Functional Endoscopic Sinus Surgery

Francisco Pernas, MD – Presenter
Patricia Maeso, MD – Discussant
The University of Texas Medical Branch
Department of Otolaryngology
Grand Rounds Presentation
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Outline

- Definitions
- Background and incidence
- Anatomy and embryology
- Patient evaluation
- FESS Concepts of Surgery
- Controversy in Sinus Surgery
- Conclusion
Background
Functional Endoscopic Sinus Surgery

- Replaced old practice of obliterating sinuses and removing mucosa. Concept of irreversibly diseased mucosa refuted.

- Functional aspect refers to:
  - Preserving normal structures
  - Removing only obstruction
  - Preserving mucosa
  - Attempt to restore function
Incidence

- Estimated at 14% of American population
- $1.77 billion per year spent on rhinosinusitis
- CRS ranks fifth compared to all diseases in frequency of antibiotic use associated with treatment.
- CRS affects 32 million ppl/yr
- Accounts for 11.6 million visits to physicians' offices.
Definitions

- Rhinosinusitis - broadly defined as an inflammation and/or infection involving the nasal mucosa and at least one of the adjacent sinus cavities
- Acute rhinosinusitis (AS) – the persistence and worsening of upper respiratory symptoms for greater than a 7-day course but lasts less than 4 weeks.
- Subacute rhinosinusitis (SAS) - is defined as nasal symptoms lasting 4 weeks to 12 weeks
Definitions

- Chronic Rhinosinusitis (CRS) – persistence mucosal inflammation for > 12 consecutive weeks despite medical therapy or occurrence of more than four episodes of symptoms a year with persistent radiographic changes

- Chronic Recurrent Rhinosinusitis (CRRS) - consists of multiple acute episodes with complete resolution of disease between episodes
Embryology
Embryology

- Two processes:
  - Embryo head develops into a structure with two distinct nasal cavities
  - Lateral nasal walls invaginate to create complex folds known as turbinates
Embryology

- Development of sinuses – 6-8 weeks of gestation

- 6th week – Simple lateral nasal wall

- 7th week – Three axial furrows form, give rise to turbinates

- 10th week - Dev of maxillary sinus (invagination of the middle meatus) and uncinate process & the bulla ethmoidalis form a narrow groove known as the hiatus semilunaris
Embryology

- 14\textsuperscript{th} week - the anterior ethmoidal cells appear as several invaginations from the upper middle meatus and the posterior ethmoidal cells from the floor of the superior meatus.
Embryology

- 56th day
Embryology

- 60th Day
Embryology

- 63 days
Anatomy
Ethmoid anatomy

- Ethmoid anatomy is complex: Labyrinth
- Lamellae
  - 1st - Uncinate
  - 2nd - Ethmoid bulla
  - 3rd - Basal lamella of middle turbinate
  - 4th - Superior turbinate
Drainage

- Frontal, anterior ethmoid & maxillary – OMC
- Posterior Ethmoids – Superior meatus
- Sphenoid sinus – Sphenoid-ethmoidal recess
Middle Turbinate

- Three components
  - First – Anterior, oriented in a sagittal plane and attached to skull base
  - Second – Middle, oriented in a frontal plane and attached to lamina papyracea (AKA basal lamella and separates ant from post ethmoids)
  - Third – Posterior, oriented in a horizontal plane and attaches to perpendicular plate of palate (forms roof of middle meatus, anterior to sphenopalatine foramen)
Middle Turbinate

- Cribiform plate
- Fovea ethmoidali
- Lateral lamella
- Anterior ethmoid artery
- Middle turbinate (1st, anterior par)
- Superior turbinate
- 2nd part of the middle turbinate
- 1st part of the middle turbinate
- Sphenoid sinus
- Posterior ethmoid
- Lamina papyracea
- Bulla ethmoidalis
- Uncinate process
- Lacrimal sac
- Agger nasi cell
- Posterior ethmoid
- Middle turbinate 3rd posterior part
Ostiomeatal Complex (OMC)

- AKA – Anterior Ethmoid Middle Meatus Complex
- Common drainage for frontal, maxillary and anterior ethmoid sinuses.
OMC
OMC

- Infundibulum – funnel shaped area whereby the maxillary, anterior ethmoid and frontal sinuses drains
- Uncinate process – Sickle shaped bony ethmoidal structure
- Hiatus Semilunaris – Half-moon shape opening of infundibulum
Uncinate Process

- Attaches to the following structures:
  1. Inf & far post. – To ethmoid process of inf. Turb
Uncinate Process

2. Ant & far sup. – To lamina papyracea, skull base or mid turb
3. Laterally – Lamina papyracea and fontanelle area
Uncinate Process
Bulla Ethmoidalis

