Sinuses Ostia and Cilia
locations and function
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R3

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Objectives:

- Physiology of paranasal sinuses drainage.

- Physiology of Mucociliary function.

- Mucociliary function and Recovery post operatively.

- Surgical considerations.

- Maxillary Recirculation phenomenon.
Physiology of paranasal sinuses

Functions of Paranasal Sinuses:

• Air-conditioning and Humidification.
• Provide Resonance to voice.
• Thermal insulators.
• Lighten Skull bones.
• Trauma Protection.
• Contribute to Facial growth.
Ventilation of Sinuses

Takes place through their ostia.

-During Inspiration, air current causes Negative pressure in Nose.

-During Expiration, Positive pressure is created in Nose and this sets up eddies which ventilate Sinuses.

-Ventilation of sinuses is Paradoxical; they are Emptied of Air during Inspiration and filled with Air during Expiration.

- If ostium Blocked Oxygen tension drops further Ciliary motion impaired Stasis of secretions.
Maxillary Sinus

- 1st sinus to develop in-utero.
- Present at birth.
- Biphasic Growth: Birth - 3 years / 7 - 18 years old.
- Adult volume 15 ml

Ostium:
- Situated high up in Medial wall.
- Opens in Posterior part of Ethmoid Infundibulum into Middle Meatus.
- It is orientated slightly off set from the parasagittal plane facing posteriorly and is usually around 5mm in diameter.
- Accessory ostium present in 25% mainly in Posterior nasal Fontanelle, Postero-inferior to Natural ostia.
Ethmoid Sinus

- 2nd sinus to develop in-utero.
- Most developed sinus at birth.
- Basal lamella of Middle turbinate divides it into Anterior and Posterior group.
- Adult size: 10-15 air cells.
- Adult volume: 2-3 ml.
- **Anterior cells** Drains into Infundibulum into Middle Meatus.
- **Posterior cells** Drains into Superior Meatus.
Frontal Sinus

- Not present at birth.
- Invade frontal bone at age of 4 years.
- Adult volume: 2-3 ml
- Underdeveloped in 5%
- Usually 2 Asymmetric Frontal sinuses separated by thin septum.

Ostium Located Posteromedially in the floor
3-4 mm in diameter.
Drainage depends on Superior attachment of Uncinate Process:

1. Attaches to Lamina paprychea:
   - Drains into Middle Meatus medial to Ethmoidal Infundibulum (between uncinate process and middle turbinate)

2. Attaches to Ethmoid Roof (Skull base):
   - Drains into Ethmoidal Infundibulum.

3. Attaches to Middle Turbinate:
   - Drains into Ethmoidal infundibulum.
Sphenoid Sinus

- Not present at birth.
- Usually 2 Asymmetric sinuses separated by thin septum.
- Reach Sella turcica by age of 7 years.
- Adult size at 12-18 years
- Adult volume: 0.5-8 ml.

- Ostium:
  o Situated in Upper part of face of sphenoid at the level of inferior one third of the superior turbinate and along a horizontal plane through floor of the orbit.
  o Located medial to posterior end of superior turbinate in 80% and laterally in 20%.
  o Drains into Sphenoethmoidal Recess.
Physiology of Mucuciliary function

❖ pseudostratified ciliated columnar epithelium rich in Goblet cells and Seromucinous glands.
❖ a fundamental function to maintain the health and defence of the nose.
❖ About 20–40 ml/day of mucus are secreted from the normal ‘resting’ nose.
❖ Mucous blanket Consists of:
  1. Superficial Mucus layer.
  2. Deep Serous layer.
  3. Cilia; 200 -300/cell.
Mucociliary Clearance:
- Mucus travels to Ostium in a Spiral manner.
- Cilia are more marked near Ostia to help in drainage.
- Cilia propel mucus into Meatuses then Nasopharynx.
- Mucociliary clearance of Maxillary and Sphenoid sinuses is towards Natural Ostium.
- Mucociliary Clearance of Frontal and Ethmoid sinuses is Downwards and Aided by Gravity.
- Mucus in Frontal sinus drains toward Ostium only from Lateral side, mucus Medial to Ostium must course Superiorly to join Lateral flow toward Ostium.
- Factor Affecting Ciliary movements:
  1. Dryness
  2. Drugs
  3. Excessive heat or cold
  5. Ciliary Structural Abnormality
  6. Smoking
  7. Infections
  8. Noxious fumes like sulphur dioxide and carbon dioxide.
Ciliary Beat Frequency, Olfaction and Endoscopic Sinus Surgery

