Paranasal Sinuses: Anatomy and Function

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Case Report—1000B.C.
Sinus Anatomy Overview

- 7 bones
- 4 paired sinuses
- 4 turbinates
- 3 meati
- Drainage system
- Nervous supply
- Vascular supply
- Related structures
Embryology

Maxilloturbinal
Ethmoturbinal
  Middle turbinate
  Superior turbinate
  Supreme turbinate
Agger nasi
Uncinate process
Ethmoid infundibulum
Sinuses
  Maxillary
  Ethmoid
Sinus Development
Pediatric Sinuses
Bony Structure

Ethmoid
Maxilla
Palatine
Lacrimal
Pterygoid plate of
Sphenoid
Nasal
Inferior Turbinate
Arterial Supply

External Carotid
Maxillary A.
Sphenopalatine
Internal Carotid
Ophthalmic A.
Ant. Ethmoid
Post. Ethmoid
Supraorbital
Supratrochlear
Innervation
Neurovascular Supply
Sinus Drainage Schema

Drainage From:
1. Frontal Sinus
2. Anterior Cells
3. Nasolacrimal
4. Middle Cells
5. Maxillary Sinus
6. Posterior Cells
7. Sphenoid Sinus
Ethmoid Sinus

- Development
  - Present at birth
  - Anterior/Posterior
  - Variability

- Structure
  - Volume/shape
  - Roof
  - Lateral wall
Ethmoid Roof

- Anterior 2/3
- Posterior 1/3
- Keros I
- Keros II
- Keros III
Ethmoid Cells

Supraorbital, Frontal Bulla, Concha Bullosa, Haller’s, Onodi Cells
Ethmoid Sinus—Related Structures

- Basal Lamella of the Middle Turbinate
  - Three planes
- Agger nasi cell
  - Childhood sinus
- Ethmoid Bulla
  - Hiatus Semiluninaris/Superior Hiatus Semilunaris
  - Suprabullar/retrobullar recesses (Sinus Lateralis)
- Ethmoid Infundibulum/Uncinate Process
- Anterior/Posterior Ethmoid Arteries
- Osteomeatal complex
Basal/Ground Lamella Of the Middle Turbinate
The Agger Nasi Cell
Ethmoid Bulla
Uncinate Process
Hiatus Semilunaris
Ethmoid Infundibulum
Suprabullar/Retrobullar Recess

Ground lamella

Hiatus semilunaris superior

Probe in ostium bet. BE & sinus lateralis
Ethmoid Arteries
Osteomeatal Complex

Middle meatus
Maxillary Sinus Ostium
Anterior Ethmoid
Drainage
Maxillary Sinus

Development
- Present at birth
- Biphasic growth
- Level of the floor

Structure
- Volume & shape
- Walls, floor, roof
Maxillary Sinus
Maxillary Sinus
Maxillary Sinus

Related Structures

- Fontanelles
- Natural ostium
  - Haller’s Cells & Sinusitis
  - Osteomeatal complex
- Accessory Ostium
- Nasolacrimal duct
Fontanelles
Natural Ostium
-Haller’s cells
Accessory Ostium
Nasolacrimal Duct
Frontal Sinus

- **Development**
  - Frontal bone at birth
  - Age 5

- **Structure**
  - Volume and shape
  - Ostium
  - Walls
    - Anterior vs. posterior

- **Related Structures**
  - Frontal recess
Frontal Sinus

Ostium
Frontal recess
Boundaries
Dumbbell shape
Sinus Lateralis
Frontal Bulla
Sphenoidal Sinus

Development
Arise within the nasal capsule (no pouch)
Age 3 begins to pneumatize

Structure
- Volume/variable pneumatization
- Wall thickness
- Position within the sphenoid
  - Relation to sella turcica
  - Sellar and postsellar relationships
Sphenoid Sinus Pneumatization

**Conchal**
- 0%—Lang
- 5%—Congdon

**Presellar**
- 23.8%—Lang
- 28.0%—Congdon

**Sellar (including “postsellar”)**
- 76.2%—Lang
- 67.0%—Congdon
Sphenoid Sinus
Sphenoid Sinus
Sphenoid Sinus

Ostium
- Size (.5-4mm)
- Location (sinus floor, anterior nasal floor, anterior sinus wall, superior turbinate, cribiform plate)
- Bony dehiscence

Related Structures
- Sphenoethmoidal recess
- Sphenoid rostrum
- Onodi cell
Sphenoid Ostium
Sphenoethmoid Recess
Sphenoid Rostrum
The Onodi Cell
Microscopic Anatomy

- Mucosa
  - Ciliated columnar epithelial cells
    - Anatomy
    - Beat frequency
    - Inhibitory effects of contact
  - Nonciliated columnar cells
    - Distribution
    - Function
  - Basal cells
Microscopic Anatomy—Cont’d

- Goblet Cells
  - Glycoproteins—viscosity and elasticity
  - Innervation (para=thick, symp=thin)

- Basement membrane
  - Submucosal glands
    - Distribution
Microscopic Anatomy
Mucous Blanket

- Two layers
  - Superficial layer
  - Sol layer

- Function
  - Superficial layer traps bacteria and particulate matter.
  - Enzymes, antibodies, immune cells
Mucociliary Transport

- Directional Flow of Mucous
  - Toward the choanae

- Ostium drainage—a stubborn beast
  - Hilding, MD

- Contact inhibition
  - Haller’s cells
  - Surgery
Mucociliary Transport
Function of Paranasal Sinuses

- Humidifying and warming inspired air
- Regulation of intranasal pressure
- Increasing surface area for olfaction
- Lightening the skull
- Resonance
- Absorbing shock
- Contribute to facial growth
New Frontiers

Sleep apnea and the sinuses
- Humidification contributes up to 6.9mm Hg serum pO2
- Mouth breathers noted to have decreased end-tidal CO2—increased serum CO2—apneas (high baseline)

Nitric Oxide (NO)
- NO produced primarily in sinuses
- Toxic to bacteria, fungi, viruses
- Increases ciliary motility
Case Report

- 39 yom with h/o sinus disease c/o headache, rhinorrhea.
- PMHx of “sinus surgery” years ago
- ROS reveals h/o two episodes of meningitis in past few years


