Introduction:

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.

The spaces in the head and neck that will be discussed are: Sinuses, Orbits, Peritonsillar, Parapharyngeal, Submandibular, Retropharyngeal, Danger Space, Prevertebral, Masticator, Ear.

Sinuses:

First the 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 sphenethmoidal 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 friontonasal 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:**

This is a complex disease process resulting in blockage of sinus drainage and accumulation of fluid leading to bacterial overgrowth. It may be treated medically or surgically, with the goal of surgery to alleviate anatomic obstructions.

**Orbits: The Chandler Classification**

- Periorbital (Preseptal) Cellulitis: eyelid edema, erythema, tenderness; no vision changes, chemosis, proptosis, or restriction of ocular muscles
- Orbital Cellulitis: proptosis, chemosis, may cause vision changes (anterior pupillary defect), may limit extraocular muscles
- Subperiosteal Abscess: collection of pus between bone and periosteum, chemosis, may have proptosis, restrict extraocular motion, and affect vision, requires urgent surgical decompression
- 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
- 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 VI), proptosis, chemosis, eyelid edema

A word about the cavernous sinus: 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.

Parapharyngeal space

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

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 (for clarity, this is also referred to as the submandibular space).

**Sublingual space:** lateral to the geniohyoid and genioglossus muscles, contains the 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.

**Retropharyngeal space**
- Potential space
- Boundaries:
  - Upper: skull base
  - Lower: mediastinum at the tracheal bifurcation
  - Anterior: buccopharyngeal fascia
  - 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

**Danger Space**
- Potential Space, named for the potential 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

**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, it contains the 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

Ear

Malignant 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. It is also (more accurately) known as necrotizing otitis externa.

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

Conclusion:

Understanding anatomical boundaries can help clinicians manage head and neck infections by predicting their spread. Mortality has decreased significantly in the postantibiotic era, but resistant organisms are spreading.
DR. PINE'S DISCUSSION OF Dr. NATILI'S GRAND ROUNDS 2011/11/30

The peritonsillar one is a great example where I bet a bunch of them probably would get better medically, but since we're there ready to open them up and that's not such a good example in an adult where you can do something there right in the ER but in a kid its potentially a big deal because it means bringing someone to the operating room when you might get away with antibiotics, so I'm always looking for things you can point to and say, well, look, it's less than one centimeter and so statistically we're going to win with a trial of antibiotics and let's try that first versus just saying, "Look, there's an abscess there that could be drained."

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