reviewed on both CT & MRI [computed tomography (CT) and magnetic resonance imaging (MRI) which are currently used for evaluation of the salivary glands. We will then provide a pictorial review of various pathological conditions that involve the salivary gland. The cases were collected using the electronic database at our institute, selecting the most representative cases of each disease entity.

Findings/Discussion:
A wide spectrum of common and uncommon salivary gland pathology will be discussed in detail through case based approach highlighting the clinical presentation and characteristic imaging features of each entity on cross sectional imaging. The disease process of the salivary glands can extend into various adjacent spaces. The location of the lesion, and its signal characteristics can help in narrowing the differential diagnosis. Very high T2 signal, enhancement, and absence of diffusion restriction would favor a less aggressive lesion.

Summary/Conclusion:
This exhibit will illustrate various pathologies that can occur within the parotid, submandibular and sublingual spaces in the pediatric population and provide a diagnostic algorithm based on clinical presentation and imaging findings that can be applied by radiologists to facilitate the correct diagnosis.
Abstract Details
Purpose:
To demonstrate the spectrum of disorders involving the temporomandibular joint in children.

Approach/Methods:
The pediatric temporomandibular joint can be involved by a variety of disorders. In this educational exhibit, we will first briefly illustrate the embryology and normal imaging anatomy of the temporomandibular joint region. Next, we will review various congenital, inflammatory, traumatic, and neoplastic disorders involving the temporomandibular joint. Finally, we will briefly illustrate some of the ultrasound and CT guided interventional techniques used for diagnosis and treatment of pediatric TMJ disorders.

Findings/Discussion:
Congenital and developmental disorders such as syndromes involving the upper branchial arches such as in hemifacial/bifacial microsomia and Goldenhaar syndromes, velocardiofacial syndrome, and Treacher-Collins syndrome often involve the temporomandibular joint in children causing a variety of deformities and symptoms. These developmental disorders and their imaging manifestations will be illustrated.

Primary osteoarthritis of the TMJ is uncommon in children. The most common indication for MR imaging of the temporomandibular joint in children is juvenile idiopathic arthritis (JIA). The temporomandibular joint is commonly involved relatively early in the course of disease, and involvement may precede frank clinical symptoms. Therefore contrast enhanced MRI of the temporomandibular joints is often utilized in this group of patients. Performing both open and closed mouth is often unnecessary in this population. The various
MRI manifestations and severity of involvement of the TMJ will be illustrated and normal variations mimicking arthritis will be shown. Other disorders involving the temporomandibular joint include erosions by aggressive cholesteatomas, heterotopic ossification particularly in the setting of long-standing arthritis, and synovial osteochondromatosis. Traumatic injury and fractures involving the temporomandibular joint is common. Finally, there can be neoplastic involvement of the TMJ by Langerhans cell histiocytosis, metastatic neuroblastoma, and head and neck sarcomas.

Summary/Conclusion:
Various conditions can involve the temporomandibular joint in children. Familiarity with the normal appearance and various pathologies of this region is essential in accurate evaluation of TMJ imaging findings and will facilitate the sometimes daunting radiological interpretation of these studies. Radiologists can also play an important role in the interventional diagnostic evaluation and treatment of these disorders.
Abstract Details
Purpose: Though lesions related to mucosal inflammation and dental disease are commonly encountered clinically and on imaging studies, many other pathologies arise from the maxilla and maxillary sinus. Whether these lesions are common or uncommon, imaging with both CT and MR is often performed as part of their initial evaluation and staging, and to inform management decisions, making knowledge of these lesions important to radiologists. The goal of this exhibit is to familiarize the reader with common and uncommon non-traumatic lesions affecting the maxilla and maxillary sinus, as well as to identify key imaging features that can help distinguish among the non-neoplastic, benign neoplastic, and malignant lesions.

Description: We present an imaging overview of maxilla and maxillary sinus lesions with attention to specific imaging findings on CT and MR that are suggestive of or specific for a particular lesion. Cases include but are not limited to the following: actinomycosis, mucormycosis, osteonecrosis, fibrous dysplasia, inverted papilloma, ameloblastoma, giant cell tumor, osteosarcoma, lymphoma, melanoma, squamous cell carcinoma and metastasis. Relevant pearls and pitfalls are reviewed.

Summary: A variety of lesions can involve the maxilla and maxillary sinus, many of which have similar or overlapping imaging findings. CT and MR play an important role in the work up of these lesions, and specific imaging findings can be used to help limit and direct the differential diagnosis. Radiologist knowledge of these lesions can inform patient diagnosis and management.
(S&M_02) Neurocranial Complications of Rhinosinusitis- A Novel Classification System

Author(s)
Matthew Deng, M.D
Neuroradiology Fellow
Yale University School of Medicine-Diagnostic and Biomedical Imaging

Role: Author
Nathan Bennington
Attending Radiologist/ Neuroradiologist
Southern Ohio Medical Center

Role: Author
Doug Silin, M.D
Assistant professor
Yale School of Medicine-Department of Radiology and Biomedical Imaging

Role: Author
Eugenia Vining, M.D
Professor
Yale School of Medicine-Department of Otolaryngology

Role: Author
Diego Nunez, M.D
Professor
Yale School of Medicine-Department of Radiology and Biomedical Imaging

Role: Author
William Zucconi, D.O
Assistant Professor
Yale University School of Medicine-Diagnostic and Biomedical Imaging

Abstract Details
Purpose:
To establish and provide support for a classification system of neurocranial complications of rhinosinusitis which are divided into 5 groups: Group I: Frontal scalp cellulitis, Group II: Meningitis and or cerebritis, Group III: Subdural and or epidural abscess, Group IV: Cerebral abscess and Group V: vascular complications. This proposed classification is analogous to the initial Chandler Classification of orbital complications of Rhinosinusitis and is put forth to aid in the diagnosis, management and conceptualization of these disease processes.

Materials and Methods:
A preliminary imaging chart review from 1990 to 2016 was performed at our institution for patients with a diagnosis of rhinosinusitis and the neurocranial complications included above. Patients for whom imaging and medical charting are available are included in the study. Patient demographics, clinical presentation, involved sinuses, management and imaging findings (including relative performance metrics of CT and
MRI) are reviewed and representative imaging findings of each category are provided along with a discussion of the pathogenesis, respective management and outcomes, where available.

Results:
Of 29 patients identified, 17% had radiographic evidence of extracranial soft tissue infections in the frontal scalp; 10% had evidence of meningitis; 52% had either subdural or epidural abscess; 7% had cerebral abscess; and 10% suffered an intracranial arterial or venous complication.

Conclusion:
Intracranial complications of rhinosinusitis carry a high mortality if not appropriately and expeditiously diagnosed and treated. They are well documented in the literature, however, a classification scheme has yet to be established. This retrospective study is provided to support this imaging based classification system with the aim of aiding the radiologist and treating physicians in the diagnosis, management and conceptualization of these disease processes.
Abstract Details

Purpose: Osteoma cutis (cutaneous ossification) of the face represents primary or secondary formation of ossified foci in the facial skin and was first described by Wilekens in 1858. It is distinguished radiologically and pathologically from calcinosis cutis by the deposition of organized matrix while the latter is characterized by the deposition of amorphous calcium salts within the skin. Secondary osteoma cutis has been well described in the radiology and dermatopathology literature. Secondary etiologies include: iatrogenic/traumatic, metabolic (e.g. Albright’s hereditary osteodystrophy), inflammatory (e.g. acne or dermatomyositis) and neoplastic (e.g. basal cell carcinoma). Primary or idiopathic osteoma cutis, when sufficiently advanced or extensive to require cosmetic intervention, has been sparsely described in the plastic surgery and dermatology literature.

As radiologists, we routinely encounter incidental, small facial calcified nodules on CT studies performed for a variety of reasons on patients without underlying cause. These incidental facial calcifications have been largely overlooked in the imaging literature. In breast imaging, benign skin calcifications are routinely encountered and thought to be secondary to sebaceous inspissations or low-grade infection.

Here, we present a retrospective review of a large CT dataset combined with a cadaveric case series to establish that routinely encountered facial dermal calcification is “Primary Miliary Osteoma Cutis”, a
Materials and Methods: 1315 consecutive sinus CTs obtained during an 8-months period and their associated demographics were retrospectively reviewed. The number of dermal radio-opaque lesions with Hounsfield Unit greater than 150 were counted and the correlation between the prevalence of these lesions and patient’s demographics was analysed using logistic regression methods. We then compare this data with a prior large cadaveric series of 33 individuals and obtained pathologic specimen.

Results: 599 males and 716 females from age 4 to 90 were included in the study (mean 52 vs. 51, p=0.259). Among these, 252 males and 301 females had facial calcified nodules (42.1% vs 42.0%, p=0.9708). Logistic regression analysis demonstrated that the patient’s age was a statistically significant predictor for having facial calcified nodules (Odds ratio = 1.0178, p < 0.001) while the patient’s sex was not (p=0.8528). Commonly encountered dermal calcifications on head and face CT are similar to benign soft tissue calcifications observed in other body parts in terms of imaging characteristics and age-dependency. Cadaveric pathological specimen revealed concentric, multiple-lamellated, osteoid cortex and adipose medulla, which correlated well with benign, normal bone formation.

Conclusion: Dermal calcified nodules, observed in routine head and face CT imaging, are common, benign, age-related finding, which has been largely overlooked in the Radiology literature. It is a manifestation of “primary miliary osteoma cutis”.

Purpose

• As radiologists, we **routinely** encounter incidental, small facial calcified nodules on CT studies performed for a variety of indications without underlying cause.

• We present a retrospective review of a **large CT dataset** combined with a **cadaveric case series** to establish that routinely encountered facial dermal calcification/ossification is “Primary Miliary Osteoma Cutis”, a common, benign and age-related finding.
Abstract Details
Background: Paranasal sinus pneumatization is a complex process with numerous computed tomography (CT) studies documenting developmental variations in the setting of underlying respiratory or inflammatory sinus disease. The purpose of this study was to investigate variation in paranasal sinus pneumatization in a population of non-diseased subjects using a metric validated for tracking individual anatomic variants as well as total sinus volume.

Methods: 591 sinus and maxillofacial CT scans were considered for study inclusion. Patients with inflammatory sinus or respiratory disease were excluded. 323 CT scans were scored using the Assessment of Pneumatization of the Paranasal Sinuses (APPS) instrument. Relevant demographic data was also recorded for the scored CT scans. Comparisons were made using the APPS score according to demographic characteristics and laterality. The prevalence of 9 individual anatomic variants, which have been validated for agreement in rater reliability, were also tracked for each scan bilaterally.
Results: Statistically significant differences were detected in paranasal sinus pneumatization in a non-diseased population according to laterality and gender. According to APPS score, the left side (4.95) was more pneumatized compared to the right (4.74, \( p=0.006 \)). Two specific variants were found to have increased prevalence on the left compared to the right. On the left, sphenoid pneumatization lateral to a line drawn from the maxillary canal to Vidian canal was more prevalent (\( p=0.034 \)). The frontal sinus was more frequently pneumatized lateral to the pupillary line on the left (\( p=0.024 \)). Males (10.16) were more extensively pneumatized than females (9.18, \( p=0.005 \)). There was no correlation of age with paranasal sinus pneumatization by Spearman rho (0.025). There were no significant differences in sinus pneumatization according to ethnicity by one-way analysis of variance (\( p=0.148 \)).

Conclusion: Substantial anatomic variation exists in paranasal sinus anatomy, even among patients without sinus disease. These variations reach statistical significance between males and females, and the left and right sides. Age or ethnicity related differences were not detected. Continued systematic research of paranasal sinus anatomy may facilitate a standard for CT sinus assessment and reporting in efforts to improve communication between radiology and clinicians.
PURPOSE

Facial nerve paralysis can cause pervasive physical, psychological, and social impairments. While slow progress has been made in the treatment of facial paralysis over the last century, the continued refinement of microsurgical techniques have expanded the treatment options for patients with chronic facial nerve paralysis. The radiologist should understand these varied and novel treatment options in order to provide clinically relevant interpretations of preoperative imaging, including critical anatomic information. Knowing the potential treatment options and altered anatomy is also important in those patients who may be candidates for revision surgery.

In this exhibit we will present a pictorial essay of the surgical approaches and imaging findings of chronic facial paralysis. Preoperative, intraoperative, and postoperative patient photographs in conjunction with multimodality imaging studies will be presented.
DESCRIPTION

The treatment of facial paralysis is best understood when the specific deficits are considered in the larger framework of the upper, middle, and lower facial subunits. Each subunit will be considered in turn, highlighting the treatment and imaging findings as they relate to the upper eyelid, lower eyelid, nasal base, nasolabial fold, oral commissure, lower lip, and chin.

Reanimation techniques can be broadly divided into static and dynamic reconstruction. Static reconstruction relies on autogenous grafts such as fascia lata, acellular human dermis (AlloDerm), or polytetrafluoroethylene (PTFE), to create suspension slings. Dynamic reconstruction goes beyond restoring facial symmetry and attempts to restore volitional or spontaneous facial movements through the use of free or regional muscle flaps.

Prior to reconstructive surgery imaging evaluation of the potential free flap donor site can be performed as complement to the physical exam and can assess the native vasculature, adequacy of the external carotid artery branches, and to identify any anatomic variants.

Post-operatively, doppler ultrasound monitoring of a subcutaneous free flap anastomosis can serve as a useful adjunct to clinical examination. Evaluation of the arterial and venous anastomosis can be particularly helpful if the clinical findings are equivocal and early imaging confirmation of arterial insufficiency or venous anastomotic thrombosis is needed.

Post-operative imaging may also be performed as an adjunct to planning revision surgery after failed reanimation procedures. CT angiography provides excellent anatomic detail, including the site(s) of vascular anastomoses and their relationship to the altered postsurgical anatomy. The remaining external carotid artery branches also often need to be characterized in detail, in order to plan for alternative arterial supply to new muscle flaps.

SUMMARY

Those reading head and neck imaging should be familiar with the commonly performed facial reanimation procedures, the critical anatomic structures involved and their post-operative appearance to provide clinically relevant interpretations and aid their surgical colleagues.
Abstract Details

Purpose:
1. Report a case of mesenchymal chondrosarcoma affecting the angle of the mandible.
2. Provide a review of the literature with particular emphasis on how to distinguish this rare neoplasm from similar lesions based on radiologic and histologic findings.

Methods:
A case presentation involving a patient with mandibular mesenchymal chondrosarcoma. A literature review was conducted on the epidemiology, radiologic and histologic findings, management approach, and prognosis of this uncommon disease entity.

Results:
A 36-year-old male with an unremarkable past medical history presented with a complaint of right-sided mandibular pain and lower lip numbness for three months. Initial examination revealed a right-sided soft tissue lesion between the patient’s first and second molars. Computed tomography of the neck and chest demonstrated an osteolytic mass with a soft tissue component involving the angle of the right mandible and the roots of three molars. Two abnormal Level 1b lymph nodes were noted adjacent to the lesion (Figure 1). An MRI of the head and neck was consistent with these findings (Figure 2). PET-CT showed intense FDG avidity of the lytic mass and its soft tissue component with no evidence of distant metastases (Figure 3). FNA revealed a collection of small, round, blue cells arranged in fascicles. Tumor cells were strongly positive for CD99 and vimentin and negative for desmin and myogenin. RT-PCR testing was negative for SYT-SSX and Ewing sarcoma fusion transcripts. The patient underwent right hemimandibulectomy with reconstruction and 30 fractions of external beam radiation therapy to a total
dose of 60 Gy. Final pathology revealed a 4.1x2.6x2.5 cm tumor with a mitotic rate of 1/10 by high-power field. There was no evidence of perineural invasion or regional lymph node involvement. Subsequent imaging studies have revealed no signs of recurrence or metastatic disease.

