ANATOMY OF HEAD AND NECK INFECTIONS

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Infections are one of the most commonly occurring head and neck pathologies
Spread of infection can be predicted by anatomic boundaries
Mortality from head and neck infections has decreased significantly since the advent of antibiotics, but resistant organisms are spreading into the community
Diagnosis and treatment will not be focus of this discussion
Spaces in the head and neck

- Sinuses
- Orbits
- Peritonsillar
- Parapharyngeal
- Submandibular
- Retropharyngeal
- Danger Space
- Prevertebral
- Masticator
- Ear
Sinuses
**Nasal Borders**

- Medially - the nasal septum (perpendicular plate of the ethmoid bone, the vomer bone, and the septal cartilage)
- Laterally - the nasal conchae; superior and middle (ethmoid bone derivation), inferior (a bone itself), and contributions from the lacrimal bone, the perpendicular plate of the palatine bone, and the maxillary bone
- Inferiorly - the horizontal plate of the maxillary bone (anterior two thirds of the hard palate) and the horizontal plate of the palatine bone (posterior third of the hard palate)
- Superiorly - the cribiform plate of the ethmoid bone (where the nerve endings of the Olfactory Nerve (CN1) open to the environment)
- Posterior - none, the nasal cavity opens to the nasopharynx via the choanae
**Sinus Drainage Patterns**

- **Maxillary Sinus** - The largest sinus, is found lateral and inferior to the lateral nasal wall below the orbit. This sinus drains, superiorly, to the middle meatus just below the ethmoidal bulla.

- **Sphenoidal Sinus** - This sinus is located in the posterior wall of the nasal cavity and opens to the sphenoethmoidal recess which is superior to the superior concha. Superior to this sinus is the pituitary gland (hypophysis) in the sella turcica of the sphenoid bone.

- **Frontal Sinus** - The frontal sinuses are located in the frontal bone of the cranium and extend across the forehead. These sinuses drain down to the middle meatus via the frontonasal duct into the anterior portion of the semilunar hiatus.

- **Ethmoidal Sinus** - These sinuses resemble bubbles and are located behind the superior lateral nasal wall. They are divided into anterior, middle and posterior cells on the basis of their drainage. The anterior cells drain to the middle meatus in the posterior portion of the semilunar hiatus. The middle sinuses empty to the center of the ethmoidal bulla. The posterior sinuses empty to the superior meatus.
SINUSITIS

A complex disease process resulting in blockage of sinus drainage and accumulation of fluid leading to bacterial overgrowth. May be treated medically or surgically, with the goal of surgery to alleviate anatomic obstructions.
ORBITS: CHANDLER CLASSIFICATION

1. Periorbital (Preseptal) Cellulitis: eyelid edema, erythema, tenderness; no vision changes, chemosis, proptosis, or restriction of ocular muscles

2. Orbital Cellulitis: proptosis, chemosis, may cause vision changes (anterior pupillary defect), may limit extraocular muscles

3. Subperiosteal Abscess: collection of pus between bone and periosteum, chemosis, may have proptosis, restrict extraocular motion, and affect vision, requires urgent surgical decompression

4. Orbital Abscess: collection of pus in orbital soft tissue, proptosis, chemosis, restricted extraocular motion, may have no light perception (may be reversible), requires urgent surgical decompression

5. Cavernous Sinus Thrombosis: Pathophysiology: perinasal sinus infection ➔ orbital extension ➔ mural thrombus forms in vessel wall (thrombophlebitis) ➔ propagates distally as clot softens and begins to seed
   • Pathogens: *S. aureus*, hemolytic *Streptococcus* and *Pneumococcus*
   • SSx: “picket fence” spiking fevers, toxemia, papilledema, paralysis of extraocular muscles (CN III, IV, and V), proptosis, chemosis, eyelid edema
Orbital Cellulitis
NOTES: The cavernous sinuses are paired, venous structures located on either side of the sella turcica. They receive venous tributaries from the superior and inferior orbital veins and drain into the superior and inferior petrosal sinuses. The cavernous sinus contains the carotid artery, its sympathetic plexus, and the oculomotor nerves (third, fourth, and sixth cranial nerves). In addition, the ophthalmic branch and occasionally the maxillary branch of the fifth nerve traverse the cavernous sinus. The nerves pass through the wall of the sinus while the carotid artery passes through the sinus itself.
Peritonsillar Space