- Anterior ethmoid air cells attached to lamina papyrcea and usually open into lateral sinus
Sinus Lateralis = Suprabullar recess and retrobullar recess
Middle turbinate: Horizontal and vertical basal lamella

Sinus Lateralis

SBR

RBR
SBR and RBR
Sphenoid Ostium

- Medial to posterior sup. turbinate
- Located between nasal septum and inferior aspect of sup. turbinate
- Located at the same level as the roof of the maxillary sinus
- Located 4 microdebrider/suction tip breaths above the choanae
- Located 7cm from nasal crest at 30°
Sphenoid Ostium

- Sphenoid sinus
- Superior turbinate
- Sphenoid ostium
- Nasal septum
- Posterior ethmoid
- Middle turbinate
- Choana
Sphenoid Sinus

- Relationships of important structures:
  - Optic nerve – superior-lateral
  - Carotid artery/cav sinus – mid-lateral
  - Vidian nerve and maxillary nerve – inferior-lateral
Square – ant clinoid process, Circles – optic canals, triangle – vidian nerve
Asterisk – pneumatization of pterygoid process
Sphenoid Classification

Conchal
0%—Lang
5%—Congdon

Presellar
23.8%—Lang
28.0%—Congdon

Sellar (including “postsellar”)
76.2%—Lang
67.0%—Congdon
Onodi Cells or Sphenoid cells
Optic Canal in Onodi Cells
Cribriiform plate
Keros Classification

- Type I
  - 1-3mm
- Type II
  - 3-7mm
- Type III
  - 7-16mm
Frontal Cells

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Single frontal recess cell above agger nasi cell</td>
</tr>
<tr>
<td>II</td>
<td>Tier of cells in frontal recess above agger nasi cell</td>
</tr>
<tr>
<td>III</td>
<td>Single massive cell pneumatizing cephalad into frontal sinus</td>
</tr>
<tr>
<td>IV</td>
<td>Single isolated cell within the frontal sinus</td>
</tr>
</tbody>
</table>
Frontal Recess

- **Anatomic Boundaries:**
  - Ant – unicate process & agger nasi
  - Post – bulla ethmoidalis and suprabullar lamella
  - Lateral – lamina papyracea
  - Medially – hiatus semilunaris or middle turb
  - Inf – Ethmoid infundibulum
  - Sup – Fovea ethmoidalis, supraorbital air cell, anterior ethmoid artery and frontal ostium
Frontal Sinus
Patient evaluation

Have a seat Kermit. What I'm about to tell you might come as big shock...
Patient evaluation

• Include in history:
  • Detailed CC
  • Allergy, asthma, asa sensitivity and polyps
  • For patients with CRS
    • Facial pain, congestion, nasal obstruction, drainage and hyposmia
  • Complete pmhx and pshx to identify co-morbidities

• A review of the medical care a patient has received prior to evaluation is also important.
Patient evaluation

- Complete head and neck exam to include:
  - basic ocular examination
    - Visual fields, extraocular eye movement
  - anterior rhinoscopy
    - Evaluate septal deviations, character of mucosa, presence of polyps
  - nasal endoscopy (typically 30°)
    - Floor, nasopharynx, middle meatus, sphenoid recess,
Pre-op CT Evaluation

- CLOSE Technique
- C – Cribriform
- L – Lamina Papyracea
- O – Orbits, onodi cell, Optic Nerve
- S – Sphenoid, Skull Base
- E – Ethmoid Arteries
C - Cribriform

- Assess the Keros type
- Look for assymetry
L – Lamina Papyracea

- Check for dehiscence or pathologic fractures
O – Orbit, Optic Nerve, Onodi Cells

- Check for dehiscence
- Assess for onodi cells (superior-lateral to sphenoid)
- Orbital slope
S – Sphenoid, Skull base

- Assess for Carotid dehiscence and aeration patterns
- Conchal, Pre-sellar, & Sellar (thickness of clivus)
Skull base

- Assess slope of skull base
- Assess if roof of sphenoid is level with skull base
E – Ethmoid Artery
FESS
Concepts of surgery
Role of surgery

- Should be considered as adjunctive to medical therapy
- CRS is an inflammatory and multifactorial disease
- Underlying causes:
  - environmental, reactive airway disease, result from generalized host factors, or genetic
- Institute medical therapy first prior to surgery unless impending complications
- Continued medical therapy is required following surgery to avoid recurrence
Defined surgical substeps are defined according to specific pathophysiologic obstruction that exist based on microanatomy.
Antrostomy

- Some speculate nitric oxide produced in maxillary sinus has bacteriostatic properties, therefore better to keep antrostomy small.
- Uncinate must be completely removed, source of recurrence.
- Mucociliary clearance remains t/o natural os.
- Antrostomy must include the natural osium and accessory osium if present.
Recirculation
Extended Maxillary Antrostomy