Conclusion:
Mesenchymal chondrosarcoma is a rare malignant neoplasm of bone and soft tissue. It has a propensity for young adults, with typical ages at presentation ranging from 20-40 years. Unlike other subtypes of chondrosarcoma, the mesenchymal variant exhibits extraskeletal origin in approximately 50% of cases. When osseous involvement does occur, mesenchymal chondrosarcoma displays a strong predilection for the axial skeleton, particularly the craniofacial bones. Radiographic imaging findings are variable and can present a diagnostic challenge. The typical radiographic description is a heterogeneously enhancing osteolytic mass with occasional lobulations and calcifications. PET-CT findings have not been well delineated. Several other diagnoses have similar features on imaging, including osteosarcoma, conventional chondrosarcoma, and fibro-osseous lesions; consequently, the radiographic features must be carefully correlated with histology and immunohistochemistry in order to ensure an accurate diagnosis. Management entails wide local excision. Given the rarity of this disease entity, adjuvant chemo- and radiotherapy recommendations remain relatively ill-defined. The ten-year survival rate is approximately 30%, and local recurrence and distant metastases are common, necessitating long-term radiologic follow-up. Radiologists and clinicians should be knowledgeable of this rare and diagnostically challenging chondrosarcomatous variant and be able to identify the radiographic and histologic findings that distinguish it from other neoplasms with similar features.
Hemorrhagic maxillary sinus mass: A rare case of symptomatic hepatocellular carcinoma metastasis to the paranasal sinuses.

Author(s)
Michael Larson, MD
Radiology Resident
Ochsner Clinic Foundation

Role: Author
Neal Savjani, MD
Radiology Resident
Ochsner Clinic Foundation

Role: Author
Paul Gulotta, MD
Staff Radiologist
Ochsner Clinic Foundation

Abstract Details
Introduction: Hepatocellular carcinoma (HCC) is an increasingly common primary malignancy of the liver, frequently seen in the setting of viral hepatitis and cirrhosis. Extrahepatic metastasis of HCC is a poor prognostic indicator. Common sites for metastasis are lungs, bones, lymph nodes and adrenal glands. We report a rare case of hemorrhage from the oral cavity in a patient with extrahepatic metastatic HCC to the maxillofacial region.

Case Report: A 50 year old man presented to the ED with massive hemorrhage (1.5 liters) from the oral cavity following the removal of his dentures. Patient had noticed episodes of minor bleeding the recent past. Physical examination by ENT revealed a necrotic tumor extending from the maxillary sinus into the oral vestibule involving the buccal sulcus. CT evaluation revealed a heterogeneously enhancing mass centered in the right maxillary sinus with erosion of the medial and lateral maxillary walls. Tumor also extended into the right sphenoid sinus. In this patient with biopsy proven HCC in the liver and multiple osseous lesions, this was presumed to represent an additional metastatic focus. Pathologic confirmation from the sinus lesion was not immediately performed secondary to a high risk of ongoing bleeding. Interventional neuroradiology was consulted for possible embolization in the setting of refractory bleeding. The patient was deemed to be a candidate and selective angiography of the external carotid artery was performed. This study revealed a large hypervascular mass centered in the right maxillary sinus which was supplied by a hypertrophied right internal maxillary artery. The angiographic appearance of this mass had characteristics typical for HCC. The lesion was embolized using 250-355 PVA particles with near complete resolution of the hypervascularity within the tumor. The patient was monitored and no further bleeding episodes occurred. The patient was subsequently discharged with a plan to follow up with radiation oncology.

Conclusion: While rare, HCC has been identified as an entity which can metastasize to the sinonasal and maxillofacial region. Patients can present with a myriad of symptoms including oral hemorrhage, proptosis, epistaxis and nasopharyngeal obstruction. We report a rare case of refractory bleeding
secondary to metastatic HCC to the maxillary sinus and oral cavity. Radiologists and ENT specialists should be aware of this entity when encountering a patient with known HCC who present with symptoms in the maxillofacial region. The role of neuroradiology in recognizing this pathology and interventional neuroradiology in treatment is discussed.
The Opticocarotid Recess: A Critical But Frequently Missed Route of Intracranial Spread of Sinus Disease

Author(s)
Sarah C. Cantrell, M.D.
Neuroradiology Fellow
University of Utah

Role: Author
Alt Jeremiah, M.D., Ph.D.
Assistant Professor Otolaryngology-Head and Neck Surgery
University of Utah

Role: Author
Richard Orlandi, M.D., FACS
Professor Otolaryngology-Head and Neck Surgery
University of Utah

Role: Author
Richard H. Wiggins, III., MD
Professor Diagnostic Neuroradiology
University of Utah Health Sciences Center

Abstract Details
Purpose: We define the endoscopic and radiologic anatomy of the opticocarotid recesses through an illustrative case series identifying the vital anatomic landscape and careful preoperative assessment prior to surgical intervention.

Materials/Methods: A retrospective review of teaching file cases at a tertiary academic center was performed to identify intracranial opticocarotid spread and complications of sphenoid sinus disease.

Results: Five cases of intracranial spread of disease were identified from the medial and lateral opticocarotid recesses.

Conclusions: The medial and lateral opticocarotid recesses are frequently missed sites of sphenoid sinus disease leading to intracranial spread, with possible significant morbidity and mortality. This important anatomic region has not been previously described in the imaging literature, and it is vital that the head and neck imager be aware of this potential pitfall.

Figure Legend. Figure 1. Coronal bone algorithm CT demonstrates the opticocarotid recess (yellow arrow) interposed between the optic nerve medially and the carotid artery laterally.

References:
Abstract Details

Purpose:
To discuss the anatomy and biomechanics of the temporomandibular joints, as well as the imaging findings associated with pathology and current trends in surgical management.

Description:
The temporomandibular joint (TMJ) can be involved by a number of pathologies, including TMJ
dysfunction and ankylosis, that may require surgical intervention. We will review the imaging anatomy of the normal joint, and the direct and indirect imaging findings of common TMJ pathology. Finally, we will explore current trends in surgical management and their associated post-operative imaging findings, including meniscal repair/replacement, anchor placement, as well as vascularized bone grafts, including metatarsal grafts. Common surgical hardware will also be covered.

Summary:
We will examine the role of imaging in the surgical management of TMJ pathology, specifically discussing post-operative findings of common and emerging TMJ procedures.
Abstract Details
PURPOSE:
We will present an approach to cross-sectional imaging diagnosis of jaw lesions, based on correlation to radiography, 3D/surgical findings, and pathology.

Basic concepts of dental radiographic acquisition and interpretation will be discussed, along with the indications for obtaining CT (cone-beam vs. diagnostic) and MRI. Pathophysiology and nomenclature of jaw lesions will be reviewed. Elements of the diagnostic approach include: patient demographics and
symptoms, location in the jaw, lesion margins and effect on surrounding bone, and internal contents (septations, soft tissue, and matrix calcification).

Imaging features of benign jaw lesions can be grouped into three differential diagnostic categories: simple cystic, complex cystic, and sclerotic. We will review multiple imaging cases with 3D/surgical and pathologic correlation. Indeterminate lesions should be biopsied to assist in surgical approach and follow-up planning.

DESCRIPTION:
DENTAL IMAGING
- Radiography/panorex
- CT: bone detail, calcification
- MRI: soft tissue, fluid-blood levels

CLASSIFICATION/NOMENCLATURE
- Odontogenic vs. non-odontogenic
- Epithelial vs. mesenchymal
- Developmental, inflammatory, traumatic, neoplastic

SIMPLE CYSTIC LESIONS
Simple cysts
- Radicular (periapical) cyst
- Dentigerous (follicular) cyst
- Simple bone cyst
- Paradental cyst
- Buccal bifurcation cyst
- Lateral periodontal cyst
- Fissural cyst
- Stafne cyst

COMPLEX CYSTIC LESIONS
- Ameloblastoma
- Ameloblastic fibroma, fibro-odontoma
- Odontogenic myxoma and fibroma
- Keratocystic odontogenic tumor; Gorlin syndrome
- Orthokeratinized odontogenic cyst
- Calcifying epithelial odontogenic (Pindborg) tumor
- Glandular odontogenic cyst
- Central giant cell granuloma
- Desmoplastic fibroma

SCLEROTIC/MIXED LESIONS
- Odontoma: compound, complex
- Fibrous dysplasia
- Ossifying fibroma
- Cemento-osseous dysplasia
- Cementoma, compound and compoplex
- Cementoblastoma
- Osteoblastoma
- Osteoma

SUMMARY:
The neuroradiologist’s standardized approach to benign jaw lesions should include assessment of clinical presentation as well as lesion location, margination, and composition.

Simple cystic lesions have characteristic radiographic appearances, and typically require no/minimal intervention. Heterogeneous (complex cystic, mixed, or sclerotic) and aggressive lesions benefit from cross-sectional imaging with biopsy for tissue characterization and detailed surgical planning.

CT should be obtained for evaluation of bone detail including margination, septations, and matrix calcification. MRI can also be helpful in characterizing soft tissue components and subtle infiltration. Through review of advanced cases with cross-sectional imaging and pathologic correlation, the radiologist will be equipped to provide informed differential diagnoses and assist in appropriate management of these diverse lesions.
(S&M_11) The International Frontal Sinus Anatomy Classification (IFAC): What the Head and Neck Imager Needs to Know

Author(s)
Sarah C. Cantrell, M.D.
Neuroradiology Fellow
University of Utah

Role: Author
Alt Jeremiah, M.D., Ph.D.
Assistant Professor Otolaryngology-Head and Neck Surgery
University of Utah

Role: Author
Richard Orlandi, M.D., FACS
Professor Otolaryngology-Head and Neck Surgery
University of Utah

Role: Author
Richard H. Wiggins, III., MD
Professor Diagnostic Neuroradiology
University of Utah Health Sciences Center

Abstract Details

Purpose:

To describe the International Frontal Sinus Anatomy Classification (2016), and the incidence of IFAC frontal cells.

Materials/Methods:

A retrospective review of normal CT sinus examinations was performed at a tertiary academic institution to record the incidence of IFAC frontal cells. Retrospective review of 300 CT sinus examinations was performed. Exclusion criteria included prior sinonasal trauma, prior sinonasal surgery, significant obstructive sinus disease, and poor visualization of the frontal sinuses secondary to artifact.

Results:

In keeping with prior published reports, frontal cells were identified in 33% of CT examinations. Agger nasi cells were identified in 85% of frontal sinus sides. Supra agger and supra agger frontal cells were demonstrated in 30% and 35% of frontal sinus sides respectively. Of the supra agger frontal cells, large supra agger frontal cells were demonstrated in 8% of frontal sinus sides. Supra bulla cells and supra bulla frontal cells were present in 21% and 15% of frontal sinus sides respectively. Surpaorbital ethmoid cells were present in 11% of frontal sinus sides. Frontal septal cells were exceedingly rare, identified in only one case.
Conclusions:

The IFAC classification system of frontal cells is superior to the outdated Type 1-4 frontal air cells classification system in not only ease of understanding, but also with regard to the surgical implications as described by the accompanying extent of endoscopic frontal sinus surgery (EFSS) classification.

References
Abstract Details
Purpose: Sinonasal tumors are relatively uncommon tumors. They make up only 3% of all head and neck cancers and only about 1% of all malignancies. Often patients do not have obvious symptoms and they present at an advanced stage and have a poor prognosis. However, imaging can play a role in detecting early cases in patients imaged for suspected sinonasal cancer or for other reasons. However radiologists must be aware of findings which can be used to distinguish between common rhinosinusitis and those lesions which are clearly malignant or indeterminate requiring further work-up.

Description: This exhibit explores numerous different types of lesions found in the sinonasal region, both benign and malignant. It reviews pertinent anatomy that radiologists need to know to communicate with their otorhinolaryngologist colleagues. It also describes the role of imaging in sinonasal lesions, namely CT scans as a screening exam and MRIs which are used as a problem solving tool in more complex cases. It reviews pertinent findings on CT such as subtle osseous changes which can alert the radiologist that the lesion is suspicious and needs further evaluation with MRI. It also reviews important findings on MRI such as signal intensity, restricted diffusion, enhancement and invasiveness which should alert the radiologist to recommend endoscopic evaluation and biopsy. The exhibit also reviews important findings in staging tumors in known cases which will help the treating physician decide between surgical treatment or other options such as radiation. The exhibit also gives examples of benign lesions which can potentially be confused for malignant lesions.

Summary: Sinonasal tumors are relatively uncommon and often have a poor prognosis due to delayed diagnosis. However, imaging of the sinuses is being performed ever more frequently and radiologists must be aware of findings that can be used to distinguish between cases of common rhinosinusitis and worrisome lesions in order to detect more cases at an earlier stage and improving patient survival.
Pathways to the Petrous Apex

Abstract Details

Purpose
- Briefly review the differential and constellation of imaging findings of petrous apex lesions.
- Introduce the main lateral skull base surgical approaches to the petrous apex.
- Identify imaging findings pertinent to the management and surgical planning of these lesions.
- Discuss the role of post-operative imaging.

Description

Petrous apex lesions range from benign and indolent to malignant and aggressive pathologies. Cross-sectional imaging can narrow the differential and often provide a specific diagnosis. Depending on the size, pathology, and location in relation to critical vascular, nervous, and temporal bone structures, these lesions can be managed by surgical resection, conservative management, or radiation therapy. Relevant clinical information, such as the patient’s age, pre-operative hearing capacity, and facial nerve function, contributes to the management and treatment outcomes.

Petrous apex lesions are difficult to access surgically, as these lesions are located deep within the skull base. While various lateral skull base approaches have been described, these procedures can be grouped into three basic categories: orbitozygomatic, transpetrosal, and retrosigmoid approaches. These approaches will be described and depicted with illustrations and/or intra-operative imaging.

Knowledge of these lateral skull base approaches and the factors that influence surgical or radiation planning allows radiologists to provide a more detailed and informed assessment. Radiologists should be aware of potential post-surgical complications, as well as expected and pertinent post-operative findings.

Summary
Petrous apex lesions are a diverse group of pathologies whose treatment modalities include surgical resection, conservative management, and radiation therapy. These lesions can be accessed by three main lateral skull base surgical approaches. Knowledge of these approaches allows radiologists to provide pertinent imaging findings that can contribute to the surgical planning of these patients.
Abstract Details
Learning Objectives

1. Review the anatomic landmarks of the anterior, middle, and posterior cranial fossae pertinent to the interpretation of skull base pathology

2. Readily identify skull base foramina

3. Organize skull base diseases with respect to the separate cranial fossae and their constituent structures

Skull base disease presents the radiologist with an extensive differential. Organizing the skull base by its separate anterior, middle, and posterior cranial fossae allows us to recognize disease patterns and narrow this differential. Delineated below are the anatomic landmarks within each cranial fossa and examples of diseases that affect them.

The anterior cranial fossa (ACF) consists of the orbital plates of the frontal bone, the cribriform plate of the ethmoid bone, and the lesser wing and anterior greater wing of the sphenoid bone. Inferior to the ACF lie the frontal and ethmoid sinuses, the nasal cavity, and the orbits. Frontal sinus disease affecting the ACF such as osteoma or invasive fungal sinusitis can be seen here. Sinonasal tumor may arise from the nasal cavity. Superior to the ACF is the frontal lobe and its meninges, which can give rise to frontal encephalocele and meningioma. The olfactory nerves and mucosa travel through foramina within the cribriform plate, where esthesioneuroblastoma can be seen.
The middle cranial fossa (MCF) consists of the body and greater wing of the sphenoid bone and the temporal bone anterior to the petrous ridge. The superior orbital fissure separates the medial greater and lesser sphenoid wings and contains the oculomotor, trochlear, abducens, and ophthalmic nerves as well as the ophthalmic vein. Foramen rotundum is situated at the anterior base of the greater sphenoid wing, inferior and lateral to the superior orbital fissure, transmitting the maxillary nerve into the pterygopalatine fossa (PPF). The vidian canal carries its artery and nerve within the sphenoid bone inferior to foramen ovale, into the PPF. Foramen ovale lies posterolateral to foramen rotundum and transmits the mandibular nerve, accessory meningeal artery, and lesser petrosal nerve. Foramen spinosum also lies posterolateral to foramen rotundum, containing the middle meningeal artery and vein and the meningeal branch of the mandibular nerve. Careful evaluation of these foramina is necessary to exclude perineural tumoral spread or invasion by meningioma or other masses.