The peritonsillar space consists of loose connective tissue between the capsule of the palatine tonsil and the superior constrictor muscle. The anterior and posterior tonsillar pillars contribute to its anterior and posterior borders, respectively. The posterior tongue forms the inferior boundary. Peritonsillar infections may readily spread to the parapharyngeal space.
Horizontal section below lingula of mandible (superior view) demonstrating bed of parotid gland

- Orbicularis oris muscle
- Buccinator muscle
- Buccopharyngeal fascia
- Facial artery and vein
- Pterygomandibular raphe
- Lingual nerve and superior pharyngeal constrictor muscle
- Masseter muscle
- Palatoglossus muscle in palatoglossal arch
- Palatine tonsil
- Palatopharyngeus muscle in palatopharyngeal arch
- Ramus of mandible
- Inferior alveolar artery, vein and nerve
- Medial pterygoid muscle
- Styloglossus muscle
- Facial nerve
- Retromandibular vein
- External carotid artery
- Parotid gland
- Stylopharyngeus muscle
- Stylohyoid muscle
- Sternocleidomastoid muscle
- Digastric muscle (posterior belly)
- Internal jugular vein, internal carotid artery and nerves IX, X and XII in carotid sheath
- Superior cervical sympathetic ganglion
- Axis (C2)
- Longus capitis muscle
- Prevertebral fascia
- Buccopharyngeal fascia and retropharyngeal space
Deep Spaces

NOTES: Supra hyoid section flattened. Note the parotid, submandibular and sublingual glands, the mylohyoid, carotid sheath.
Parapharyngeal Space

- Other names: lateral pharyngeal or pharyngomaxillary space
- Shape: inverted pyramid
- Boundaries:
  - Superior: skull base
  - Inferior: junction of the posterior belly of the digastric muscle and greater cornu of the hyoid bone
  - Anterior: pterygomandibular raphe and medial pterygoid muscle bound the space
  - Posterior: prevertebral fascia
  - Medial: superior constrictor, tensor, and levator veli palatini muscles
  - Lateral: parotid gland, mandible, and lateral pterygoid muscle

- Compartments:
  - Prestyloid (anterior): contains fat, styloglossus and stylopharyngeus, lymph nodes, deep lobe of the parotid, internal maxillary artery, inferior alveolar, lingual, and auriculotemporal nerves
  - Poststyloid (posterior): contains carotid artery, internal jugular vein, sympathetic chain, and cranial nerves IX, X, XI, and XII.

- Connections to other deep spaces:
  - posteromedially: retropharyngeal space
  - inferiorly: submandibular space
  - laterally: masticator space
  - medially: peritonsillar space
PARAPHARYNGEAL SPACE

- lateral pharyngeal space
- space of the body of the mandible
- temporo-mandibular recess
- masticator space
- submaxillary space

a- temporalis muscle
b- zygomatic arch
c- masseter muscle
d- ramus of the mandible
e- medial pterygoid muscle
f- superior constrictor
g- middle constrictor
h- inferior constrictor
i- submandibular gland
Parapharyngeal Space

- Parotid gland
- Lateral pharyngeal space
- Pterygoid muscle
- Mandible
- Masseter muscle
- Buccinator muscle
- Prevertebral space
- Retropharyngeal space
- Superior constrictor muscle
**Submandibular Space**

- **Boundaries:**
  - Superior: mucosa of the floor of the mouth
  - Inferior: digastrics muscle and hyoid bone
  - Anterior: mylohyoid muscle and anterior belly of digastrics
  - Posterior: posterior belly of the digastric and stylomandibular ligament
  - Medial: hyoglossus, mylohyoid, styloglossus, genioglossus, and geniohyoid muscles
  - Lateral: platysma and mandible

