An Illustrative Review of Parotid Pathology

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Objectives

Following this presentation, one will be able to understand:

• Normal boundaries and associated structures of the parotid glands
• Imaging patterns and appearances of various inflammatory, infectious, obstructive, and autoimmune processes of the parotid glands
• Clinical and multi-modality imaging manifestations of common benign and malignant parotid neoplasms
• Characteristic findings associated with congenital cystic and vascular lesions of the parotid glands

This presentation is best suited for radiologists in training and radiologists seeking a refresher of various parotid pathologies
The Parotid Gland

- Parotid gland is the largest salivary gland
- It has the highest incidence of pathology among the major salivary glands
  - Benign processes far outweigh malignant processes in terms of incidence
- Imaging is useful in:
  - Determining the morphology of parotid lesions and potential etiologies
  - Surgical planning for resection
  - Evaluating extent of malignant spread, if present
Boundaries of Parotid Gland

- Posterolateral to masseter muscle & mandible
- Anterior to mastoid process
- Medial margin extends thru stylomandibular tunnel with deepest portion positioned in the prestyloid compartment
- Surrounded by superficial layer of the deep cervical fascia

T1 Axial image highlighting the parotid gland (*) and its boundaries
Parotid Gland Anatomy

Associated Structures

• Parotid (Stenson’s) Duct
  – Arises anteriorly from the parotid gland
  – Parallel course to masseter before turning medially
to pierce buccinator & oral mucosa at level of the
  2\textsuperscript{nd} molar

• Facial vein
  – Divides parotid gland into superficial and deep
    lobes

• Facial Nerve
  – Often difficult to visualize extracranial segments
  – Exits styloid foramen lateral to styloid process and
    posterior belly of the digastric muscle
  – Pierces posterior aspect of parotid gland
  – 5 branches arise while traversing parotid gland

T1 & T2 axial images of parotid gland highlighting associated structures
Pathology of the Parotid

Parotitis
- Infectious
- Sialolithiasis/Obstructive
- Autoimmune

AIDS-related parotid lesions
- Benign lymphoepithelial lesions (BLELs)

Tumors
- Benign
- Malignant

Congenital lesions
- First Brachial Cleft Cyst
- Venolympathic Malformation

Axial contrast enhanced CT MIP showing a large left parotid mass
Parotitis

• Refers to Inflammation of parotid gland caused by:
  – Viral or bacterial infection
    • May be acute or chronic
  – Ductal obstruction
    • Obstructing mass (e.g. sialolithiasis)
    • Scarring of the parotid duct
  – Autoimmune diseases
    • Sjögren Disease, Lymphoepithelial lesions (LELs)
• May be acute or chronic
  – Chronic inflammation leads to glandular fibrosis & atrophy

Axial contrast enhanced CT showing an enlarged left parotid gland with surrounding inflammation
Infectious Parotitis

**Imaging**
- CT, MRI and Ultrasound show similar features:
  - Enlargement of gland
  - Hyperemia/enhancement
  - Surrounding inflammation
- Viral causes have a predilection for bilateral involvement
- Bacterial etiologies typically unilateral & more likely to have surrounding inflammation with suppurative lymph nodes

Coronal & axial contrast enhanced CT images showing an enlarged, hyperenhancing left parotid gland and suppurative adenopathy
Sialolithiasis

Background

• Refers to calcification within a salivary duct
• More common in submandibular duct, but also affects the parotid duct
• May form anywhere along the duct or within the parotid gland
• When large enough, the calcification can obstruct the duct and result in inflammation
Parotid Sialolithiasis

**Imaging**

- Calcification along course of parotid duct best seen on CT
  - May also be seen on ultrasound
- With obstruction, often see:
  - Dilatation of parotid duct proximal to stone
  - Inflammation, enlargement, & hyperenhancement of gland
- MRI valuable for determining if the obstruction is acute or chronic
  - Acute: Increased T2 signal due to inflammation
  - Chronic: Increased T1 due to fatty glandular atrophy