The posterior cranial fossa (PCF) consists of the temporal bone posterior to the petrous ridge, the occipital bone, and the posterior sphenoid bone body. Anteriorly, the dorsum sellae separates the hypophyseal fossa from the clivus. The clivus is a popular location for chordoma, chondrosarcoma, and metastatic disease. Lateral to foramen magnum are the jugular foramina, where paraganglioma and schwannoma can be seen. Anterior to the jugular foramen is the internal acoustic meatus, where cholesterol granuloma may manifest. The internal auditory canal allows extracranial passage of cranial nerves VII and VIII. Diseases seen here include schwannoma, endolymphatic sac tumor, and vascular malformation. Medial to the jugular foramina and tubercles run the hypoglossal canals and their nerves; schwannoma can be seen affecting the hypoglossal nerve.
Abstract Details
PURPOSE: Gorham disease, also known as Gorham-Stout disease or vanishing bone disease, is a rare condition characterized by progressive osteolysis due to replacement by uncontrolled proliferation of hemangiomatous or lymphangiomatous tissue. While it can occur in any bone, involvement of the skull or skull base is unusual. The radiographic differential diagnosis of Gorham disease includes a variety of benign and malignant processes, and tissue diagnosis is required for definitive diagnosis.

CASE REPORT: A 33 year-old woman developed left-sided head pain. Initial imaging demonstrated lytic bone destruction of the calvarium, and biopsy at that time was reportedly consistent with Gorham disease. Her symptoms and imaging slowly progressed over several years, despite treatment with a variety of medical therapies. She ultimately underwent left suboccipital craniotomy, and pathology revealed low-grade fibrosarcoma without evidence of vascular morphology. This was followed by radiation therapy for unresectable residual disease.

IMAGING FINDINGS: CT demonstrated regional lytic bone destruction with replacement by hyperattenuating soft tissue involving the left temporal and parietal bones, and left greater than right occipital bone with erosion of both inner and outer tables. At MRI this lesion demonstrated hyperintensity on T2-weighted images and homogenously enhancing infiltration of the calvarium on post-gadolinium T1-weighted images with subjacent dural thickening/enhancement. On MRV, the adjacent left transverse-sigmoid sinus junction was narrowed by mass effect or infiltration.

SUMMARY: Spindle cell sarcomas such as low-grade fibrosarcomas may convincingly mimic the radiographic features of Gorham disease. It is important to obtain adequate tissue when Gorham disease is being considered to ensure a definitive pathological diagnosis prior to treatment, in order to maximize the opportunity to offer curative therapy of alternative diagnoses.
Abstract Details
Purpose: This exhibit highlights the first reported case of a lipoblastoma arising in the eustachian tube. We review the anatomy and embryology of the eustachian tube, and discuss the pathophysiology and imaging appearance of lipoblastomas.

Case Description: A 13 month-old male presented for evaluation of an enlarging left ear mass, originally noted at 4 months of age. Several rounds of antibiotic therapy were administered for presumed otitis media. Hearing was presumed normal, although formal screening had not been performed. Otoscopy revealed a polypoid mass filling the EAC. Imaging demonstrated a fat-containing mass in the eustachian tube, which was resected via post-auricular approach. Pathology demonstrated benign appearing fat with a focal area of myxoid change suggesting a maturing lipoblastoma.

Imaging: CT demonstrates a fat-containing mass in the left eustachian tube, extending from the bony
EAC toward the torus tubarius. The left middle ear and mastoid air cells are opacified, without ossicular erosion. MRI shows a correlating T1 hyperintense tubular mass with signal loss on fat-saturated sequences, confirming the presence of macroscopic fat. No abnormal gadolinium enhancement.

Discussion: The eustachian tube is derived from the first pharyngeal pouch and the second endodermal pouch, which together comprise the tubotympanic sulcus. The lateral portion gives rise to the tympanic cavity, with the medial portion developing into the eustachian tube proper. Structurally, the eustachian tube consists of a lateral bony portion and a medial fibrocartilaginous portion. The junction between these segments is the isthmus, and forms the narrowest portion of the eustachian tube. Medially, the tube terminates in the lateral nasopharyngeal wall at the level of the inferior nasal concha. An elevated ridge of fibrocartilage at the base of the tube gives rise to the torus tubarius. A mucosal reflection along the distal longus coli muscle forms the fossa of Rosenmüller, which lies immediately posterosuperior to the torus tubarius. These structures serve as anatomic landmarks on cross-sectional imaging studies, and together flank the ostium of the eustachian tube.

Lipoblastomas are rare, benign mesenchymal tumors which arise from embryonic white fat. Most cases occur before the age of 3, with approximately 40% diagnosed in the first year of life. While these tumors do not exhibit aggressive behavior or metastasize, they can become symptomatic from mass effect due to progressive growth. The majority of these tumors occur in the extremities, with only a small minority occurring in the head or neck. Lipoblastomas mimic benign lipomas on imaging. On CT, they appear as circumscribed fat-attenuation masses. On MRI, lipoblastomas are hyperintense on both T1 and T2 weighted FSE sequences, demonstrate signal loss on fat-saturated images, and do not enhance on post-gadolinium images. The diagnosis of lipoblastoma is made at histopathology, where the presence of myxoid matrix and fibrous septae suggest the diagnosis. Left unresected, lipoblastomas eventually differentiate into mature lipomas. While these lesions are benign, the standard treatment is complete surgical resection. Long-term prognosis is excellent, with variable 5-year local recurrence rates ranging from 10-25%.
Differentiating Lesions of the Sphenoid and Clivus

Author(s)
Elliott Friedman, MD
Assistant Professor
University of Texas Medical School at Houston

Abstract Details
Purpose:
To demonstrate imaging characteristics of a variety of osseous lesions of the sphenoid bone and clivus, highlighting imaging clues for diagnosis, thereby allowing the radiologist to suggest appropriate followup or treatment.

Description:
The sphenoid bone and clivus, centrally located at the skull base, are susceptible to a range of developmental and acquired pathologies. Clinical symptoms, when present, are generally not specific to a given pathology, but instead reflect involvement of adjacent neurovascular structures, associated CSF leak, or compression or involvement of the adjacent brain. Frequently, lesions in this region are discovered incidentally on imaging acquired for other reasons, or due to a nonspecific generalized symptom like headache. Radiology plays a crucial role in distinguishing benign “do not touch” lesions from malignant or infectious/inflammatory etiologies which require a more aggressive therapy.

This exhibit will illustrate a number of central sphenoid and clivus pathologies, which have overlapping imaging characteristics, highlighting the imaging features that point to the correct diagnosis. Several of these lesions were misinterpreted on initial reading. For example, in the included figure is a right sphenoidal mass initially interpreted as ground glass density reflecting fibrous dysplasia but actual pathology was osteoblastic prostate cancer metastasis. Initial characterization of this mass as benign pathology triaged the patient.

Summary:
A variety of osseous lesions occur centrally in the sphenoid bone and clivus, discovered incidentally or secondary to nonspecific symptoms that are more attributable to lesion location rather than a specific pathology. Given the essential role that imaging plays in diagnosis of these lesions, radiologists bear a crucial responsibility in ensuring that appropriate followup and treatment are achieved, and in the case of benign lesions, that unnecessary surveillance or intervention is not pursued.
Abstract Details
The purpose of our presentation is to describe a case presentation of a chondrosarcoma of the skull base presenting with vocal cord paralysis. A review of the radiologic characteristics of skull base chondrosarcoma in reference to our case example will be included.

We present a case of a 30 year-old female who presented via referral from ENT clinic for further imaging evaluation of sore throat and left vocal cord paralysis. CT soft tissue neck demonstrates findings consistent with left vocal cord paralysis and left sternocleidomastoid and left trapezius muscle atrophy. Further examination at the level of the skull base reveals a 1.7-cm lesion with apparent chondroid matrix
at the left petro-occipital fissure extending into the jugular foramen resulting in cranial nerve X and XI dysfunction. The radiologic differential diagnoses include chordoma, meningioma, metastases, plasmacytoma, and petrous apex cholesteatoma.

Skull base chondrosarcoma is rare malignant cartilaginous tumor, which accounts for about 6 percent of all skull base tumors. The majority of skull base chondrosarcomas arise at the petro-occipital fissure and are typically solitary and well-circumscribed. On CT bone windows, approximately half demonstrate the characteristic chondroid matrix with ring or arc-like calcifications. The microscopic grading has prognostic value for chondrosarcomas. The majority are well-differentiated conventional chondrosarcomas (ie. Grade 1) which have been reclassified as “atypical cartilaginous tumors” (ACT/CS1) by the World Health Organization 2013 classification system. Other types include moderately differentiated (grade 2), poorly differentiated (grade 3), high grade mesenchymal chondrosarcoma and extraskeletal myxoid chondrosarcoma.
Abstract Details

Purpose
Glioblastoma (GBM) is highly malignant primary brain tumor. The median survival time is approximately 9-12 months instead of combined therapy. In spite of their invasive growth characteristics, extradural spread is rarely occurrence especially without previous surgical procedures. In addition to the short survival of patients with GBM, it is suggested that dura provides excellent protection against infiltration of tumor cell. We report an exceptional case of GBM spreading to the orbita, ethmoid and sphenoid sinuses with a long-term survivor. The aim of this report is to improve our understanding about the invasion mechanism of glioma cells with extradural extension and the prognostic factors of GBM so that we can make timely and accurate diagnoses.

Methods
A 34-year old woman presented with progressive vision loss and severe headaches with moderate
personality change. Imaging studies revealed a large right frontal mass with edema and midline shift. The mass had extended into the right optic canal, right posterior ethmoidal air cells and the right sphenoid sinuses and reached the skull base involving the right Meckel's cave. She underwent the operation in order to obtain a diagnosis and decompress the optic nerve. Tumor was removed partially. She tolerated the procedure without intraoperative complications. Final pathology revealed GBM. She received radiation and chemotherapy.

Three months after the operation she suffered intracerebral hemorrhage deep in the right frontal lobe within the tumor. She underwent the right frontotemporal parietal craniectomy with clot evacuation and anterior temporal lobectomy. She remained paretic on the left side postoperatively.

Her condition remained stable for 7 years after the second operation, at which time she complained of increased sinonasal drainage, and obstructed nasal breathing for past three months. She had been evaluated by ENT specialist and CT and MRI revealed a mass in the nasopharynx without significant necrosis, extension into the sphenoid sinus, right cavernous sinus and right orbit. Possible differential include lymphoma, radiation induced sarcoma, aggressive meningioma and recurrent GBM. The operation of endoscopic nasopharyngeal biopsy was performed. Pathology of nasopharyngeal mass showed GBM.

Results
The patient has been underwent the adjuvant temozoromide therapy (150 to 2000 mg per square for 5 days) and tumor is controlled.

Conclusion
In this case, the tumor was located in the inferior surface of the right frontal lobe adjacent to the basal dura of anterior cranial fossa. We suspect that the tumor extend through the dural slit around the optic nerve and directly invaded the bone of the skull base. In addition, second unscheduled operation induced by intratumoral hemorrhage combined cerebral infarction achieved favorable result as gross total resection. As a result, after 7 years from diagnosis with GBM, her tumor relapsed into extradural lesion. We should consider the possibility of the recurrence even though the lesion is extracranial and the origin of tumor is well controlled. And it is no exception in GBM patients.
(SB_08) Case report - An unusual case of large cystic pituitary adenoma presenting with psychiatric symptoms

Author(s)
Ritu Bordia, MBBS, MPH
Attending Physician
Winthrop-University Hospital

Abstract Details
Purpose - To present an unusual case of pituitary adenoma which presented with psychiatric symptoms.

Background - Pituitary adenomas are common skull base pathology. Completely cystic macroadenomas have been reported. However, the presentation of these cystic adenomas is similar to other adenomas with headache and visual or endocrine symptoms being the most common. We report a case of very large cystic adenoma presenting with psychiatric symptoms.

Case description - A 54 year-old male was brought to the ER for acute psychosis preceded by several years of progressive personality change. Past medical and surgical history as well as initial laboratory analysis were non-contributory. A non-contrast CT scan and subsequent contrast enhanced MRI revealed a large, nearly completely cystic, sellar and suprasellar mass with well circumscribed borders. It measured 4.5 x 7.6 x 8.5 cm and extended into the right frontal horn, interpeduncular cistern, prepontine cistern, left Meckel's cave. There was encasement of bilateral internal carotid, bilateral anterior, middle and posterior cerebral arteries. It demonstrated marked subfrontal and subtemporal extension. There was some hemorrhage in the lesion but no calcification was identified. There was no restricted diffusion.

Pre-operative imaging differential considerations included craniopharyngioma, epidermoid cyst, or racemose neurocysticercosis.

The patient underwent partial resection. Pathology revealed pituitary adenoma with positive staining for prolactin.

Summary- Cystic pituitary macroadenoma should be considered in the differential diagnosis of infiltrating cystic lesions of the skull base.
Abstract Details
Purpose: To illustrate the CT appearance of both common and less well known fissures and foramina of the skull base. The anatomic relationship of these structures, as well as their contents will be described. Familiarity with these fissures and foramina can be important for diagnosis of skull base pathologic processes, evaluation of disease extension, and avoiding potential diagnostic pitfalls such as fracture mimics.

Methods/Results: The resolution and anatomic depiction available with routine CT has increased substantially in the past decade. Small skull base neural foramina that were not visible, or only seen with special high resolution targeted techniques are now routinely visible.

The most recognized neural foramina are those associated with cranial nerves, such as the superior orbital fissure, optic nerve canal, foramen rotundum, foramen ovale, internal auditory canal, jugular foramen, and hypoglossal canal. CT evaluation of suspected cranial nerve pathology requires detailed inspection of these foramina. Lesser known foramina and fissures will also be described, including the greater and lesser palatine foramina, foramen of Vesalius, innominate foramen, craniopharyngeal canal, medial basal canal, petromastoid canal, inferior tympanic canal, mastoid canaliculus, foramen caecum, condylar canal, vestibular aqueduct, cochlear aqueduct, foramen lacerum, Dorello’s canal, Vidian canal, carotid canal, jugular foramen, tympanomastoid fissure, occipitomastoid fissure, stylomastoid foramen, anterior and posterior ethmoidal canals, subarcuate canal, foramen spinosum, and singular canal.

Conclusion: Knowledge of the skull base foramina and fissures is clinically useful, and may lead to improved detection of subtle disease such as perineural tumor spread from head and neck carcinoma, congenital and acquired vascular abnormalities, and avoid misdiagnosis of a fracture mimic.
Multicentric Chordoma: An Uncommon and Incompletely Understood Presentation

Abstract
Multicentric chordoma is an exceedingly rare presentation of an uncommon malignancy. Chordomas are locally invasive and have high local recurrence rates. However, multicentricity has been reported very rarely. We present such a case and review the literature for reported cases of multicentric chordoma, their imaging appearances and management. A more diffuse pattern complicates treatment strategies for this slow growing, locally invasive neoplasm.

A 75 year old male presented to his physician for speech and tongue dysmotility, occipital pain and fifteen pound weight loss. Subsequent magnetic resonance imaging revealed a large clival mass, later discovered to be chordoma, by image guided biopsy. He underwent subtotal resection through transpalatal and transpharyngeal approaches with tracheostomy creation. 70 cGy of adjuvant radiation therapy ensued, in 35 fractions. Two years after surgery, the patient reported increased difficulty with his speech and swallowing. An MRI at that time showed osseous lesions involving multiple vertebral bodies of the cervical spine. He underwent an additional 36 cGy of radiation therapy focused upon the cervical spine. Upon careful review, some of these lesions were present on initial MRI imaging, prior to biopsy and surgery.

Data on metastatic patterns of chordoma are limited. As research on the molecular characteristics of chordoma continues to support the long held notion that chordomas arise from notochord remnants, it is more likely that our patient’s tumors represent one of few reported cases of a multicentric presentation. Recent efforts have sought to better explain the inciting variables that lead to chordoma and future efforts...
will hopefully clarify the cause for this exceedingly rare appearance, as well as outline new therapies.
Abstract
Objective: (1) Describe a case series of skull base osteomyelitis patients with variable presentation. (2) Analyze the role of imaging, surgical biopsy, and empiric antibiotic therapy.
Methods: Clinical presentation, course, patient demographics, comorbidities, imaging, surgical intervention, microbiology, pathology, and antibiotic management of a series of patients with skull base osteomyelitis will be reviewed.
Results: A total of eight patients were identified. There were a variety of initial symptoms, which included otorrhea, ear pain, hearing loss and headache as well as cranial nerve deficits. In particular, vocal cord paralysis was noted in three patients, and four patients had facial nerve deficits. In several patients, this resulted in work ups for other neurologic disease processes prior to a diagnosis of skull base osteomyelitis. No patients were acutely ill and there were no mortalities. All patients had imaging studies, which included CT, MRI, and nuclear medicine scans (Tn-99, Gallium), and some underwent surgical intervention (mastoidectomy or nasopharyngeal biopsy). All patients received prolonged courses of antibiotics. Complications, including neurovascular complications, will be reviewed.
Conclusion: Skull base osteomyelitis can have devastating sequelae with high mortality rates. In our series, this entity presented in a number of different ways. Patients tended to be less critically ill and the diagnosis was often less clear-cut, requiring a combination of clinical and radiographic evaluation. Additionally, interpretation of imaging is nuanced. Therefore, the algorithm for diagnosis and treatment typically benefits from a conscientious and multi-disciplinary approach.
Purpose:
This educational exhibit will review the emerging importance of Gamma Knife Radiosurgery in treatment applications of trigeminal neuralgia, skull base meningiomas, and vestibular schwannomas. For each topic, discussion will include the pertinent imaging findings that create actionable radiology reports, including critical anatomic considerations, preoperative imaging evaluation, expected post procedural changes, and procedure related complications.