- Advocated by some (R. Casiano) in refractory maxillary disease
- Middle meatal sinusotomy opened widely anteriorly (up to NLD), posteriorly to post wall of max sinus, superiorly to roof of max sinus and inferiorly to inferior turbinate.
- Inferior maxillary antrostomy performed inferiorly into the inferior meatus, post to Hasner’s valve (lacrimal punctum).
Extended Maxillary Antrostomy
Extended Maxillary Antrostomy

<table>
<thead>
<tr>
<th>Patient #</th>
<th>Age (y)</th>
<th>Gender</th>
<th>Number of previous Caldwell-Luc procedures</th>
<th>Number of previous endoscopic procedures</th>
<th>Location of extended maxillary antrostomy</th>
<th>Last follow-up (mo)</th>
<th>Symptomatic relief on last visit</th>
<th>Postoperative endoscopic exam findings on last visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>73</td>
<td>M</td>
<td>2</td>
<td>3</td>
<td>Right</td>
<td>86</td>
<td>Complete</td>
<td>Minimal crusts, mucous</td>
</tr>
<tr>
<td>2</td>
<td>44</td>
<td>F</td>
<td>0</td>
<td>1</td>
<td>Left</td>
<td>10</td>
<td>Complete</td>
<td>NED</td>
</tr>
<tr>
<td>3</td>
<td>58</td>
<td>F</td>
<td>2</td>
<td>1</td>
<td>Right</td>
<td>5</td>
<td>Partial</td>
<td>Patchy edema</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>M</td>
<td>1</td>
<td>2</td>
<td>Bilateral</td>
<td>22</td>
<td>Complete</td>
<td>Polypoid changes</td>
</tr>
<tr>
<td>5</td>
<td>43</td>
<td>F</td>
<td>0</td>
<td>1</td>
<td>Bilateral</td>
<td>17</td>
<td>Partial</td>
<td>NED</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>M</td>
<td>1</td>
<td>2</td>
<td>Left</td>
<td>41</td>
<td>Partial</td>
<td>Mucous</td>
</tr>
<tr>
<td>7</td>
<td>46</td>
<td>F</td>
<td>0</td>
<td>1</td>
<td>Left</td>
<td>4</td>
<td>Complete</td>
<td>Polyp debrided in clinic</td>
</tr>
<tr>
<td>8</td>
<td>21</td>
<td>F</td>
<td>0</td>
<td>1</td>
<td>Left</td>
<td>25</td>
<td>Complete</td>
<td>NED</td>
</tr>
<tr>
<td>9</td>
<td>36</td>
<td>F</td>
<td>1</td>
<td>2</td>
<td>Bilateral</td>
<td>21</td>
<td>Complete</td>
<td>NED</td>
</tr>
</tbody>
</table>
Frontal Sinusotomy

- Question on to perform or not
- Do as little as possible but as much as necessary
  - Some advocate ethmoid dissection and monitor
- Graduated approach to frontal sinuses

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>No exploration</td>
<td>Recess not manipulated</td>
</tr>
<tr>
<td>Frontal recess dissection</td>
<td>Probe/visualize ostium</td>
</tr>
<tr>
<td>Frontal sinusotomy</td>
<td>Enlarge ostium</td>
</tr>
<tr>
<td>Frontal sinus drillout</td>
<td>Drillout floor</td>
</tr>
<tr>
<td>Frontal sinus obliteration</td>
<td>Obliterate sinus</td>
</tr>
</tbody>
</table>

- Should evaluate need with sagittal recons
- Evaluate A-P and Mediolateral dimensions, assess neo-osteogenesis and pneumatization
Frontal Sinusotony

- Common causes of Frontal sinus disease:
  1. Infundibular disease obstructing frontal recess
  2. Mucosal disease and expansion of the agger nasi air cells
Controversy in Rhinology

Balloon Sinuplasty
Balloon Sinuplasty

- Developed in 2006
- Different from prior French biliary catheter in that new technique can fracture bones
- Kennedy concludes that this technique may lead to bacterial introduction and subsequent osteitis, mucositis, and mucoceles.
Frontal Balloon Sinuplasty

- Bolger et. al. in ‘07 published results
- 24 week f/u
- Exclusion criteria patients with extensive sinonasal polyps, prior surgery, CF
- Enrolled 115 patients
- f/u patency was 80.5%
- Patency could not be assessed in 17.9% secondary to anatomy
- Nonpatent 1.6%
Frontal Balloon Sinuplasty

- Revision was required in three sinuses (1%) and three patients (2.75%)
- SNOT-20 scores improved
- Reported 9 cases of bacterial sinusitis, managed with oral abx
- No other adverse events reported
References

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