Axial CT image showing a calcified stone within the proximal aspect of the parotid duct
Grayscale sonographic image of same patient with a dilated parotid duct & heterogeneous echotexture within the parotid gland tissue
Parotid Sialolithiasis

Imaging: MRI

With permissions: O’Brien WT. Top 3 Differentials in Neuroradiology. Thieme, 2015

T2 and enhanced T1 fat sat images show enlargement, increased T2 signal & enhancement of the right parotid gland, as well as dilatation and inflammation along Stenson’s duct; a T2 hypointense obstructing stone is seen within the distal duct
Sjögren Syndrome

**Background**
- Autoimmune disease with cell-mediated destruction of salivary & lacrimal glands
- Results in xerostomia & keratoconjunctivitis sicca
- Anti-Ro and Anti-La antibodies
- Chronic lymphocytic inflammation increases risk for non-Hodgkin lymphoma

**Pathologic Findings**
- Infiltrative lymphoid tissue
- Interfollicular plasmacytosis
- Interstitial fibrosis and acinar atrophy

H&E stain showing infiltration of lymphocytes which appear to be destroying salivary gland acini while sparing the ductal epithelium
Sjögren Syndrome

Imaging

- Early appearance shows diffuse small parotid cysts
- Subsequently, solid intraparotid lesions develop alongside cysts
- End stage disease shows glandular atrophy with fatty replacement and/or fibrosis
- Findings best visualized on MRI
  - T2 hyperintense cysts
  - Eventual decreased T1 & T2 signal due to fibrosis

Axial & coronal T2 fat-sat images showing innumerable bilateral T2 hyperintense parotid cysts in a patient with Sjögren syndrome
AIDS-related Parotid Lesions

Background
- Benign lymphoepithelial lesions (BLELs) occur in ~5% of AIDS patients
- Results from lymphoid hyperplasia

Pathologic findings
- See lymphoid hyperplasia, cysts, & intraparotid ductal dilatation

Imaging
- Bilateral mixed cystic and solid parotid lesions of varying sizes
- Cervical adenopathy commonly seen
- Prominent adenoidal tissue (common in AIDS)

Coronal contrast enhanced CT and T1 MR images highlighting numerous hypodense (CT) and T1 hypointense (MR) cysts involving both glands, representing lymphoepithelial lesions

Courtesy of Richard Latchaw, M.D.
Common Parotid Tumors

Benign
• Pleomorphic Adenoma
• Warthin Tumor

Malignant
• Mucoepidermoid Carcinoma
• Adenoid Cystic Carcinoma
• Lymphoma
Parotid Tumors

- 85% of salivary gland neoplasms occur in the parotid glands
- 80% are benign, 20% malignant
- Clinical presentation typically not useful in distinguishing between benign & malignant disease
Pleomorphic Adenoma

**Background**
- Also known as benign mixed tumor
- Most common parotid neoplasm (80%)
- Typically presents between 40 and 60 years of age as a painless palpable mass
- Most often located within the superficial lobe, but may involve the deep lobe as well
- Can occasionally degenerate into carcinoma

**Pathologic findings**
- Biphasic epithelial & mesenchymal cells
- Epithelial cells may be spindled or rounded
- Stroma is usually myxoid or chondroid

H&E stain showing a well circumscribed biphasic nodule with a mixture of bland round epithelial cells, spindled myoepithelial cells and a background of myxoid stroma
Pleomorphic Adenoma

Imaging

- **US**
  - Hypoechoic ovoid or lobular lesion
  - +/- posterior acoustic enhancement

- **CT**
  - Solid ovoid mass with homogeneous & often delayed enhancement

- **MRI**
  - T1 hypointense ovoid mass
  - T2 hyperintense
  - Homogenous enhancement

Axial & coronal contrast enhanced CT images of a pleomorphic adenoma showing an **ovoid enhancing mass** in the superficial right parotid lobe.
Axial MR imaging showing an intraparotid mass that is T2 hyperintense, T1 hypointense, and enhances following contrast administration.
Warthin Tumor