Description:
Gamma Knife Radiosurgery is an increasingly utilized treatment modality in cases of medically refractory trigeminal neuralgia. Preoperative imaging evaluation requires assessment of cause (neurovascular conflict, skull base mass, multiple sclerosis, etc.), delineation of the trigeminal nerve course, and target planning. Postoperative findings are reviewed with attention to the presence of expected nerve root contrast enhancement. Additionally, changes in diffusion tensor imaging and trigeminal nerve tractography, as well as CT-based preoperative planning when MRI is contraindicated are discussed.

Meningiomas are the most common intracranial neoplasm, accounting for approximately 20-30% of all CNS tumors. In many cases gross total resection or even significant surgical cytoreduction is precluded by proximity to critical structures (e.g. dural venous sinuses, cranial nerves) and limitations of surgical approach (e.g. skull base or posterior fossa). Accordingly, Gamma knife radiotherapy has found application as an adjuvant therapy following subtotal resection and as primary treatment of surgically inaccessible lesions. Preoperative imaging requires attention to critical radiosensitive skull base structures; a variety of expected post treatment changes are reviewed.

Vestibular schwannomas account for the vast majority (95%) of all intracranial schwannomas and comprise the bulk of cerebellopontine cistern masses. Gamma Knife Radiosurgery is becoming a preferred treatment modality of small and moderate sized lesions (Koos classification I-III), as comparable rates of tumor control, higher rates of serviceable hearing preservation, and lower rates of facial nerve injury are noted compared with microsurgical dissection. Discussion of preoperative imaging
emphasizes the major determinants of procedure related sensorineural hearing loss, staging classification, and the importance of cystic tumor types. The phenomenon of post treatment pseudoprogression and the expected treatment related changes, as well as complications including hydrocephalus and tumoral cyst formation are reviewed.

Summary:
Gamma knife radiosurgery is an increasingly utilized non-invasive therapeutic option in a variety of common skull base conditions. The entities discussed above all have unique preoperative considerations and post procedural imaging findings which may challenge the radiologist. This educational exhibit reviews pertinent findings from the initial radiosurgical work up and treatment planning through follow up and potential complications.
Abstract Details

Purpose:
To illustrate the added value of obtaining concurrent noncontrast skull base CT and MRI studies in the preoperative planning of cerebrospinal fluid (CSF) leak repair.

Description:
CSF leaks represent the intermittent release of CSF through osseous defect(s) along the skull base, which left untreated, can lead to complications including intracranial hypotension, headache, seizures, or intracranial infection. Treatment requires surgical repair of the bone defect and duroplasty. Most osseous defects in the skull base can be effectively demonstrated with the use of thin slice multidetector non contrast CT and meticulous inspection of reformatted images. Once a bony defect is identified by CT, the question arises as to whether this deficiency corresponds to the site of CSF leak. Not all bony defects are associated with an underlying dural deficiency. An opacity extending through a bone defect or fluid collecting in the adjacent sinus or middle ear cavity increases the likelihood that the bone defect is the site of CSF leak. Due to the inherent limitation of CT for soft tissue characterization, the concomitant use of MRI becomes crucial, because no other currently available imaging modality will provide adequate tissue characterization. Added value of MRI lies in evaluating for additional underlying pathology such as ecchordosis physaliphora (figure). The preoperative localization of the bone defect by CT and the characterization of tissues by MRI is essential for adequate surgical planning.

This exhibit will illustrate the utility of obtaining both a non contrast MRI and a high resolution non contrast CT of the skull base for the comprehensive preoperative evaluation of this challenging pathology.

Summary:
Dedicated MRI of the skull base and temporal bones provides important preoperative information to the surgeon, which complements CT findings, prior to definitive CSF leak repair.
Solitary fibrous tumor/Hemangiopericytoma (SFT-HPC) represents a spectrum of fibroblastic mesenchymal neoplasms. Although initially described arising from the pleural cavity, these tumors can be found at almost any site in the body, including the central nervous system. The purpose of this exhibit is to present the clinical, radiological and pathological findings of a SFT-HPC arising at the cerebellopontine angle and discuss the recent 2016 CNS WHO classification change of these tumors.

Description:
A 55-year-old woman presents with acute left-sided hearing loss, progressive dizziness and nausea.

Magnetic resonance imaging of the brain without and with intravenous contrast demonstrated a heterogeneous 3.1 x 2.5 x 2.7 cm rim-enhancing broad dural-based mass in the left cerebellopontine angle with mass effect on the left middle cerebellar peduncle. The lesion demonstrated cystic changes, as well as foci of low T2 signal consistent with calcium or old hemorrhage. A small focal outpouching of the mass extended superiority across the tentorium into the middle cranial fossa.

Primary differential considerations prior to surgery included an acoustic schwannoma and meningioma.
The patient underwent a suboccipital craniotomy with gross total excision of the tumor. At the time of surgery, the mass appeared to spread along the dura and was also partially adherent to adjacent cranial nerves.

Pathology demonstrated a mitotically active spindle cell neoplasm. By morphology, the neoplasm was most in keeping with a tumor from the hemangiopericytoma - solitary fibrous tumor family.

Summary:
While previously classified as distinct tumors, it is now recognized that solitary fibrous tumors and hemangiopericytomas are overlapping entities. When occurring within the central nervous system, SFT-HPC tumors are typically intracranial and arise from the dura.

This exhibit will demonstrate a rare case of SFT-HPC at the cerebellopontine angle presenting with sensorineural hearing loss. The clinical, imaging and pathologic features of this entity will be discussed. In addition, the exhibit will review the recent change in the 2016 CNS WHO classification of these tumors.

Including SFT-HPC as a potential diagnostic consideration is important when encountering a CP angle mass. In addition, understanding the new classification of these tumor types, as well as the grading, will be important for radiologists when encountering this entity in clinical practice.
The pterygopalatine fossa (PPF) is a small fat-filled space shaped like an inverted pyramid, bounded posteriorly by the fused pterygoid plates and the base (root) of the sphenoid bone, medially by the palatine bone, and anteriorly by the maxillary bone. It is an important area, as it is a neurovascular crossroad of structures between the middle cranial fossa, masticator space, orbit, and oral and nasal cavities.

Given its many connections, it can act as a conduit for the spread of disease across the spaces of the head and neck, which may result in complex diagnostic and therapeutic implications. The importance of the PPF has been illustrated in diagnosing perineural tumor spread, however the PPF is often involved in non-malignant processes. The purpose of the exhibit is to 1) illustrate the anatomy of
the PPF with its openings and contents, 2) analyze the imaging approach of the pterygopalatine fossa and discuss optimized advanced imaging techniques, and 3) illustrate non-malignant pathologies that can involve the PPF.

Description/Table of contents:

This is a retrospective teaching exhibit with cases identified from the database of a tertiary university hospital to illustrate PPF anatomy and pathologies.
- We review and discuss the anatomy of the PPF using diagrams, CT and MR images from our database.
- We discuss the CT and MR imaging techniques and protocols and their impact on routine clinical imaging in order to evaluate the PPF and to better identify normal structures and pathological findings.
- We describe the imaging findings of non-malignant pathologies affecting the PPF: infection including bacterial and fungal disease, inflammatory conditions such as polyposis, granulomatous diseases and IgG4-related disease, vascular anomalies, nerve sheath tumors, osseous pathologies, and trauma (fractures, hematomas).

Summary:

The anatomic location of the PPF makes it one of the main crossroads of the skull base. This pictorial review aims to help the reader better understand the anatomy of the “inverted pyramid” structure of the PPF, its important passageways and communications, in order to scrutinize for abnormalities and identify important non-malignant pathological conditions that can involve the PPF.

Uploaded File(s)

Figure A and B: Sinonasal polyposis. CT soft tissue (A) and bone (B) windows, shows the presence of polyoid soft tissue causing widening of the right PPF.

Figure C and D: Le Fort 2 fracture in the right side and Le Fort 3 fracture in the left side. Le Fort fracture implies fracture of the pterygoid plate.
Abstract Details
Purpose: We report a case of Mikulicz Syndrome (MS) in a 43 year old female.

Description: Clinical presentation, physical exam and imaging findings of Mikulicz disease (MD) and MS will be reviewed. Patient photograph, MRI images and pathological specimens will be reviewed. In addition we will review the history of the disease and evolution in diagnosis and associated diseases. Specifically, the distinction between MD and MS will be addressed.

Summary: We report a case of Mikulicz Syndrome in a 43 year old patient and review the medical literature and evolution in pathological diagnosis.
Abstract Details

Purpose: Conventional sialography requires cannulation of the salivary ducts and instillation of contrast media. MR Sialography is a noninvasive alternative. Using a combination of standard spin echo sequences, balanced steady-state free precession, and MRCP-type sequences, it is an effective means of imaging the salivary ducts and surrounding glandular architecture. We present a case of a 66 year old female with recurrent right submandibular sialoadenitis.

Methods: MR sialography was performed using axial T1, single shot turbo spin echo, multiplanar STIR, multiplanar balanced fast field echo (BFFE), and 3-D high resolution MRCP-type sequences. After discussion of the procedure with the patient and confirmation of no allergies to citrus, lime wedges were provided orally prior to each sequence to induce salivation. Plane of imaging obliquities were tailored to the submandibular duct. Three-dimensional reformats were produced using Vitrea® software.

Results: The submandibular glands and ducts were visualized through the secondary branches. Axial STIR and BFFE Spectral Presaturation with Inversion Recovery (SPIR) sequences allowed the best visualization of the gland parenchyma and demonstrated mild asymmetric edema on the right (Fig 1). Best seen on BFFE and MRCP sequences, the right submandibular duct was mildly dilated, without focal stricture. A second radicle arising from the right sublingual gland joined the submandibular duct at approximately two thirds of the way to the punctum (Fig 2-4). This normal variant is commonly referred to
as Bartholin’s Duct (1). Proximally, the duct was dilated to the punctum. There were no discernible sialoliths along the length of the duct. The left submandibular duct was normal.

At sialoendoscopy, there was a fleck of calcium at the right submandibular duct orifice. Copious salivary egress followed dilation of the punctum, corroborating imaging findings of ductal dilation.

Conclusions: MR sialography allows thorough evaluation of the salivary glands, ducts, and surrounding soft tissues without the need for ductal cannulation, instillation of contrast media, or ionizing radiation. As such, it is feasible in cases of acute sialoadenitis or contrast allergy. Conventional sialography may be slightly more sensitive for submandibular sialolithiasis, and remains preferable for fine, distal sialoliths. Yet the procedure fails more than twice as often as MR, and may result in distal displacement of sialoliths. Further, fine sialoliths may not be clinically relevant (2,3). MR sialography is a viable, noninvasive means of evaluating salivary gland pathology, increasing patient comfort and reducing radiation dose.

References:

A Minor League of Major League Players: Tumors and tumor-like entities of the Minor Salivary Glands

Author(s)
Jared M. Steinklein, MD
Assistant Professor
Hofstra University Northwell School of Medicine

Role: Author
Kudrat K. Gill, MD
Radiology Resident
Hofstra Northwell School of Medicine

Role: Author
Deborah R. Shatzkes, MD
Professor of Radiology
Hofstra Northwell School of Medicine

Abstract Details
BACKGROUND/PURPOSE: Minor salivary gland (MSG) are ubiquitous in the head and neck, and disease thereof is often mistaken for more common primary aerodigestive disease. These small rests of salivary tissue may harbor malignancy at much higher incidence than in their major salivary gland counterparts, (reported up to 80% malignancy rate in some studies). Additionally these tumors not be as readily appreciated clinically both due to their submucosal origin and sometimes deep and sometimes aberrant location. As salivary tissue, lesions may be of neoplastic origin or non-neoplastic, such as inflammatory, autoimmune or granulomatous. For these reasons, a detailed knowledge of MSG anatomy/pathophysiology and individual disease entities is key. Specific sites of disease presented include the oral cavity (most commonly), the naso- and oropharynx, buccal space, larynx, and the parapharyngeal space. The role of imaging with both CT and MRI will be presented along with a discussion of surgical and nonsurgical treatments. Paramount findings, notably perineural tumor spread will be stressed, given its notoriety with salivary malignancies, particularly adenoid cystic carcinoma.

MATERIALS/METHODS: As an educational exhibit, illustrations and case examples will display embryology and relevant anatomy, and radiographic appearance of MSG tumors with emphasis on appropriate CT and MR imaging techniques. Salivary gland diseases to be covered (but not limited to): benign mixed tumor, adenoid cystic carcinoma, mucoepidermoid carcinoma, Sjogren’s disease and IgG4 deposition disease. Selected case series within the literature will be cited to highlight differences between major and minor salivary tumors, and incidences within varied subsites of the aerodigestive tract. Special attention is given to perineural tumor spread, notably involving the trigeminal and facial nerves, and its relevance to MSG tumor prognostication. Throughout this exhibit, images will be presented in an educational and interactive way to allow for optimal self-participation and effective recall.
SUMMARY: While minor salivary gland disease is less common than other primary neoplastic or inflammatory conditions in the anatomy in which they lie, there are features and patterns of disease entities that may shed light on an imaging diagnosis, and ultimately aid clinicians in prognosticating and tailoring a treatment plan. Both CT and MRI are complementary, with advantages of MRI in the evaluation of the oral cavity due to diminished dental-related artifact and optimal soft tissue contrast for tumor mapping. Specifically, MR is advantageous in illustrating the submucosal nature to a MSG lesion and allowing characterization of tumor behavior based on its margins and spread of disease, notably via the perineural route. On the other hand, CT exposes the extent of bony change and provides navigational data when necessary. This exhibit will cover the background and pathophysiology of MSG tumors, anatomy and a brief review of embryology, and use imaging findings to highlight a myriad of pathologies arising within the minor salivary glands.
Palate masses, though well known in dental and maxillofacial literature, are oft-overlooked entities in radiology circles. The palate is a complex intersection of tissues, including the squamous epithelium of the hard and soft palates, and the hundreds of minor salivary glands deep to it. We aim to share our institutional experience with some of these rarer benign and malignant abnormalities and their imaging characteristics, which should be included in the differential diagnosis of palate masses or asymmetries. A retrospective review of our archives from 2006 to 2014 revealed imaging of various malignant masses of the palate, including squamous cell carcinoma of the hard palate, adenoid cystic carcinoma, mucoepidermoid carcinoma, and polymorphous low-grade adenocarcinoma, as well as benign masses and congenital anomalies, such as chronic sclerosing sialadenitis – initially though to be pleomorphic adenoma, and myoepithelioma. Histologic slides obtained during biopsy are also included, as well as a short description of the tumor’s pathology. Though it is difficult to distinguish palate masses radiologically, and tissue biopsy is often essential for diagnosis, imaging is important to delineate location and possible spread of tumor, which in turn dictates appropriate treatment.
Dynamic susceptibility contrast perfusion MR imaging in the evaluation of parotid gland tumors

Author(s)
Shin Young Park
fellowship
Busan national university hospital

Role: Author
Hak Jin Kim
professor
Busan national university hospital

Abstract Details
Introduction
To determine the efficacy of dynamic susceptibility contrast perfusion MR imaging (DSC-MR) against conventional and diffusion-weighted (DW) MR imaging for differentiating parotid gland tumors.

