Current management of Eustachian Tube Dysfunction

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When all else fails...

“I’m afraid you have Eustachian Tube Dysfunction”
Overview

- History of the Eustachian Tube
- Anatomy, Histology and Physiology
- Pathophysiology and association with Otitis Media
- Eustachian tube function tests and endoscopic assessment
- Medical management of ETD
- Surgical management of ETD
  - Dilatory dysfunction
  - Patulous ET
“It originates at the anterior course of the base of the skull, and takes an anterior course toward the pterygoid process of the sphenoid bone. It consists of two parts: the first solidly connected with the temporal bone, close to the tympanic cavity; the second soft, partly ligamentous, partly cartilaginous, directed towards the nasopharynx.

Cross sections of the tube are not perfectly round and the inner part is twice as wide as the outer part.”

Bartholomeus Eustachius (1510-1574)  Guichard Joseph DuVerney (1648-1730)  Antoine Maria Valsalva (1666-1732)  Toynbee, Politzer and Bezold
Anatomy and Physiology
Bony-cartilaginous structure

Osseous

Cartilaginous

11-14mm

20-25mm
Regional anatomy

- Avg. thickness of anteromedial wall of osseous ET 1.5-3mm
- Dehiscent carotid artery in 2% of pop
Cartilaginous Eustachian Tube

Torus tubarius

Inf Turbinate
Peritubal musculature

Artwork courtesy of Oskar Kujawski
Three main functions:

1. Pressure regulation of the middle ear
2. Protection from nasopharyngeal secretions and sound pressure
3. Drainage of secretions produced within middle ear
Eustachian tube mucosa

- Mucosal lining continuous with nasopharynx and middle ear
- Characterized by ciliated pseudostratified columnar epithelium
- Mixture of goblet, columnar and ciliated cells with varying densities along the Eustachian tube
Eustachian tube dilatory dysfunction

Obstructive Dysfunction
- Mucosal inflammation (most common)
- Adenoid hypertrophy
- Neoplasm or other anatomical obstruction

Functional Dysfunction
- Limited cartilage mobility
- TVP and/or LVP dysfunction
How to evaluate patient with ETD

- Predominant symptom of aural fullness
  - Usually associated with hearing loss
- In severe cases → otalgia
- History of recurrent otitis media and associated findings/complications (atelectasis, retraction pockets or cholesteatoma)
- DDx: patulous ETD, TMJ disorders, superior semicircular canal dehiscence, cochlear hydrops and increased ICP
7-item Eustachian Tube Dysfunction Questionnaire (ETDQ-7)

<table>
<thead>
<tr>
<th>Over the past 1 month, how much has each of the following been a problem for you?</th>
<th>No Problem</th>
<th>Moderate Problem</th>
<th>Severe Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pressure in the ears?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Pain in the ears?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. A feeling that your ears are clogged or “under water”?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. Ear symptoms when you have a cold or sinusitis?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. Crackling or popping sounds in the ears?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6. Ringing in the ears?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. A feeling that your hearing is muffled?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Total item score cutpoint >14.5 or mean item score of >2.1
Patient evaluation

- Question about inflammatory processes (i.e. allergic rhinitis, chronic rhinosinusitis, laryngopharyngeal reflux and smoke exposure).
- Be aware of history of cleft palate, granulomatous disease, cystic fibrosis, Sampter’s triad or Kartagener’s syndrome.
- Eustachian tube function tests: Valsalva maneuver, Toynbee test, Nine-step test, Tympanometry, Sonotubometry.
ET endoscopic technique

- Flexible or rigid endoscope
- Direct endoscope into longitudinal axis of tube which runs $45^\circ$ laterally and superiorly to nasal floor
- Examine tubal orifice and lumen
  - Mucosal inflammation or hypertrophy, excessive mucus, hyperemia and cobblestoning
- Phonate “K-K-K”, swallow, yawn
- Video, slow motion playback
Normal L Eustachian tube function