Background
- Benign parotid tumor
- Also referred to as papillary cystadenoma lymphomatosum
- 2nd most common salivary gland tumor
- Typically diagnosed between 60 and 70 years of age
- Strong association with smoking
- Slow painless growth, typically in the tail of the parotid

Pathologic Findings
- Double layer of epithelial cells overlying lymphoid stroma
- May develop papillary projections or fluid-filled cysts

H&E stain with low and high power microscopy. This encapsulated lesion is composed of oncocytic cells with trademark “double layers”. The stroma consists of lymphocytes with germinal centers. Small cysts are present.
### Warthin Tumor

#### Imaging

- **Ultrasound:**
  - Ovoid mass with hypoechoic solid component & hypo- to anechoic cystic components
  - Solid components often demonstrate internal vascular flow

- **CT:**
  - Ovoid cystic & solid mass with mild enhancement of solid components

- **MRI:**
  - Solid portion of mass is T1 hypointense
  - Cystic component often T2 hyperintense but variable based on proteinaceous content
  - Minimal-mild enhancement

Grayscale sonographic images showing an ovoid/lobular anechoic lesion with a hypoechoic soft tissue component peripherally
Warthin Tumor

Axial enhanced MIP & coronal CT images showing a cystic and solid mass within a fatty parotid gland
Mucoepidermoid Carcinoma

Background

- Most common salivary gland malignancy
- Typically diagnosed between 30 and 60 years of age
- Slight female predominance
- Patients usually present with a painless and palpable mass
- High-grade lesions may present with pain associated with extraglandular spread, perineural invasion, or intracranial extension

Pathologic Findings

- Clustered cords of squamous, mucous, or intermediate cells
- Occasional sebaceous or goblet type cells
  - Inflammatory reaction to mucin or keratin

H&E stain show a macro and microcystic mass with goblet cells, mucin pools, and bland intermediate cells
Mucoepidermoid Carcinoma

**Imaging**
- Solid mass with varying degree of cystic change, if present
- May have circumscribed or irregular (high grade) borders
- Ultrasound:
  - Heterogeneously hypoechoic
- CT
  - Hyperdense with enhancement of solid components
- MRI
  - T1 hypointense and T2 intermediate to hyperintense
  - Enhancement of solid components

Enhanced CT images showing a lobular, peripherally enhancing mass within the superficial left parotid lobe
Mucoepidermoid Carcinoma

Imaging: MRI

• High grade mucoepidermoid carcinoma

Axial T1 and coronal T2 fat sat images demonstrate a superficial parotid mass with irregular borders & increased T2 signal intensity
Adenoid Cystic Carcinoma

Background
- 2nd most common primary parotid malignancy
- Peak incidence between 40 and 60 years of age
- High risk for perineural invasion
  - Symptoms of facial pain or facial nerve paralysis

Pathologic Findings
- Cribriform, solid, or tubular pattern
- Small bland myoepithelial cells with scant cytoplasm & dark compact angular nuclei
- PAS+ excess basement membrane material & mucin
- Peripheral perineural invasion

H&E Stain showing a proliferation of bland myoepithelial cells forming the classic cribriform (or “punched-out” cyst-like) ductal structures which are filled with mucoid material.
Adenoid Cystic Carcinoma

 Imaging

• Often has irregular margins

• US
  – Hypoechoic mass
  – +/- posterior acoustic enhancement

• CT
  – Homogeneously enhancing parotid mass
  – May have smooth or irregular borders

• MRI
  – Low signal on T1
  – Moderate T2 hyperintensity
  – Homogeneous enhancement

Contrast enhanced T1 weighted images show an irregularly marginated & diffusely enhancing mass involving the superficial and deep parotid lobes

US imaging showing a hypoechoic parotid mass with angulated margins
Parotid Lymphoma