Materials and methods
We included 7 malignant parotid tumors, 17 pleomorphic adenomas, 4 Warthin’s tumors, 2 schwannomas, and 3 benign parotid lesions (oncocytoma, atypical lymphoid hyperplasia, and florid reactive follicular hyperplasia). Only tumors larger than 1.0 cm were included in our study. 25 parotid tumors underwent surgical resection, 8 underwent ultrasonography-guided core needle biopsy. T1-weighted, T2-weighted, DW, DSC, and contrast-enhanced T1-weighted MR imaging were performed in all patients with parotid gland tumors. The signal intensity time curve of the tumor was obtained. Dynamic susceptibility contrast percentage (DSC%) was calculated and correlated with pathological findings. The apparent diffusion coefficient (ADC) value of the solid component was measured on DW MR images. Tumor to parotid gland signal intensity ratios (SIRs) of solid components were correlated with these pathologies.

Result
DSC% was significantly higher in malignant parotid gland tumors (59.09%) than benign tumors (36.88%) (p=0.018). DSC% cutoff value was 49.30% for distinguishing between benign and malignant parotid gland tumors (sensitivity, specificity, and accuracy of DSC% threshold of over 49.30% were 71.4%, 68.0%, and 68.75%, respectively). ADC value and SIRs on T2-weighted images were higher in benign parotid gland tumors, especially pleomorphic adenomas than in Warthin’s tumors (p < .01) and malignant tumors (p < .01). ADC cutoff value was 0.876 for distinguishing between benign and malignant parotid gland tumors (sensitivity, specificity, and accuracy of ADC threshold of over 0.876 were 85.71%, 84.62%, and 84.85%, respectively).

Conclusion
Dynamic susceptibility contrast perfusion MR imaging with SIR measurements and ADC value can play a role in differentiation between pleomorphic adenomas and other parotid gland tumors.
A 55-year-old male presented with left parotid swelling in December 2013 in Hong Kong. He complained of progressive left parotid swelling for 2 years, with drooping of left angle of mouth for 2 months. Physical examination showed a 4cm left parotid mass, which was not mobile with no skin tethering. Left facial nerve palsy was noted, in which only the left lower face was involved. No cervical lymphadenopathy was detected. Flexible laryngoscopy showed that the nasopharynx was unremarkable. Fine needle aspiration was non-diagnostic, showing mainly benign salivary gland and adipose tissue. Ultrasound demonstrated a 4.4cm hypoechoic mass in the left parotid gland. Magnetic resonance imaging demonstrated abnormal soft tissue mass at the deep lobe of parotid, extending into the left parapharyngeal space with a widened stylomastoid notch (Fig. 1). No enlarged cervical lymph node was seen. Computed tomography of the thorax and abdomen showed no evidence of distant metastasis.

The patient had a history of nasopharyngeal carcinoma of stage III (T3N0) disease, diagnosed in 2001. Treatment regime included concurrent chemoradiotherapy followed by adjuvant chemotherapy. 3D conformal radiotherapy was used, with a regime of 70 Gy in 35 fractions (2 Gy per fraction) over 6 weeks. He received three cycles of concurrent chemotherapy with cisplatin 100mg/m2 intravenously on day 1, during the weeks 1, 4 and 7 of radiotherapy. After completion of radiotherapy, the patient received three cycles of adjuvant chemotherapy with cisplatin 80mg/m2 on day 1 plus 5-fluorouracil 1000mg/m2 by 96-hour continuous infusion
on day 1, once every 4 weeks. The mean and median radiation dose to the left parotid gland were 48.4Gy and 48.2Gy respectively. Repeated follow-up magnetic resonance imaging of the nasopharynx showed no evidence of local recurrence.

The patient had undergone radical left parotidectomy and facial nerve graft on 17th May, 2014. The tumour infiltrated the facial nerve, external carotid artery, parotid vein and the adjacent muscle. Histological examination demonstrated poorly differentiated sarcoma, in keeping with post-radiation sarcoma in this clinical context, stage 1 disease (T1N0M0). The sarcoma touched the peripheral margin at multiple foci. Oncologist recommended post-operative chemotherapy in view of the positive margin and high chance of recurrence, but the patient declined and opted for observation.

The patient complained of left facial pain one year after the surgery in April 2015. PET-CT showed a 3.0cm lesion with increased uptake around the surgical clips at the left parotid resection bed. The standardized uptake value (SUV) was 4.1, suspicious of local recurrence. Surgical excision of the lesion was performed on 7th May 2015, with histology confirming local recurrence. However, follow-up MRI on 17th August 2015 showed a new ill-defined heterogeneous enhancing mass at the left parotid space, near the resection margin, highly suspicious of residual disease. Palliative chemotherapy was offered to the patient but he declined. The patient was last seen in 18th September 2015, and he was referred to the palliative care clinic for supportive treatment.
(SG_07) Oncocytoma Presenting as a Fat-containing Parotid Mass

Abstract Details
Oncocytoma Presenting as a Fat-containing Intraparotid Mass

A.A. Nagelschneider, C.L. Anzalone Jr., D.R. DeLone, D.L. Price, and J.J. Garcia

Purpose: To describe a rare appearance of a parotid oncocytoma containing extensive macroscopic fat.

Description:
An 87-year-old woman with a history of breast cancer status post lumpectomy as well as questionable history of lower extremity melanoma presented with a lump under her left ear, which she noticed three months prior while applying skin cream. She was asymptomatic and initially deferred further workup.
Upon developing TIA symptoms, she underwent a head CT at an outside facility which demonstrated enlargement of the superficial and deep lobes of the left parotid gland, with mixed soft tissue and fat attenuation. Outside T1-weighted imaging demonstrated extensive, heterogeneous T1 hyperintensity. There was suppression of these corresponding regions on fat-saturated T2 imaging and post-gadolinium imaging. The soft tissue components enhance with gadolinium relative to normal parotid parenchyma. The mass demonstrated diffusion restriction. The stylomastoid foramen was spared. Outside FNA was performed and review of histologic slides at our institution demonstrated groups of oncocytic cells.

The mass was subsequently resected, and the pathology specimen revealed an oncocytoma in a background of extensive oncocytic metaplasia; a histochemical stain for mitochondria (PTAH) and an immunohistochemical stain for p63 confirmed the diagnosis of oncocytoma.

Summary: Our case demonstrates an unusual finding in a parotid oncytoma, the presence of extensive intratumoral fat. While oncocytoma with intratumoral fat has been described in the kidney (Helenon et al., Radiographics, 1997), a previous case series of 9 parotid oncocytomas (Patel et al., AJNR, 2011) did not demonstrate any cases with T1 hyperintensity. The mass in our case was not isointense to normal parotid on fat-saturated T2 and post-contrast images (i.e. not “vanishing” as described by Patel et.al.) but in fact the non-fatty components were hyperintense on T2 and enhanced on post-contrast images. Our goal is to demonstrate a rare finding in parotid oncocytoma, which may create a diagnostic dilemma in differentiating an oncocytoma from more aggressive fat-containing parotid neoplasms such as liposarcoma.

(T&P_01) Ectopic Mediastinal Parathyroid Adenoma: Illustrated Case-Based Review and Imaging Work-Up

Author(s)
Islam A. Shehata Elhelf, M.D
Resident-Diagnostic Radiology
University of Iowa Hospitals and Clinics/ Cairo University

Role: Author
Jack Kademian, MD
CLINICAL ASSISTANT PROFESSOR
UNIVERSITY OF IOWA

Role: Author
Toshio Moritani, MD
CLINICAL PROFESSOR
UNIVERSITY OF IOWA

Role: Author
Aristides Cappizano, MD
CLINICAL ASSISTANT PROFESSOR
UNIVERSITY OF IOWA
Abstract Details
Purpose:
Review the imaging work-up of parathyroid adenomas through the discussion of a case of ectopic mediastinal adenoma. We stress on the technique and advantages of four dimensional CT (4D CT) scan for diagnosis and localization of parathyroid adenomas.

Description:
A 58-year-old male patient presented with worsening fatigue, bilateral knee pain and history of multiple bilateral renal stones. Laboratory work-up revealed hyperparathyroidism. First-line imaging work-up included ultrasound and nuclear scan. Ultrasound showed no evidence of parathyroid adenoma in the neck. Dual phase sestamibi scan showed persistent delayed radiotracer uptake in a nodular mediastinal lesion. 4D CT scan was ordered to confirm the diagnosis and provide precise preoperative localization. The lesion showed intense arterial enhancement with washout of contrast in the delayed phases, a perfusion pattern consistent with parathyroid adenoma. In addition, 4D CT precisely localized the ectopic adenoma to the superior mediastinum in the region of the aorto-pulmonary window. Based on this imaging workup, patient underwent mediastinoscopy and resection of the mass lesion. Pathology results confirmed the diagnosis of ectopic parathyroid adenoma.

Conclusion:
Imaging work up of parathyroid adenomas includes neck ultrasound, dual phase sestamibi scan and 4D CT scan. 4D CT has the advantage of better spatial resolution that allows precise pre-operative localization of ectopic adenomas. Also, the perfusion pattern of parathyroid adenoma during 4D CT helps to differentiate an adenoma from its main mimics, namely lymph node and ectopic thyroid tissue.
A case of papillary carcinoma in ectopic lingual thyroid tissue associated with a thyroglossal duct cyst

Abstract Details
Purpose:
Review how ectopic thyroid tissue and thyroglossal duct cysts arise during fetal development and their imaging characteristics on CT and MR.

Know that neoplasm can arise within ectopic thyroid tissue as illustrated by a case of a 23 year old female.

Discuss when to suspect ectopic thyroid malignancy and the role of imaging in diagnosis and presurgical evaluation.

Description:
A 23 year old female presents for the evaluation of two neck masses. Contrast enhanced CT and MR show a solid intensely enhancing mass in the suprathyroid soft tissues invading the hyoid bone and multiple mixed cystic and solid masses in the right lateral neck. Histologic analysis of the suprathyroid neck mass after excision reveals papillary carcinoma within ectopic thyroid tissue associated with thyroglossal duct remnant. Analysis following excision of one of the cystic masses in the right lateral neck reveals thyroid tissue without definite identifiable malignant features. This and similar smaller right level II masses are considered to represent metastatic lymph nodes given their imaging appearance and the low likelihood of benign ectopic thyroid tissue occurring in the lateral neck. The patient subsequently underwent total thyroidectomy with radioactive ablation of residual thyroid tissue.

Summary:
Ectopic thyroid tissue occurs in various locations along the gland’s embryologic descent tract and is susceptible to developing primary thyroid neoplasms. A high index of suspicion should be maintained for thyroid tissue located outside the embryologic descent tract, even in the absence of malignant features on histology and especially in the presence of a primary thyroid cancer.
Preoperative localisation in primary hyperparathyroidism: do we need both sestamibi & ultrasound to offer unilateral parathyroidectomy?

Author(s)
Mira Deshmukh, MBBS, BSc
General Surgical Doctor
Luton and Dunstable University Hospital

Role: Author
Deepak Shrestha
Associate Specialist General Surgery
Luton and Dunstable University Hospital

Role: Author
Charlotte Fowler
General Surgical Doctor
Luton and Dunstable University Hospital

Role: Author
Kai Low
Consultant Radiologist
Luton and Dunstable University Hospital

Role: Author
Thayahlan Iyngkaran
Consultant Radiologist
Luton and Dunstable University Hospital

Role: Author
Duraisamy Ravichandran
Consultant Breast and Endocrine Surgeon
Luton and Dunstable University Hospital

Abstract Details
Background: Pre-operative localisation allows lateral parathyroidectomy in patients with primary hyperparathyroidism (PHPT). Our aim is to study the relative contribution of sestamibi and US in pre-op localisation.

Methods: We reviewed 112 consecutive patients with PHPT who had both US and sestamibi followed by surgery. When both scans were in agreement a lateral parathyroidectomy was usually performed. Others had a collar incision and bilateral neck exploration.

Results: 6 patients were not cured and 2 of these patients underwent re-exploration. Two others were lost to follow-up. Among 106 patients that were cured (including 2 re-explorations) the contribution of US and MIBI in localising the adenoma to the correct side (left or right) was as follows;
MIBI Ultrasound
localised correct side negative Localised wrong side Total
localised correct side 48 16 2 66 (62%)
negative 13 17 2 32
localised wrong side 4 3 1 8
Total 65 (61%) 36 5

Among 2 re-explorations, one was a surgical failure (adenoma correctly localised but only found on re-exploration) and one imaging failure (4-gland hyperplasia wrongly diagnosed as single gland disease by both scans).

Conclusions: Offering unilateral approach when both scans localise the same side appears to be the safest as there was only one case where both scans localised the wrong side. However, this will only allow unilateral surgery in less than half the patients. Individual accuracy of both scans are the same. Using a single scan will increase unilateral surgery rates but at the risk of increased negative exploration due to false positives.
Diagnostic Performance and Interobserver Agreement of 4-Dimensional Computed Tomography Parathyroid Scans in Patients with Primary and Secondary Hyperparathyroidism

Author(s)
Bundhit Tantiwongkosi, MD
Assistant Professor of Radiology and Otolaryngology
University of Texas San Antonio

Role: Author
Viet Nguyen, MD
Radiology resident
University of Texas San Antonio

Role: Author
Fang Yu, MD
Radiology resident
University of Texas San Antonio

Role: Author
Achint Singh, MD
Assistant Professor
University of Texas San Antonio

Role: Author
Wilson Altmeyer, MD
Assistant Professor
University of Texas San Antonio

Abstract Details
Purpose: The purpose of this study is to assess the diagnostic performance of 4D-CT scans for preoperative localizing pathologically proven hyperfunctioning parathyroid glands.

Materials and Methods:
This IRB-approved retrospective study of 4D-CT parathyroid imaging at a tertiary referral center between 2011 and 2015 was performed with radiological, surgical, hormonal and pathological correlation. Inclusion criteria include availability of intraoperative reports, pathology, parathyroid level and performance of preoperative 4D-CT imaging. Histology, surgical findings, and reduction of intraoperative parathyroid hormone levels are used as gold standards. Three neuroradiologists, blinded to the clinical results, independently interpreted the studies. Performance of 4D-CT was evaluated based on determination of laterality and quadrant of the pathologically proved lesions. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), accuracy and 95% confidence interval were calculated. Fleiss’ kappa was used to assess the interobserver agreement.

Results:
Sixty seven patients with primary and secondary hyperparathyroidism were included. Sixty two patients have a single adenoma and 5 patients have multiple adenomas or hyperplasia. A total of 72 glands were proven to have parathyroid adenomas or hyperplasia. The sensitivity, specificity, PPV, NPV and accuracy
are 85%, 97%, 96%, 86% and 91% for lateralization and 75%, 95%, 85%, 92% and 90% for quadrant localization respectively. Fleiss’ kappa value is 5.6 (moderate interobserver agreement).

Conclusion:
4D-CT is a robust method in localization of hyperfunctioning parathyroid glands with high accuracy and at least moderate interobserver agreement.
Inaccurate Parathyroid (PTH) Biopsy Diagnoses: Why this Occurs and a Method to Improve Diagnostic Accuracy

Author(s)
Alan N. Schwartz, MD
Medical Director
SPRI

Role: Author
Bob Ly, MD
MD
Skagit Valley Hospital

Role: Author
Alan Boudousqui, MD
MD
Swedish

Role: Author
Andrew Gilkerson, Masters Anthropology
Administrative Assistant
SPRI

Role: Author
Michelle Hippke, US Technology Degree
Ultrasound Technologist
Alliance

Role: Author
Scott McCorkell, MD
MD
Alliance

Abstract Details
How and when to perform PTH biopsies and how to correlate pathology results with Imaging and Pre-Biopsy Test Probability will be discussed.

Accurate Parathyroid Detection is becoming increasingly more important to surgeons who wish to do truly minimally invasive removal of pathologic Parathyroid glands, rather than 4-gland explorations. The radiology literature reveals significant limitations of imaging. Biopsy prior to surgery can prove beneficial to improve confidence in the imaging diagnosis. Infrequently we require biopsy of PTH glands but on occasion biopsy of Parathyroid glands is advisable (~5% of PTH cases worked-up).

When a Parathyroid biopsy is performed it needs to produce an accurate diagnosis. The current reality of practice is that biopsy results are often the final word, even if it contradicts the imaging and the patient's
chemical and diagnostic history (Pre-Biopsy Test Probability). Biopsies need to be preformed/handled/ordered properly to yield a diagnosis that is extremely accurate.

Patients in whom Parathyroid biopsy is warranted include but are not restricted to prior neck surgeries; suspected intra-thyroidal Parathyroid glands; prior negative work-ups; and patients in whom a biopsy may avoid a bilateral exploration.

PTH biopsies are performed after imaging and only if the biopsy will add significant confidence to the pre-surgical diagnosis. Initially, our community standard was to perform only FNA histology.