Courtesy of Dr. Dennis Poe
Endoscopic view of obstructive dysfunction secondary to mucosal edema and reflux
Endoscopic view of obstructive dysfunction secondary to adenoid hypertrophy

Courtesy of Dr. Dennis Poe
Endoscopic view of functional dysfunction secondary to muscle incoordination

Courtesy of Dr. Dennis Poe
## Mucosal inflammation rating scale

<table>
<thead>
<tr>
<th>Scale</th>
<th>Endoscopic correlate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Normal</td>
<td><img src="image1.jpg" alt="Normal" /></td>
</tr>
<tr>
<td>2. Mild edema and/or erythema</td>
<td><img src="image2.jpg" alt="Mild Edema/Erythema" /></td>
</tr>
<tr>
<td>3. Moderate inflammation with dilatory compromise</td>
<td><img src="image3.jpg" alt="Moderate" /></td>
</tr>
<tr>
<td>4. Severe inflammation with inability to dilate open</td>
<td><img src="image4.jpg" alt="Severe" /></td>
</tr>
</tbody>
</table>
Medical management

- Directed toward underlying cause
- No FDA approved medical therapy for non-specific ETD
- Systemic/topical decongestants and antihistamines not shown to be effective in improving ET function in children with poor ET function
- Intranasal steroids – mixed evidence
  - In young children, 1) short-term benefit against OME as adjunct to antibiotics (vs antibiotics alone), 2) higher rate of resolution of OME and adenoid hypertrophy and better symptom scores compared to no tx at all
Management of Eustachian Tube Dysfunction With Nasal Steroid Spray: A Prospective, Randomized, Placebo-Controlled Trial

Michael B. Gluth, MD; Darren R. McDonald, MD; Amy L. Weaver, MS; Christopher D. Bauch, PhD; Charles W. Beatty, MD; Laura J. Orvidas, MD

- **Objective:** To determine the efficacy of intranasal aqueous triamcinolone acetonide in treating the tympanometric signs and symptoms of eustachian tube dysfunction
- **Patients:** Adults (≥18 years) and children (6-17 years) presenting with otitis media with effusion, negative middle ear pressure, or both
- **Intervention:** The 2 treatment arms consisted of aqueous triamcinolone or matching placebo administered once daily intranasally for 6 weeks
- **Main outcome measure:** Resolution of abnormal tympanometry and change in symptom scores
- **Results:** Ninety-one patients presenting from September 1, 2005, through December 31, 2008, with otitis media with effusion or with negative middle ear pressure. No statistically significant difference in normalization of abnormal tympanometric signs was demonstrated with the active treatment arm compared with placebo on either a per-patient basis (19% vs 32%; \( P = .18 \)) or a per-ear basis (22% vs 35%; \( P = .15 \)); There was also no significant difference in the overall post-study symptom score between the 2 treatment arms
- **Conclusion:** Findings do not support the use of intranasal steroid sprays to treat the manifestations of eustachian tube dysfunction.
Intranasal aerosolized surfactant

- Based on theory that ET is a compliant, liquid-lined tube whose surface tension is directed inward… and that crucial to normal ventilatory function is equilibrium between critical opening pressure and the ET’s surface tension.
- **Hypothesis**: Surfactant (+/- steroids) lowers surface tension, therefore lowering ET passive opening pressure.
- **Results**:
  1. Significant reduction in POP
  2. Significant decrease in OME days
  3. Significant normalization of tympanometry
  4. Significant decrease in culture positive effusions
- **Conclusion**: Intranasal surfactant reduced severity and duration of middle ear infections in AOM in this animal model.
Surgical management
Adenoidectomy

- Obstructive function
- Harboring biofilms producing micro-organisms

Tympanostomy tubes

- Recurrent AOM and persistent ME atelectasis or effusion recalcitrant to medical tx
- Complications: tympanosclerosis, perforation, otorrhea, retraction and cholesteatoma
Laser tuboplasty

Kujawski et al:

- 108 patients with hx of 5 or more TT placements for chronic persistent OME, CHL > 5 years and rapid development of OME after extrusion or obstruction of most recent TT
  - Failure in improvement of OME despite 12 wks of nasal corticosteroid sprays +/- oral antihistamines (in case of allergy hx) +/- PPI (in case of reflux hx) final inclusion criteria
- Diode or CO2 laser
Eustachian Tuboplasty

Laser tuboplasty
Laser tuboplasty

- 58% (63/108), 54% (53/98) and 60% (56/92) of ears completely normalized after 1, 2 and 3 years of follow up, respectively.
- Seven ears (6.48%) required post op TTs because of recurrent effusions.
- Allergic rhinitis and LPR may negatively influence outcome of LET.

Post op

Pre op
Microdebrider tuboplasty

Metson et al:
- 20 patients with CRS and ETD who underwent concurrent ESS
- Mean PTA decreased by 6 dB, ETD sx improved in 70% and abnormal tympanograms improved in 65%
- Elevated tissue eosinophil count (probable allergic rhinitis) and prior sinus surgery correlated with failure of mETP
Eustachian tuboplasty

Balloon dilation
**Eustachian tuboplasty**

**Balloon dilation**

- Poe at al looked at 11 adult patients with persistent OME → unilateral BDET with 7mm x 16mm Acclarent balloon to 12 atm for 1 min
  - All cases were successfully dilated
  - 100% could self-insufflate by Valsalva immediately
  - 5 of 11 (45%) ears had complete resolution of OME (all had type A tympanograms except one who had a type C)
  - Average mucosal inflammation 2.91 → 1.73 (p=.003)
  - Mucosal laceration within lumen of ET in 45% of patients, limited to mucosa and considered clinically acceptable; no major adverse effects reported
Balloon dilation

- McCoul and Anand looked at 22 adult patients with ETD based on symptoms and abnormal tympanogram.
- They performed 35 BDET procedures with 5/7mm x 24mm Acclarent balloon to 10 atm for 2 min + partial inferior turbinectomy.
- Significant postoperative improvement noted in tympanometry (97% normal vs 0% preop) and otoscopic appearance (100% not retracted vs 94% retracted preop).
- ETDQ-7 scores at 3, 6, 12, and 24 weeks significantly improved.

1.9
Balloon dilation of Eustachian tube

Courtesy of Dr. Dennis Poe
Functional results on videoendoscopy

Pre-op

Resting Position

Balloon Dilation Right Eustachian Tube

Dilated Position

3 weeks post-op
Summary of BDET

- Safe and effective procedure that can offer long-term relief of ETD
- Less invasive compared to laser or microdebrider tuboplasty leading to decreased morbidity and complications
- Can be a useful adjunct to endoscopic sinus surgery, is easy to use and employs existing endoscopic instrumentation
- Provides therapeutic option in office setting
  - Catalano et al: BDET under topical anesthesia well tolerated and effective in treatment of ETD up to 30 weeks of follow up
- Surgeons should be familiar with surgical and regional anatomy (CT t-bone to r/o ICA dehiscence), not dilate bony ET and only offer procedure to patients with recalcitrant symptoms of ETD or persistent OME who have shown improvement with TT placement; also recognize there is no billable code
Patulous ETD

• Patulous ET is due to a longitudinal loss of tissue volume in the valve of the cartilaginous tube
• Associated with significant weight loss and pregnancy; 1/3 with no identifiable cause
• Sx: Autophony of voice + breath and aural fullness; tympanic membrane excursions with ipsilateral nasal breathing
• Surgical treatment involves submucosal augmentation to narrow valve, “shim” catheter insertion to block/narrow ET and tubal obliteration
• Larger studies with long-term F/U are needed
Future research

- Comparison between different Eustachian Tuboplasty techniques
- Larger studies investigating the feasibility and efficacy of office based balloon dilation Eustachian tuboplasty
- Investigating the role of endoscopic, transnasal monopolar cauterization of hypertrophied adenoids and posterior tubal cushion tissue in addition to ESS in patients with CRS and ETD
Thank you
References