Background

• Malignant lymphomatous involvement of parotid gland
  – Non-Hodgkin lymphoma, or less commonly:
    – Primary parenchymal type (MALT)
• Risk factors
  – Immunodeficiency
  – Autoimmune diseases, including Sjögren syndrome
  – Prior radiation treatment

Pathologic findings

• Microscopic features vary depending on lymphoma subtype, but are morphologically and immunophenotypically similar to the nodal counterparts
• Depending on the subtype, microscopy shows proliferation of small mature or larger immature cells

H&E stain showing an intraparotid lymph node with proliferation of small mature lymphocytes with effacement of the normal lymph node architecture. Lesional cells demonstrated an immunoprofile compatible with chronic lymphocytic lymphoma.
Parotid Lymphoma

**Imaging**

- May be solitary, multiple, unilateral, bilateral, or diffuse
- Often see associated cervical adenopathy
- Ultrasound
  - Hypoechoic mass(es)
  - +/- Hypervascularity on color Doppler
- CT
  - If nodal type, nodes will be discrete masses with moderate enhancement
  - If parenchymal, will see ill-defined infiltrative solid mass
- MRI
  - Intermediate signal on T1 & variable but often intermediate to low signal on T2 with moderate enhancement

Axial enhanced CT images showing a large mass infiltrating the right parotid gland with associated conglomerate cervical adenopathy
Developmental Lesions -
First Branchial Cleft Cyst

Background

• Results from abnormal closure of developmental branchial cleft

• First branchial cleft cysts:
  – Second most common branchial cleft anomaly after the far more common 2nd branchial cleft cyst
  – Occur anywhere from the external auditory canal to the angle of the mandible
    • Commonly located within the parotid gland
  – May have a draining sinus tract to the external or middle ear

• Risk of:
  – Superinfection
  – Mass effect on adjacent structures
First Branchial Cleft Cyst

**Imaging**
- Oval, round, or lobulated cystic mass
- **US:**
  - Anechoic to hypoechoic
  - Posterior acoustic enhancement
- **CT:**
  - Simple fluid density
  - Thin wall
- **MRI:**
  - High T2 signal intensity
  - Variable T1 signal based on protein content
- No enhancement unless superinfected; then may see peripheral and surrounding inflammatory enhancement

Axial contrast enhanced CT image showing a hypodense, nonenhancing cystic mass within the left parotid gland
Venolymphatic Malformation

Background
• Spectrum of venous & lymphatic developmental abnormalities
• Lesions often cross fascial planes to involve multiple spaces of the neck

Imaging
• Venous malformations avidly enhance
  – May contain flow voids
  – Presence of phlebolith is considered pathognomonic
• Lymphatic malformations may be unilocular or multilocular
  – Fluid-fluid levels, due to hemorrhage, are characteristic
  – Peripheral & septal enhancement more pronounced with superimposed infection
• Many cases demonstrate characteristics of both

Axial T2 fat sat image showing a multi-loculated cystic mass on the right involving multiple spaces of the neck, including the parotid space; fluid-fluid levels with different signal intensities are consistent with intralesional hemorrhage.
Summary

• A variety of pathologic processes affect the parotid glands
• Common congenital lesions include a Type 1 branchial cleft cyst and venolymphatic malformation
  – Congenital lesions may be complicated by infection of hemorrhage
• Inflammatory parotitis may result from an infectious process, autoimmune disorder, or ductal obstruction
  – Viral parotitis and Sjögren are typically bilateral processes
  – Bacterial parotitis and ductal obstruction are typically unilateral
• Benign lymphoepithelial lesions are not uncommon in AIDS patients
  – Often see associated adenopathy and prominent adenoidal soft tissue
• The majority of parotid neoplasms are benign with pleomorphic adenoma being the most common
  – Irregular margins suggest malignancy over a benign lesion
• It is essential to have a working knowledge of the imaging manifestations of parotid lesions, as imaging plays a key role in work-up and management
References

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