At our center we noted that the post-biopsy pathology diagnoses in 4 patients did not correlate well with the Imaging diagnosis of an abnormal Parathyroid and/or with the Pre-Biopsy Test Probability. FNA interpretations for these patients included oncocytic Thyroid cells (2) and normal thyroid/epithelial cells (2). In all of these patients the biopsy samples were re-examined with Immunohistochemistry (IHC) and/or PTH levels from the aspirate and were subsequently re-classified as PTH tissue.

In addition, in 1 outside case a PTH gland-FNA was diagnosed as thyroid cells and this resulted in a 2-year delay in care before the abnormal parathyroid was correctly identified at our center.

We now perform FNA histology, IHC and/or PTH levels on all PTH biopsy samples. Since instituting this protocol we have performed 4 PTH biopsies (approximately 6-months). In 1 case the FNA was read as PTH with knowledge of a positive PTH IHC and PTH level. In 1 case the FNA was read initially as possible/probable PTH and in another case it was initially read as thyroid. In both cases the diagnosis was changed to definitive PTH when ICH and/or PTH levels returned. In 1 other case the sample was inadequate for FNA, IHC and PTH levels.

Four patients diagnosed as Atypical Thyroid nodules by Imaging had FNA biopsy and concurrent IHC and/or PTH levels. In 3 patients FNA, IHC and/or PTH levels confirmed benign thyroid tissue and in 1 patient oncocytic thyroid (Hurtle) cells were identified.

When PTH biopsies are properly performed and handled and FNA, IHC and/or PTH levels are ordered and the results are correlated with specific Imaging findings and Pre-Biopsy Test Probability, then errors decrease, accuracy increases and patient care improves. These specifics will be discussed.
Abstract Details
Purpose: Describe the approach to head and neck masses using CT to guide biopsy with a review of the anatomical spaces of the head and neck where representative pathological cases of each space are provided.

Description: The anatomical spaces of the head and neck have been divided into several distinct regions based on fascial planes. Division of these spaces aids in generating a differential diagnosis regarding pathology in each of these spaces. Utilizing the parapharyngeal space as a central landmark, origin of masses in the head and neck can be elucidated due to mass effect exerted on the parapharyngeal space. Once a space of origin and differential diagnosis can be determined, histological diagnosis often is required. Based on the knowledge of the head and neck anatomy and review of prior literature, an approach to biopsy can be developed. This exhibit will review the various approaches available to access and biopsy of masses in the head and neck utilizing CT-guidance. Representative cases will be illustrated.

Summary: This exhibit will review the pertinent head and neck anatomical fascial spaces necessary to locate pathology and generate a differential diagnosis. Approach to CT-guided biopsy of these masses will be reviewed and interesting cases will be demonstrated.
Abstract Details
Abstract: Introduction: Traumatic intracranial pseudoaneurysm following transphenoidal surgery has been described, but these typically involve the internal carotid artery and avulsion of the anterior communicating artery (AComm) is uncommon. Traditionally open surgery has been employed in its management, which can be technically challenging and may impart greater morbidity than an interventional approach.

Case Presentation: An 80 year-old man underwent endoscopic transphenoidal surgery for endocrinologically-active pituitary adenoma. On postoperative CT angiography, the patient was noted to have a new anterior communicating artery pseudoaneurysm with iatrogenic avulsion as the probable cause. Under biplane fluoroscopic guidance, the pseudoaneurysm was accessed via microcatheter technique and balloon-assisted coil embolization was performed. Following completion angiography to confirm no residual pseudoaneurysm, the patient was transferred in stable condition to the neuro-
intensive care unit. At 6 month follow-up, the patient is well and possesses no neurological deficit. At that time MR angiography was performed which showed no coil migration or residual pseudoaneurysm.

Discussion: Traditionally, these cases require endovascular vessel sacrifice or surgical intervention. To our knowledge, endovascular treatment of an AComm aneurysm following transphenoidal surgery has not been described previously. Imaging and clinical follow-up is essential following treatment of this complication. In this discussion, we review several other cases of vascular injury following transphenoidal surgery and the endovascular approaches to their management.
Abstract Details

Background Facial AVMs are associated both with risk of hemorrhage and considerable psychosocial as well as cosmetic distress. Head and neck AVMs are the second most common outside of the brain, but despite being a richly-vascularized area, giant and diffuse lesions of the magnitude reported are rare and typically evolve from iatrogenesis.

Case description A 32 year-old male presented with a pulsatile facial mass which had treated unsuccessfully at numerous outside intuitions. Imaging revealed a diffuse facial AVM with extensive bilateral supply, and a ligated left external carotid artery. Though incurable, endovascular treatment was required frequently for hemorrhagic events and palliation were delivered via the contralateral supply due ligation of a direct route to the nidus.

Conclusion We report a case of giant facial AVM which initially imparted significant psychosocial morbidity, but as a result of proximal ligation and improper embolization grew into a tremendous lesion the size and extent of which has not been reported previously. It remains absolutely essential that no attempt at palliation or cure be made that cannot directly target the nidus of an AVM, and this ever the more crucial in rich-supplied areas such as the face. Endovascular embolizations remains the first and often only option during when emergent therapy We further discuss additional patients in this series with similar presentations and lesions, to analyze approaches to management.
Vascular trauma in the neck can have life-threatening complications. The diagnosis of vascular trauma in the neck must be vigorously pursued, as missed diagnosis may result in irreversible neurologic injury. Knowledge of vascular and zonal anatomy will help the radiologist appreciate and grade vascular injury, which determines prognosis and subsequent treatment. Our aim is to define vascular and zonal anatomy in the neck, and familiarize radiologists with the Grading Scale of Blunt Cerebrovascular Injury (Denver). These metrics are important to convey in radiologic reporting and help define the treatment approach and imaging follow-up.
Neurosarcoidosis presenting with stroke like symptoms and radiographic findings suggestive of large vessel vasculitis of the neck.

Author(s)
Rani Bashiti, MD
Radiology Resident, PGY 3
Providence Hospital and Medical Centers

Role: Author
Alula Kenfe, MD
Staff Radiologist
Providence Hospital and Medical Centers

Role: Author
Michael Warren, MD
Chief Resident, R3
Providence Hospital and Medical Centers

Role: Author
Giselle Marshall, MD
PGY3 Radiology Resident
Providence Hospital and Medical Centers

Abstract Details
INTRODUCTION:
Sarcoidosis is multisystem granulomatous inflammatory process which can essentially involve any organ and is characterized histologically as non-caseating granulomas. Although nervous system involvement is relatively rare, affecting approximately 5-10% of cases, patient’s presenting with stroke and radiographic findings suggestive of large vessel vasculitis, has not been reported to our knowledge. We report a unique case of systemic sarcoidosis presenting with stroke like symptoms and carotid arterial wall thickening.

CASE REPORT:
A 45 year old African American with no known significant past medical history presented to our Emergency Department complaining of new sudden onset dysarthria, left lower extremity weakness and ataxia. Initial CT of the head demonstrated no obvious acute intracranial abnormality. MR imaging of the brain and cervical spine was subsequently performed with intravenous Gadavist which demonstrated a focal area of restricted diffusion within the right ventral aspect of the pons with associated extensive diffuse nodular leptomeningeal enhancement. Several enlarged supraclavicular and superior mediastinal lymph nodes were visualized on the cervical spine images. The differential diagnoses at this time included infection such as Tuberculosis, metastatic neoplastic process and granulomatous disease like Sarcoidosis.

Interestingly, an ultrasound of the carotids the following day demonstrated marked circumferential wall thickening of the right distal carotid artery and carotid bulb. No significant luminal narrowing or abnormal Doppler flow was demonstrated. Diagnostic considerations at this time remained unchanged and included systemic sarcoidosis with large vessel vasculitis.
Due to complaining of shortness of breath, a CT of the thorax was performed which showed bilateral interstitial thickening with reticulonodular opacities were demonstrated in a bronchovascular distribution, predominantly involving the upper lobes, in addition to diffuse mediastinal and hilar lymphadenopathy.

The constellation of the above mentioned findings in addition to the clinical history which included elevated serum ACE level, placed systemic sarcoidosis with large vessel vasculitis on the top of our differential. This was eventually supported via histologic evaluation of an endobronchial biopsy of the right upper lobe which described chronic inflammation with coalescing epithelioid granulomata, compatible with sarcoidosis.

Of note, a CT angiogram of the head and neck was performed to evaluate the extent of vascular involvement and redemonstrated isolated circumferential wall thickening of the distal right common carotid artery and carotid bulb.

DISCUSSION:
Sarcoidosis is an idiopathic granulomatous inflammatory condition that may occur within any site in the body and is characterized by the formation of non-caseating granulomas. A combination of clinical history, radiographic features and histopathologic results help establish the diagnosis. Sarcoidosis most commonly affects the lungs, lymph nodes, skin and eyes. It relatively rarely affects the nervous system, and significantly more rarely presents with stroke or large vessel vasculitis. Our case is unique in that we have a patient who presented with stroke as well as radiographic features suggestive of large vessel vasculitis, specifically of the right carotid artery. This is the only case report, to our knowledge, of a patient with systemic sarcoidosis who presented with this combination of findings.
Abstract Details
Purpose: The vertebral artery plays a critical role in the perfusion of the spinal canal contents and intracranial posterior fossa structures. A multitude of pathologies can arise from, within, and around the vertebral artery including among others: dissection, pseudoaneurysm, stenosis, traumatic AV dural fistula, vascular anomalies, and functional occlusion. It is imperative for a head and neck imager to understand the normal vascular anatomy, congenital variations, pathology, and imaging associated with the vertebral artery. Radiologists and clinicians who are confronted with clinical findings must be able to determine the appropriate imaging, management, and treatment options for these patients. The goal of this exhibit is to review the normal vertebral artery anatomy, congenital variations, spectrum of vertebral artery pathology, and the interventional treatment options available to the radiologist.

Description: Radiologic imaging has a central role in the evaluation, diagnosis, and treatment of vertebral artery pathology. This exhibit will present a variety of multi-modality imaging examples including, but not limited to, congenital anomalies, atherosclerotic stenosis, dissection, pseudoaneurysm, extrinsic functional compression, AV malformations, AV fistulas, and dissecting aneurysm with subarachnoid hemorrhage. This exhibit will be presented in a case-based imaging format. The imaging findings, with descriptions of differentiating characteristics, important differential considerations, and treatment options available will be discussed. In addition, we will use angiographic images to present endovascular treatment options of common and uncommon vertebral artery pathology.

Summary: After reviewing this exhibit the reader will better understand the wide variety of vertebral artery and surrounding structure pathology, imaging findings, and endovascular treatment options. It is imperative that radiologists are able to recognize a wide spectrum of vertebral artery pathology and provide accurate diagnoses thereby leading to appropriate imaging follow-up and therapeutic endovascular choices.
Author(s)
Nikhil Madhuripan, MD
Resident
Baystate Medical Center

Abstract Details
Purpose:
1. To review indications for head and neck CTA in trauma
2. Protocol for CTA and MRA in trauma
3. Review spectrum of imaging findings in CT and MRI at risk for vascular injuries and associated arterial and venous injuries on CTA.

Materials and Method: A multimodality review of vascular injuries was compiled using images drawn from our institution, a Level 1 trauma center. Literature review was also done to provide a rounded discussion of the injuries detailed.

Results:
1. Introduction
2. Head and neck trauma associated with vascular injuries (review of plain film/CT/MRI/Conventional angiography findings)
3. Protocol for CTA and MRA in trauma
4. Review of corresponding findings in CTA and MRA

Conclusions: By using a structured approach we can heighten our sensitivity in identifying vascular injuries associated with head and neck trauma
(TB_01) Revisiting Modified Classification and Spectrum of Imaging Findings in Congenital Anomalies of Inner Ear on CT and MRI and Assessing the Feasibility for Cochlear Implant

Author(s)
Gaurav V. Watane, MBBS, MD
Assistant Professor
Grant Medical College & Sir JJ Group of Hospitals

Abstract Details
The purpose of this exhibit is-
1) To review the imaging anatomy of temporal bone.
2) To gain an awareness of the classification of the congenital cochleo-vestibular anomalies.
3) To learn the technique and spectrum of imaging findings of inner ear anomalies on CT and MRI.
4) To assess the feasibility for cochlear implant.

Outline of exhibit-
1) Review of embrology and anatomy of inner ear
2) Imaging Techniques- HRCT and MRI
3) Modified classification of congenital anomalies of Inner Ear with illustrative cases
4) Role of MRI And HRCT for Cochlear Implant Feasibility
(TB_02) Cautious assessment for intracranial complications associated with mastoid findings.

Author(s)
Umber Shafique, M.D
Radiology resident
University of Iowa

Role: Author
Moritani Toshio, MD
Attending
Supervisor

Abstract Details
Purpose
To assess clinical and imaging findings in patients with mastoid pathology and associated intracranial complications.

Authors:
U Shafique, T Moritani

Institution:
University of Iowa hospital and clinics, Iowa city, IA

Approach/Methods:
We reviewed clinical features and imaging findings (CT, MRI, diffusion-weighted imaging and ADC map and MRV) of mastoid pathology, and associated intracranial complications based on our institutional experiences and the literature.

Findings/Discussion:
We will discuss the etiology and pathophysiology of mastoid findings and associated intracranial complications. Mastoid pathologies include acute mastoiditis, simple vs coalescent mastoiditis, and latent indolent mastoiditis involving mastoid antrum without evidence of middle ear infection, cholesteatoma, mastoid fractures and fluid collection/hematoma, non-specific mastoid fluid collection and tumor involvement. Associated complications showing in this presentation include acute meningitis/cerebritis/ventriculitis, subperiosteal abscess, Bezold abscess, subdural empyema, brain abscess, cerebral venous sinus thrombosis, acute cerebral or cerebellar infarction, brain contusion, hematoma, pneumocephalus and tumor extension. We will demonstrate anatomy of mastoid antrum, mastoid air cells and middle ear cavity to explain the root of intracranial or extracranial extension.

Summary/Conclusion:
We demonstrate clinical features and imaging findings of CT and MRI/MRV of mastoid pathology and associated intracranial complications and discuss the anatomy, etiology, pathophysiology and the clinical significance.
References:
3. Shah LM1, Khaleel ZL, Harnsberger HR, Wiggins RH. Mastoid findings secondary to posterior fossa
dural venous sinus thrombosis.
(TB_03) Subarachnoid Fat Embolism and Lipoid Meningitis Following Autologous Fat Grafting for Translabyrinthine Resection of Vestibular Schwannoma

Author(s)
Nathan M. Coleman, M.D.
Radiology Resident
Department of Radiology & Imaging Sciences, Indiana University School of Medicine

Role: Author
Nicholas A. Koontz, M.D.
Assistant Professor of Radiology
Department of Radiology & Imaging Sciences, Indiana University School of Medicine

Role: Author
Aminata Traore, M.D.
Neuroradiology Fellow
Department of Radiology & Imaging Sciences, Indiana University School of Medicine

Role: Author
Stephen F. Kralik, M.D.
Assistant Professor of Radiology
Department of Radiology & Imaging Sciences, Indiana University School of Medicine

Role: Author
Kristine M. Mosier, DMD, Ph.D.
Associate Professor of Radiology
Department of Radiology & Imaging Sciences, Indiana University School of Medicine

Abstract Details
Purpose:

The purpose of this exhibit is to report an unusual case of subarachnoid fat embolism and associated lipoid meningitis following translabyrinthine resection of vestibular schwannoma, detailing clinical features and imaging findings.

Description:

Subarachnoid dissemination of fat emboli is a rare complication of autologous fat grafting following neurosurgical intervention, including neurotologic surgery [1, 2]. While this may manifest as an incidental imaging finding without apparent correlating clinical symptoms [1, 2], it can be seen in conjunction with CSF leak and aseptic chemical/lipoid meningitis [1, 3, 4]. Although the incidence of subarachnoid fat emboli
complicating translabyrinthine craniectomy for resection of vestibular schwannoma has previously been thought to be very rare and relegated to case reports [2, 3, 4], a retrospective single institution study found subarachnoid fat microemboli in 85% (n = 22 / 26) of patients post-translabyrinthine vestibular schwannoma resection, suggesting that this may be an under-recognized phenomenon [5].