- **The mylohyoid muscle** divides the submandibular space into a superior sublingual space and an inferior submaxillary space (also referred to as the submandibular space).
  - Sublingual space: lateral to the geniohyoid and genioglossus muscles,
    - Contains: sublingual gland and Wharton’s duct.
    - Teeth apices anterior to the second molar lie superior to the mylohyoid line and thus involve the sublingual space.
  - Submaxillary space
    - Contains submandibular glands and lymph nodes.
    - Infections of the second and third molars initially involve the submandibular or parapharyngeal space, because their roots extend below the mylohyoid line.
LUDWIG’S ANGINA

Sublingual space

Submaxillary space
Retropharyngeal Space

- Potential space
- Boundaries:
  - Upper: skull base
  - Lower: mediastinum at the tracheal bifurcation
  - Anterior: buccopharyngeal fascia, lining of the posterior pharynx and esophagus
  - Posterior: alar fascia
- Contains: lymph node and connective tissue
- Routes of entry: direct spread from the parapharyngeal space, or lymphatic spread from the paranasal sinuses or nasopharyngeal region
Submandibular space

- submental space
- submaxillary space
- sublingual space
- lateral pharyngeal space
- retropharyngeal space
- danger space

- masticator space
a- ramus of the mandible
b- masseter muscle
c- medial pterygoid muscle
d- alar fascia

- infection pathway
Danger, Will Robinson!
Danger Space

- Potential Space, dangerous for rapid inferior spread of infection to the posterior mediastinum through its loose areolar tissue

- Boundaries
  - Superior: skull base
  - Inferior: diaphragm
  - Anterior: alar fascia, retropharyngeal space
  - Posterior: prevertebral fascia
  - Lateral: transverse processes of vertebrae

- Contains: sympathetic trunk

- Routes of entry: retropharyngeal, parapharyngeal, or prevertebral spaces
DANGER SPACE

- suprasternal space
- pretracheal space
- retrovisceral and retropharyngeal spaces
  a. retropharyngeal space
  b. retrovisceral space
- danger space
- prevertebral space
Prevertebral Space

- Potential space
- Boundaries
  - Superior: clivus of the skull base
  - Inferior: coccyx
  - Anterior: prevertebral fascia
  - Posterior: vertebral bodies
  - Lateral: transverse processes
- Contains: paraspinous, prevertebral, and scalene muscles, vertebral artery and vein, brachial plexus, and phrenic nerve
- Routes of entry: infection of the vertebral bodies and penetrating injuries
Masticator Space

- **Boundaries:**
  - Superior: skull base
  - Inferior: submandibular space
  - Lateral: masseter, superficial temporal fascia
  - Medial: medial pterygoid, parapharyngeal space
  - Anterior: posterior wall of maxillary sinus, buccal space
  - Posterior: parotid

- Contains: mandible and muscles of mastication (masseter, temporalis, medial pterygoid, lateral pterygoid), the third portion of the trigeminal nerve, which enters through the foramen ovale, the internal maxillary artery, and much of the buccal fat pad

- **Subspaces:**
  - Masseteric: between the masseter muscle and ramus of mandible
  - Pterygoid: between the pterygoid muscles and ramus
  - Superficial temporal: superficial temporal fascia and temporalis muscle
  - Deep temporal: between the deep temporal fascia and temporal bone

- **Route of entry:** most commonly from the third mandibular molars
Masticator Space

Graphic representation (axial view) of structures of the left masticator space: (1) masseter muscle; (2) medial pterygoid muscle; (3) lateral pterygoid muscle; (4) temporalis muscle; (5) pterygopalatine fossa; and (6) sphenopalatine foramen.
Masticator Space with Subspaces
**EAR**

- Necrotizing otitis externa is an aggressive and potentially fatal infection originating in the external canal, with progressive spread along the soft tissues and bone of the skull base, ultimately involving intracranial structures.

- Posterior spread (usually of *P. aeruginosa*) leads to clouding of the mastoid air cells. With medial spread, displacement and erosion of ossicles occur, while anterior spread may produce temporomandibular joint arthritis and mandibular condyle osteomyelitis. Intracranial spread may result in meningitis, brain abscess or cavernous sinus thrombosis.
Necrotizing Otitis Externa

Showing invasion into parapharyngeal space
CONCLUSION

- Understanding anatomical boundaries can help clinicians manage head and neck infections by predicting their spread

- Mortality has decreased significantly in the postantibiotic era
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