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❖ CBF Postoperatively the CBF of both sides of the nose showed significant improvement postoperatively.

❖ The improvement of CBF shows a linear pattern reaching the **normal values after 6 months** with the greatest improvement between months 4 and 6, despite that the postoperative endoscopic examinations demonstrated normal mucosa at around 3 months.
### Table 3. Distribution of STT (n = 60)

<table>
<thead>
<tr>
<th>STT min</th>
<th>Preoperative</th>
<th>Postoperative</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 month</td>
</tr>
<tr>
<td>1–10</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>11–20</td>
<td>31</td>
<td>15</td>
</tr>
<tr>
<td>21–30</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>31–40</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>41–50</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>51–60</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>NR</td>
<td>19</td>
<td>8</td>
</tr>
</tbody>
</table>

Accordingly, the average STT was 27.4, 25.5, 24.8 and 21.7 min.
NR = No response.
50 CRS patients.

Samples of the nasal mucosa were also examined under transmission electron microscopy before and 3 months after functional endoscopic sinus surgery (FESS).

Saccharin test was performed.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Incidence of slow mucociliary clearance (&gt;30 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucociliary transport</td>
<td>Controls</td>
</tr>
<tr>
<td></td>
<td>(no.)</td>
</tr>
<tr>
<td>&lt; 5 min</td>
<td>8</td>
</tr>
<tr>
<td>15–30 min</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 30 min</td>
<td>1</td>
</tr>
</tbody>
</table>
Result: Nasal mucociliary clearance was assessed in 50 healthy controls, 50 active and 50 chronic passive smokers of more than 5 years duration in the age group of 25 - 50 years. NMC time in control group was 8.57 ± 2.12, in active smokers 23.08 ± 4.60, and 20.31 ± 2.51 minutes in passive smokers. The difference in mean value of two samples was statistically significant as compared to controls.
Surgical consideration in sinuses surgery

maxillary sinus

• first step is the identification and assessment of the natural ostium of the maxillary sinus by using optics with an angular view.

• This is the indispensable first step for enlarging the natural ostium if needed and to perform further surgical steps and to avoid the occurrence of “missed ostium sequence” (MOS)
Maxillary recirculation syndrome

❖ Mucus recirculation syndrome (MRS) is a phenomenon that was first reported by Messerklinger in 1978, as a cause of chronic rhinosinusitis (CRS).

❖ The normal physiological paths of mucoid secretions from the various sinuses flow through the natural sinus ostia to the nasopharynx through propulsion by ciliary clearance where the secretions can be subsequently swallowed.

❖ In contrast, when an additional opening is present in a sinus wall, the secretions can deviate from the normal pathway, and reenter the sinus through the unnatural surgical ostium.

❖ Although the sinus itself may be otherwise clear, this can result in symptoms of sinus pressure, nasal congestion, and recurrent sinusitis.
Methods:
• 10 Symptomatic patients endoscopically diagnosed with recirculation, 9 involving the maxillary sinus and 1 involving the sphenoid.
• All patients had previous sinus surgery.
• All treated in the office under topical ± local anesthesia.

Results:
All 10 patients had significant improvement or resolution of the symptoms associated with recirculation, with no further endoscopic evidence of mucus recirculation.
Thank you