Case Report:

A 40-year-old man presented with several months of tinnitus and left-sided sensorineural hearing loss. MRI demonstrated an avidly enhancing mass extending from left cerebellopontine angle to internal auditory canal fundus consistent with vestibular schwannoma, for which he underwent uncomplicated translabyrinthine approach resection. The immediate post-operative CT demonstrated an intact fat graft with mild subarachnoid pneumocephalus.

At one month follow-up, the patient reported postauricular fluctuance, severe headache, and subjective fevers. MRI revealed multiple globular foci of T1 signal hyperintensity throughout subarachnoid spaces, specifically involving the bilateral perimesencephalic cisterns, along the cisternal segment and root entry zone of the left trigeminal nerve, and along the tentorial incisura. These showed complete signal loss on fat-saturated sequences, consistent with fat globules. Additionally noted was new mild ventricular dilatation, subtle leptomeningeal enhancement along the midbrain, pons, and cerebellar peduncles, and a new T2 hyperintense collection extending through the fat graft and into the left postauricular neck consistent with pseudomeningocele. He was admitted to the neurosurgery service and underwent shunt placement, after which he experienced rapid improvement in symptoms and was discharged the following day.

Summary:

Subarachnoid fat embolism from necrosis of the free fat graft following translabyrinthine craniectomy is of controversial incidence and variable clinical significance. Radiologists should be aware of this phenomenon and potential complications of chemical/lipoid meningitis, hydrocephalus, and pseudomeningocele, which may require shunt placement for management.

References


4. Hwang PH, Jackler RK. Lipoid meningitis due to aseptic necrosis of a free fat graft placed during neurotologic surgery. Laryngoscope 1996;106:1482-6

Branchio-oto-renal Syndrome: A Case Report

Author(s)
Daniel J. Choe, DO
Radiology Resident, PGY-III
Saint Barnabas Medical Center

Role: Author
Rahul V. Pawar, MD
Attending Neuroradiologist
Saint Barnabas Medical Center

Role: Author
Lyle R. Gesner, MD
Program Director, Section Chief of Neuroradiology
Saint Barnabas Medical Center

Abstract Details
Introduction
We present a case of branchio-oto-renal syndrome (BOR), also known as Melnick–Fraser syndrome, with several characteristic findings on the temporal bone computed tomography (CT). BOR syndrome is one of many syndromes within a spectrum of embryological developmental anomalies, distinguished from branchio-otic (BO) syndrome by the presence of renal anomalies. BOR is a rare autosomal dominant disorder that presents with branchial cysts or fistulae, external ear and middle ear malformations, hearing loss (sensorineural, conductive, or mixed) and renal anomalies which range from mild hypoplasia/dysplasia to complete agenesis (1, 2). Research estimates that BOR/BO syndrome affects approximately 1 in 40,000 people and represents 2% of profoundly deaf children.

Discussion
Our case exhibits the bilateral findings of funnel-shaped configuration of the internal auditory canals (IAC) with expansion of the porus acoustici, vestibular aqueductal dilatation, bulbous appearance of the basal turns of the cochlea, mild truncation of the lateral semicircular canals, deformed and possibly fused ossicular chain, hyperaeration/expansion of the mesotympanum and epitympanum, and high riding right jugular bulbs. Anatomic abnormalities of the middle ear cavity and inner ear anatomy suggests mixed sensorineural and conductive hearing deficits.

Key findings not seen in our case are outlined: Angulated course of the external auditory canal (EAC) with variable asymmetric stenosis/ataresia. Variable underdevelopment of middle ear cavity (MEC), dysmorphic broad incus short process, horizontal orientation long/heighted process, malleus & incus fusion. Tapered basal cochlear turn, horizontal cochlear orientation (coronal), hypoplastic, offset "unwound" middle/apical turns (axial). Globular horizontal semicircular canal (SCC), absent/hypoplastic posterior SCC, dilated/bulbous vestibular aqueduct, flared IAC, widened facial nerve canal, medial facial
nerve deviation (toward the side of the cochlea), anomalous course of the labyrinthine segment, obtuse angle anterior genu, dilated and anomalous eustachian tubes, variable decreased intercarotid distance, and petrous bone angulation. Lacrimal stenosis/aplasia and abnormal palate/mandible can also be seen in these patients.

Several key mutations have been elucidated as possible causes for BOR syndrome, which is known to have high penetrance with variable expression, ranging from mild to lethal presentations. Rare cases of spontaneous mutations have also been reported. Proteins produced from the EYA1 (8q13.3 locus), SIX1, and SIX5 genes (19q13.3 locus) play important roles in embryological development. Research suggests that the protein interactions of these genes are essential for the normal formation of ears, second branchial arch, and kidneys.

Management
High resolution CT with coronal reformatted images are recommended for evaluation of temporal bone anomalies in BOR syndrome. Management involves surgical excision of branchial anomalies, if present, auditory augmentation or reconstructive surgery for patients with microtia or EAC atresia. Patients with significant renal dysfunction may require dialysis or renal transplantation. Reports of cochlear implantation for branchio-oto-renal syndrome are quite rare in the medical literature, but have been performed successfully (3, 4). BOR syndrome can be distinguished from other entities such as bilateral facial microsomia, bilateral mandibular hypoplasia, variable EAC-middle ear malformation, or otofaciocervical syndrome by using renal ultrasound to identify renal anomalies. Renal function should be monitored in these patients as renal failure can develop over time.
Post-Operative Imaging of the Temporal Bone: Mastoidectomy and Beyond

Author(s)
Whitney Feltus
RADIOLOGY RESIDENT PHYSICIAN
NEW YORK PRESBYTERIAN - COLUMBIA

Role: Author
Golub Justin
PHYSICIAN - OTOLOGY/NEUROTOLOGY
NEW YORK PRESBYTERIAN HOSPITAL - COLUMBIA

Role: Author
Gul Moonis, MD
PHYSICIAN - NEURORADIOLOGY
NEW YORK PRESBYTERIAN HOSPITAL - COLUMBIA

Abstract Details
Post-Operative Imaging of the Temporal Bone: Mastoidectomy and Beyond

Background
The temporal bone is one of the most intricate subjects in radiology requiring attention to fine details. The millimeter structures housed within perform important functions for our daily lives. Most notably they package analogue signals for the brain, allowing us to interact with the outside through the sense of hearing. Although these thin structures are vulnerable to destruction, advances in the field of Otology and imaging aid in restorative and/or preventive treatments. Understanding the surgical techniques and materials as well as expectations on pre- and post-operative imaging are important for making the correct diagnosis.

Description
We reviewed several patients with a variety of temporal bone pathologies who underwent surgical intervention and received pre- and/or post-operative imaging.

Educational Goals and Teaching Points
The goal of this educational exhibit is to:
1) Describe the importance of and list common imaging modalities/techniques for post-operative evaluation
2) Review common and uncommon surgical procedures (including temporal bone resection, mastoidectomy tympanoplasty, canalplasty, myringotomy, ossiculoplasty, cochlear implant, stapedectomy and surgery for superior semicircular canal dehiscence)
3) Illustrate expected post-operative appearances and complications

Summary:
There is a wide array of complications and surgical procedures involving the temporal bone. Understanding
the complex anatomy and reviewing cases of common post-operative appearances can help physicians make appropriate diagnoses, and ultimately help provide the gift of normal hearing.
Abstract Details
Purpose:
Hearing loss is a common medical problem effecting nearly two thirds of older adults. While many patients are diagnosed and treated on a clinical basis, a large percentage of patients undergo CT or MRI imaging as part of their work up. Understanding of the causes and imaging features of typical and atypical causes of hearing loss is essential for prompt diagnosis and treatment. Therefore, familiarity with the imaging findings on CT and MRI is crucial for the radiologist. We present a wide spectrum of common and uncommon causes of hearing loss at our institution.
Description:
We will review the anatomy of hearing as well as typical and atypical causes of hearing loss. This pictorial review will be organized on an anatomic basis and will include: brainstem pathology including infarction, hemorrhage, mass lesion and demyelination; cisternal/intracanalicular pathology including schwannoma, meningioma, leptomeningeal carcinomatosis, and dolichoectasia of the vertebral artery compressing the cochlear nerve; middle ear pathology including otomastoiditis, cholesteatoma, and invasive nasopharyngeal carcinoma with obstruction of the Eustachian tube; inner ear pathology including otospongiosis, labyrinthitis ossificans, traumatic etiologies, dehiscence of the superior semicircular canal, and endolymphatic sac tumor.

Summary:
Typical and atypical causes of hearing loss encompass a wide spectrum of pathology, many of which can be suggested or diagnosed base on their radiologic findings. Prompt recognition of imaging features and accurate diagnosis of the causes of hearing loss is essential to guide appropriate patient care and management.
A Rare Presentation of Bilateral Petrous Apex Cephaloceles

Author(s)
Jason DiVito, DO, MBA
PGY-4
Memorial University Medical Center Radiology Department

Role: Author
Andreas Schilling, M.D.
Attending Neuroradiologist
Memorial Health University Medical Center

Abstract Details
The purpose of this case report is to illustrate a specific presentation and clinical manifestations of bilateral petrous apex cephaloceles. Since bilateral petrous apex cephaloceles are such a rare entity that many radiologists do not encounter in their careers, the computed tomographic (CT) and magnetic resonance imaging (MRI) characteristics will be discussed so that these lesions are easily identified. Moreover, the clinical presentation of this case will be reviewed and contrasted to other typical presentations after reviewing the medical literature. In this way, the radiologist can help referring physicians to match the presenting symptoms with the radiographic findings. Furthermore, the unique imaging finding characteristics of this case will be compared and contrasted to other cases in radiology literature to point out subtle differences in how such entities can present.

This project will rely upon utilizing epic electronic medical record to review the presenting symptoms and presentation of the patient and to explore the surgical outcome/treatment. PACS will be used to view all medical imaging and to retrieve all imaging in DICOM format.

The results will show a presentation of rare bilateral petrous apex cephaloceles and how this entity was the cause/initiation of long standing headache and sensineural hearing loss. The work will present possible surgical outcomes and statistics relating to surgical technique and resolution of particular symptoms. CT and MRI presentations will be highlighted in the work so that the imaging findings will be salient and easily recognizable.
Abstract Details
Purpose
Temporomandibular Joint (TMJ) evaluation requires knowledge of the normal anatomy and biomechanics in order to appropriately diagnose pathology that can result in TMJ dysfunction. This exhibit will review the typical MR appearance of the TMJ with an overview of anatomy. Specific cases were selected that highlight common findings that result in TMJ dysfunction. This is important as TMJ dysfunction is a common entity and MR findings help guide invasive and non-invasive treatment.

Approach/Methods
Retrospective review of MR studies with TMJ protocol from the Cleveland Clinic Foundation over the calendar year 2016-present day. Specific cases include a normal TMJ to overview anatomy, with attention to cases that highlight common pathologies, as well as a few rare entities that cause TMJ dysfunction.

Findings/Discussion
MR imaging of the TMJ includes careful evaluation of the anatomy, with relationship to biomechanics, in order to understand the range of pathology that can affect the TMJ. Biomechanical dysfunction can predispose to disk displacement, subsequent DJD or AVN. Retrospective review of cases will be included in the final presentation with representative imaging examples. A normal case will also be included to overview TMJ anatomy.

Our exhibit will conclude with a brief analysis of the studies performed during the 2016 calendar year to the present day from the Cleveland Clinic Foundation. Specifically, with our experience at a tertiary care center, MR evaluation of the TMJ has a high yield, as the majority of patients are evaluated prior to imaging by clinicians who have extensive experience in TMJ diagnosis and treatment.

Summary/Conclusion
MR imaging of the TMJ is becoming more commonplace as more physicians are turning to imaging evaluation for diagnosis. Understanding the normal anatomy of the TMJ, with relationship to biomechanics, is crucial for both diagnosis and treatment purposes. In our experience at a tertiary care center, MR evaluation is extremely high yield when ordering physicians who specialize in both diagnosis
and treatment of TMJ dysfunction is considered.
(TB_09) Malignant otitis externa versus external ear cholesteatoma on CT temporal bone

Author(s)
Geoiphy G. Pulickal, MD, FRCR
Associate Consultant
Alexandra Health, Singapore

Role: Author
Ashish Chawla, MD, ABR
Consultant
Alexandra Health

Abstract Details
Purpose

To review pertinent imaging differences between external auditory canal cholesteatoma (EACC) and malignant otitis externa (MOE).

Description
EACC refers to the abnormal migration of external ear ectoderm it can be seen either spontaneously or in relation to ectoderm insult (trauma or surgery). The congenital form secondary to the presence of ectodermal rests in the external ear is rather rare.

MOE is an aggressive infective/inflammatory process involving the external ear with subsequent involvement of the adjacent soft tissues and skull base.

Both conditions tend to occur in an elderly population with both sets presenting with otorrhea and otalgia. The majority of patients with MOE tend to have underlying diabetes as well. The hallmark of MOE is diffuse florid soft tissue inflammation with underlying bony erosion and even abscess formation.

Treatment focuses on prompt glycemic control and aggressive antibiotic coverage with surgical drainage if indicated. EACC on the other hand usually appears as a focal soft tissue lesion and scalloping of the underlying bone with or without flecks of remnant bone fragments. The treatment pillar of EACC is debridement with surgical excision of the matrix in advanced cases.

Summary

EACC and MOE are two conditions of the external ear which tend to occur in an elderly population. Our pictorial review will highlight the pertinent findings of each condition thus helping the reporting radiologist to guide further management.
Occlusion of the Internal Auditory Canal - A Causative Mechanism for Vestibular Schwannoma induced Hearing Loss

Author(s)
John A. Butman, MD, PhD
Lead Physician, MRI
National Institutes of Health

Abstract Details
Purpose:
To present imaging findings supporting the hypothesis that occlusion of the internal auditory canal (IAC) is the inciting event that alters cochlear fluid homeostasis, first demonstrated by an accumulation of abnormal protein in the inner ear fluids and later manifest as audiovestibular dysfunction e.g. sensorineural hearing loss (SNHL).

Materials & Methods:
MRI findings from neurofibromatosis 2 (NF2) patients enrolled in a natural history study, using high resolution FLAIR imaging to suppress signal from normal endolymph and perilymph to reveal subtle alterations in the protein content of these intralabyrinthine fluids were reviewed.

Results:
Cases with SNHL demonstrated abnormal signal from the labyrinth. Cases with normal intralabyrinthine fluid signal demonstrated normal hearing. Cases with an occluded IAC (no CSF communication from the CPA to the modiolus) typically had an abnormal labyrinth signal. Cases with no occlusion invariably had normal signal.
Particularly instructive were (1) cases of very small tumors with profound SNHL and (2) cases of large tumors with normal hearing. Examples of (1) show that these small tumors were situated at the cribriform plate where the cochlear nerve enters the modiolus. In this location, these tumors are perfectly situated to block the normal circulation between the CSF and the perilymph and, in support of the hypothesis, elevated protein in the cochlea was demonstrated. Examples of (2) revealed that the IAC has remodeled around these large tumors such that a pathway of CSF from the cerebellopontine angle cistern can be demonstrated. In these cases FLAIR signal in the inner ear is normal, and there hearing is normal.

Discussion:
Because vestibular schwannomas are tumors of the vestibular nerve in the IAC, mechanisms postulated for the associated audiovestibular dysfunction focus more on the nerve than on the sensory end organ. However, two common observations cannot be explained by a nerve centered mechanism. First, is the dissociation of SNHL and tumor size. Many patients with small tumors suffer from a profound SNHL, and, conversely, many patients with large tumors have preserved hearing. Second, significant facial nerve dysfunction is almost never found even for large tumors, even though there is no a priori reason why the facial nerve and the cochlear nerve should respond differently to pressure exerted from a mass on the vestibular nerve. These observations suggest that the mechanism of SNHL should be sought elsewhere. The detection of abnormal signal in the labyrinth in all patients with SNHL indicate that labyrinth homeostasis is altered. But if the tumor is not in the labyrinth, what accounts for this biochemical degradation? These observations are accounted for by the proposed mechanism, i.e., (1) tumor growth leads to (2) occlusion of the IAC which results in (3) accumulation of protein in the cochlea (4) which eventually leads to hearing loss.
Conclusions:
Occlusion of the IAC is proposed as the inciting event that leads to audiovestibular dysfunction in NF2 patients with vestibular schwannoma. Hyperintense signal in the labyrinth on FLAIR MRI is a marker which demonstrates the accumulation of intralabyrinthine protein, an intermediate stage in this process.
Spontaneous Otogenic Pneumocephalus presenting with Intraventricular Air

Author(s)
James G. Naples, MD
ENT Resident
UCONN

Role: Author
Kalpana L. Mani, MD, MEd
Neuroradiologist
Jefferson Radiology

Role: Author
Gul Moonis, MD
PHYSICIAN - NEURORADIOLOGY
NEW YORK PRESBYTERIAN HOSPITAL - COLUMBIA

Role: Author
Paul Schwartz, MD PhD
Director, Neurosurgical oncology and skull base surgery
Hartford Hospital

Role: Author
Belachew Tessema, MD
Assistant Clinical Professor
UCONN

Abstract Details
Purpose:

Pneumocephalus from an otogenic source is often caused by surgery, trauma, tumor, or infection, but can also rarely be spontaneous, related to congenital skull base defects in the setting of pressure gradients across the middle ear and intracranial compartment (via a ‘coke bottle’ effect in the setting of low intracranial pressure versus a ‘ball valve’ phenomenon in the setting of high middle ear pressure). Spontaneous otogenic pneumocephalus is generally visualized in the regional extra-axial CSF space, and intraparenchmal air has also been infrequently reported.

Herein we describe a rare case of spontaneous otogenic pneumocephalus presenting initially with only intraventricular air, a phenomenon that to our knowledge has been reported less than 5 times in the literature dating back to 1884. Despite its rarity, this treatable etiology is useful for radiologists and referrers to be aware
of in the differential diagnosis of unexplained pneumocephalus. We review the symptoms, mechanisms, imaging appearances, and treatment of spontaneous otogenic pneumocephalus.

Description:

A 57 year old woman presented with a two month history of worsening neurological symptoms including headache and imbalance, as well as right ear fullness. Initial MR imaging performed for headache demonstrated moderate, intraventricular air (Figure 1A) and a variant right temporal lobe cerebrospinal fluid cleft extending from the extra-axial space adjacent to the inferior temporal gyrus to the ventricular margin of the temporal horn, appearing contiguous with both. Follow up CT temporal bone demonstrated few areas of tegmen tympani and tegmen mastoideum thinning/potential dehiscence without middle ear/mastoid opacification (Figure 1B); CT sinus was negative without anterior skull base dehiscence or adjacent sinonasal opacification. Additional history revealed no recent or remote sinonasal, otologic, intracranial or spinal procedures; no history of skull base neoplastic or inflammatory processes, trauma, nor infectious symptoms. There was, however, a long-standing history of eustachian tube dysfunction, exacerbated in recent months, for which the patient routinely performed valsalva maneuvers.

The patient underwent both neurosurgical and ENT evaluation. The otological exam revealed intact tympanic membranes and no middle ear effusion. An audiogram demonstrated mild, mixed low frequency hearing loss of the right ear with negative pressure on tympanometry.

Follow up non-contrast head CT demonstrated tiny foci of air along the temporal lobe CSF cleft (Figure 1C). Subsequent lateral skull base MRI with thin section heavily T2 weighted (CISS) coronal images demonstrated a tiny inferiorly projecting cephalocele along the lateral tegmen mastoideum (Figure 1D); intraventricular air had resolved (not shown). A pre-operative CTA demonstrated extra-axial air adjacent to the associated tegmen defect (Figure 1E). The patient underwent temporal craniotomy at which time the defect of the tegmen mastoideum and of the adjacent dura were identified and repaired (Figure 1F).

Summary:

Spontaneous otogenic pneumocephalus is a rare condition, resulting from congenital dehiscence of the tegmen tympani or tegmen mastoideum in conjunction with pressure differentials across the defect, which occasionally may present with intraventricular air. The skull base defect can be subtle and identification may require multiple modalities or imaging performed at different time points. Surgical repair is the definitive therapy.
Lateralization of the ICA associated with cochlear carotid dehiscence: three cases.

Author(s)
Julie Guerin, MD
neuroradiology fellow
Mayo Clinic, Rochester, MN

Role: Author
Jack Lane, MD
Neuroradiologist
Mayo Clinic

Abstract Details
Lateralized internal carotid artery (ICA) is a rare petrous ICA variant in which the ICA enters the skull base more posterolateral to the cochlea than normal with protrusion into the anterior mesotympanum. This anomalous course, specifically defined as the ICA genu positioned lateral to the vertical aspect of the bony cochlear labyrinth, leads to a reduction in the normal carotid canal–cochlear interval. Carotid-cochlear dehiscence (CCD) is a rare developmental abnormality previously described independently from an anomalous ICA course. Although CCD may be asymptomatic, common associated symptoms include both sensorineural and conductive hearing loss and pulsatile tinnitus. The purpose of this educational exhibit is to review the imaging findings of these anomalies when seen together, to demonstrate the difference in courses between lateralized and aberrant ICA and to emphasize that appropriate recognition is important for prevention of vascular injury in future surgical interventions.

We feature three patients with both lateralized ICAs and associated frank CCD. The first patient is a 64 year-old woman with a longstanding history of sensorineural hearing loss on the left. Temporal bone CT revealed lateralized left ICA with focal dehiscence with the middle and apical turns of the left cochlea. The second patient, a 63 year-old man, presented with left conductive hearing loss, right sensorineural hearing loss and bilateral tinnitus. Temporal bone CT showed bilateral lateralized ICAs with focal dehiscence of the apical turns of the cochlea. The third patient is a 72 year-old man who was being evaluated for temple and jaw pain and received imaging for possible giant cell arteritis. He was incidentally found to have a lateralized left ICA with focal dehiscence between the carotid canal and the middle turn of the cochlea.

In summary, lateralized ICA is an anomalous ICA course distinct from the more familiar aberrant ICA that predisposes to CCD. In the limited prior reports of CCD, there is no reported association with ICA lateralization. Likewise, prior descriptions of lateralized ICA do not adequately distinguish between thinning and dehiscence of the carotid–cochlear interval. Our case series demonstrates frank carotid-cochlear dehiscence associated with lateralized ICA. Although both sensorineural and conductive hearing loss has been reported, associated conductive loss suggests a possible “third window” effect. Proper recognition of these associated anomalies may have diagnostic implications in patients being evaluated for hearing loss and tinnitus and for prevention of vascular injury during subsequent surgical interventions.
Abstract Details

Tinnitus is a buzzing or ringing sensation in one or both ears without a known external stimulus. Tinnitus is relatively common within the US population and is a common indication for imaging studies. Tinnitus can be divided into pulsatile and non-pulsatile (continuous) tinnitus. Pulsatile tinnitus corresponds with the patient’s heartbeat and often has a specific, identifiable cause when evaluated with imaging.

There are multiple known causes of pulsatile tinnitus which can be broadly divided into neoplastic and vascular etiologies. Neoplastic tumors are typically hypervascular in nature and affect the temporal bone, often a paraganglioma, or the skull base causing arteriovenous shunting. Vascular causes can be further subdivided into arterial, arteriovenous and venous etiologies, which can be congenital or acquired in origin. Arterial etiologies range from internal carotid atherosclerosis, occlusion, dissection, aneurysm, fibromuscular dysplasia to aberrance/lateralization. Dural arteriovenous fistula and carotid-cavernous fistula are the most commonly encountered arteriovenous causes of tinnitus while the vast majority of venous etiologies represent anatomical variations of the basal veins and sinuses, or of the jugular vein such as dehiscence of the jugular bulb, jugular diverticulum or stenosis. Intracranial hypertension and Paget’s disease are rarer known causes of tinnitus.

The purpose of this educational exhibit is to familiarize the radiologist with the spectrum of anatomic variations and pathologies causing pulsatile tinnitus and their appearance on different imaging modalities. Each type of pathology will include discussion, pertinent images and literature references as appropriate. The goal of this educational exhibit is to aid the reader in the awareness, recognition and diagnosis of the various imaging findings that may be seen in a patient with pulsatile tinnitus.
(TB_14) Imaging the TMJ: A systematic approach and pictorial review

Author(s)
Nikhil Madhuripan, MD
Resident
Baystate Medical Center

Role: Author

Shan Li, MD
Staff Neuroradiologist
Baystate Medical Center

Abstract Details
Purpose: The temporomandibular joint is an infrequently imaged joint with a range of pathologies. The infrequent rate at which this study is performed restricts the radiologist from maintaining familiarity with the systematic approach to interpretation and identification of the most frequently seen pathologies. This review aims at providing one such systematic approach along with a pictorial review of the important TMJ pathologies.

Approach: The images used in the review were collected entirely from the Baystate system. MR and CT imaging findings were focused on, being the ideal modes of evaluation. The pathologies reviewed included but were not limited to condyle and meniscal dislocation, meniscal tear, osteomyelitis, neoplasms including benign and malignant such as neurofibroma, plasmablastic lymphoma, adamantinoma, degenerative disease and findings related to trauma. The pitfalls of misinterpreting normal findings were analyzed and reviewed.

Discussion: A systematic approach makes the evaluation of the TMJ easy, quick and straightforward. The topic was divided into. 1. Review of the normal joint anatomy and the normal MR, plain film and CT appearance. 2. Protocols for MR and CT image acquisition. 2. Normal variants mimicking pathology. 3. Common pathologies. 4. Suggested follow up for imaging findings.

Summary: With familiarity to normal imaging findings, this uncommonly encountered imaging study can be tackled with finesse.
Abstract Details
The incidence of sensorineural hearing loss is approximately 1 in 1000. Increased newborn screening and early detection now allow for patients to be imaged earlier in life. In addition, early cochlear implantation has been shown to improve clinical outcome. CT of the temporal bone and MRI of the internal auditory canals are often ordered by Otorhinolaryngologists to identify the etiology of the hearing loss and to define the anatomy for potential cochlear implantation.

The objective of this presentation is to review the causes of congenital sensorineural hearing loss which can be identified by imaging. Although there are several acquired causes of sensorineural hearing loss, an emphasis will be placed on the imaging findings of congenital etiologies. While common causes of sensorineural hearing loss such as enlarged vestibular aqueduct and cochlear nerve deficiency are often easily identified, more subtle findings such as cochlear aperture stenosis, deficiency of the modiolus, enlarged endolymphatic sac, semicircular canal dysplasia and mild cochlear malformations may be overlooked. For optimal evaluation of these subtle inner ear anomalies, the radiologist must have a comprehensive knowledge of inner ear anatomy.

This presentation will include a brief introduction of the pertinent imaging anatomy followed by an organized, anatomic specific, approach to the imaging of the pathology of congenital sensorineural hearing loss. After the completion of this presentation, participants will be familiar with the normal inner ear anatomy and will be equipped with an organized approach to identify the common and uncommon etiologies of congenital sensorineural hearing loss.
Prevalence of internal auditory canal (IAC) diverticulum and its relation to otosclerosis: A single institution experience.

Author(s)
Kaley Pippin, MD
Resident
University of Kansas Medical Center Department of Radiology

Role: Author
John Leever, MD
Neuroradiologist
University of Kansas Medical Center Department of Radiology

Role: Author
Luke Ledbetter, MD
Neuroradiologist
University of Kansas Medical Center Department of Radiology

Abstract Details
Background and Purpose: The presence of focal low attenuation out-pouching or diverticulum at the anterolateral internal auditory canal (IAC) is an uncommon finding on CT imaging of the temporal bone. Previous case reports refer to this lesion as a form of cavitary otosclerosis [1-4] and suggest this appearance is suggestive of severe disease [3]. In our experience, this imaging finding can be present without the clinical diagnosis or additional imaging findings of otosclerosis. The purpose of this study is to establish the prevalence of internal auditory canal (IAC) diverticulum and its association with clinical otosclerosis.

Methods: A single center, retrospective review of temporal bone computed tomography (CT) examinations obtained between January 2013 and January 2016 was performed to determine the prevalence of IAC diverticula. The prevalence of otosclerosis on imaging in this population was also determined in order to evaluate for a correlation between IAC diverticula and otosclerosis. Electronic medical records of all patients were reviewed to obtain demographic information. Additional clinical information and audiology results were reviewed in those patients with IAC diverticula.

Results: Approximately 815 temporal bone CT examinations were performed in the study time period. Of the 391 examinations reviewed to date, IAC diverticula were identified in eight patients (2.0%). Additional imaging and clinical findings of otosclerosis were present in two of eight patients with IAC diverticula (25%). Of the remaining 383 patients without IAC diverticula, 19 patients (5.0%) had additional findings of otosclerosis on imaging.

Conclusions: IAC diverticula are an uncommon finding on temporal bone CT in patients both with and without additional imaging findings of otosclerosis. In our population, IAC diverticula are more common
as an incidental finding and less common with additional findings of otosclerosis. Given the incidental nature of the majority of the IAC diverticula, these lesions may either represent sub-clinical otosclerosis or a rare anatomic variant and are not related to otosclerosis severity. Additional clinical or audiometric examination may be indicated in this population to evaluate for subtle or pre-clincal otosclerosis.

References:
Cochlear implants are surgically-implanted prosthetic devices that electrically stimulate the cochlear nerve to provide hearing. Preoperative evaluation for a cochlear implant includes computed tomography (CT) or magnetic resonance imaging (MRI) of the temporal bone to evaluate the patency of the cochlea, identify congenital malformations, and assess surgical anatomy.

In this exhibit, we show a case based checklist approach to the role of imaging with a special emphasis on surgeon’s perspective. We will also review relevant temporal bone anatomy for cochlear implantation, understand the role of CT and MRI in evaluation of cochlear implantation as well as review expected postsurgical findings and potential complications. A brief overview of surgical approaches for cochlear implantation, available devices and MR scanning in patients with implants will also be discussed.
Pearls, Pointers and Pitfalls in Imaging of the Petrous Apex

Abstract Details

Purpose:
The purpose of this exhibit is to provide a concise description of both common and uncommon pathologic processes involving the petrous apex, emphasizing CT and MR imaging characteristics that can assist the radiologist in creating an appropriate differential diagnosis.

Description:
Pathology involving the petrous apex can present a diagnostic challenge. This is not only due to the diversity of pathologic processes occurring at this location, but also the presence of anatomic variants which can mimic pathology, thereby posing a potential diagnostic pitfall, particularly to the inexperienced radiologist or clinician, which can lead to diagnostic errors and unnecessary patient anxiety.

The initial portion of the exhibit will discuss the anatomy of the petrous apex and its anatomic relationship to important adjacent structures. Understanding this anatomy not only provides a framework for potential pathologic processes, but is essential to correlating imaging findings with clinical presentations, as well as assisting clinicians in determining appropriate management.

The remainder of the exhibit will include a case-based review of petrous apex pathology, including lesions arising directly from the petrous apex such as cholesterol granulomas and cholesteatomas, lesions secondarily involving the petrous apex such as chondrosarcomas and chordomas, as well as important mimics such as asymmetric pneumatization, effusions, and carotid aneurysms. Each case will include pointers and pearls that can assist in determining the appropriate differential diagnosis.

Summary:
Pathologic processes involving the petrous apex can present a diagnostic challenge. Knowledge of the
potential lesions occurring at the petrous apex, as well as knowing the key differentiating imaging features, is critical to formulating an appropriate differential diagnosis. In addition, familiarity of the possible pathologic mimics is critical to avoiding potential diagnostic pitfalls.

This exhibit offers a concise review of petrous apex anatomy and pathology, providing a framework for aiding in both lesion detection and diagnosis.
Abstract Details
Purpose:
Recognition of vascular ear “tumors” on noninvasive imaging is important in order to direct the appropriate diagnostic approach and management. Catastrophic consequences from a diagnostic misstep such as unwarranted biopsy must be averted.

Objective:
This presentation aims to review the noninvasive imaging characteristics of vascular ear masses. Their salient features on invasive imaging including the role of catheter angiography on management approach are also presented (as applicable).

Findings/Discussion:
The differential diagnosis of vascular retrotympanic mass includes glomus tympanicum, hemangioma, aberrant course of the internal carotid artery, and dehiscent jugular bulb. Endolymphatic tumor is an aggressive, locally invasive hypervascular neoplasm associated with von Hippel Lindau syndrome. The role of noninvasive modalities (i.e., CT & MRI) in the diagnosis of each of these conditions is reviewed. Catheter angiography may be utilized to define the vascular supply of endolymphatic sac tumors, and for treatment planning including presurgical embolization.

Summary/Conclusion:
Although rare, vascular masses of the ear must be recognized in order to prevent catastrophe from an unwarranted biopsy.