Balloon Eustachian Tuboplasty

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Minimally Invasive Office ENT Course
Silverstein Institute 27 February 2013
Eustachian Tube Valve

Mastoid

Middle Ear

Bony isthmus

Valve

Endoscopy of ET

- Osseus ET usually patent
  Hopf et al ('91), Chays et al ('95)
- Pathology in cartilaginous ET
  Kujawski ('00), Poe et al ('00)

Endoscope

4mm flexible or rigid
Optic or CCD for slow motion

Left Normal ET

Closed - resting

Dilated - active
2 Phases of dilation

- **LVP** - posterior cushion elevation
- **TVP** - lat movement ant-lat wall

Artwork courtesy Dr Oskar Kujawski
Nasopharyngeal view of Left Eustachian tube

Slow motion endoscopic video

Dissection
Allergic rhinitis
Left Bulbous Posterior Cushion & OME
Middle ear pathology correlates with presence of ET pathology, not severity

OME

TM retraction

Posterior Atelectasis

Severe Atelectasis
ET DYSFUNCTION
Slow Motion Video Endoscopy Results: n=82
Dilatory Dysfunction

Obstructive Dysfunction (92%)

- Mucosal inflammation most common
  - Allergy, Rhino-sinusitis, Adenoiditis, Reflux
  - Other inflammation (Infection or Immune mediated - Samter’s, Mid ear primary disease, Wegener’s)
  - Nasal steroid drops (Flixonase™ not FDA approved in USA)
- Adenoid hypertrophy compressing ET during swallow
- Limited cartilage mobility
- Neoplasm or anatomical obstruction (rare)

Dynamic Dysfunction (8%)

- TVP & LVP dysfunction - hyper- hypo- dyskinesis
- Dyscoordination between muscles

Patulous ET

- Concave defect in superior ant-lat wall (n = 18)
Lymphoid Hyperplasia in the Torus Tubarius

Lymphoid follicle

[Image: Microscopic view of lymphoid hyperplasia in the Torus Tubarius]
Biofilms in Otitis Media

- 92% of 26 children receiving tubes – Hall-Stoodley et al, JAMA 2006
- Kania et al 54% of 9 children undergoing adenoidectomy for OME Laryngoscope 2008
- Early evidence for biofilms in ET
  Poe, Kinnuri, Aarnisalo 2010
Indications for ET Surgery

- Persistent OME or Non-adherent atelectasis
- Type B or C tympanogram
- Symptomatic (Conductive HL, pain or blockage in ear with pressure changes)
- Symptoms improved with tympanostomy tube
Balloon Dilation of the ET
Indications and Preliminary Results
Cross Sectional Slices along 3D Volume Reconstruction from CT with contrast filling ET & Middle Ear
Axial CT post dilation with contrast in lumen

Tubal volume widened 0.16 – 0.49 cm³ (357%)

Greatest dilatory effect was in middle of cartilaginous portion

Adverse effects limited to mucosal tears

Presented American Otologic Society 2009

Balloon dilation of the cartilaginous ET since June 2009

- General anesthesia, supine, day surgery
- Transnasal endoscopic approach, 45° Hopkins rod (Karl Storz, Tuttlingen, Germany)
- Sinuplasty balloons 6 x16 mm, 12 atm, 2 mins (Acclarent, Inc., Menlo Park, CA)
- Outcomes: Valsalva maneuver, mucosal inflammation rating scale, otomicroscopy, tympanogram
Mucosal inflammation rating scale

1 Normal

2 Mild edema and or erythema

3 Moderate inflam, compromise of dilation

4 Severe inflam, inability to dilate open.
Balloon dilation of L cartilaginous ET
Results

n = 11

Adults > 5 yrs OME, failed M&T

Adverse events: Mucosal laceration 5 (45.5%)
Complications: C 6-7 radiculopathy 1 (9.1%)

Poe, Silvola, Pyykkö
Otolaryngol Head Neck Surg 144(4), 563 2011

* p < 0.001  ** p = 0.003
Balloon Dilation
Right Eustachian Tube

Resting Position
Dilated Position

Pre-op Balloon Dilation
3 weeks post dilation
Histology Pre- & 6 weeks Post-Balloon Dilation

Pre balloon

Post balloon
Balloon Eustachian Tuboplasty
Silvola J, Poe D - Lahti, Finland

N = 49 patients

- Indications: OME, Atelectasis (B,C tympanogram)

- 44/49 (89.8%) initial relief of symptoms & signs, able to Valsalva - Early failure 5/49 (10.2%)

- >6 month follow up
  - 35/49 (71.4%) continued complete relief
  - 11/49 (22.5%) small or intermittent relief
Conclusions: Eustachian Tuboplasty

Indications:

- Irreversible mucosal disease with OM despite maximal medical control of underlying etiologies (Allergy, Chronic Rhinosinusitis, Reflux, other inflammatory)
- Multiple ventilating tubes or Flight/Scuba recurrent barotrauma

Studies needed

- Basic science (reverse translational) studies on effects of ET dilation or other mucosal stripping
- Is ET surgery appropriate in children?
- Long term controlled studies
Coding

- 31237 – Nasal endoscopic surgery
- 69400 – ET catheterization
- 69405 – ET catheterization from middle ear
- 69799 - Unlisted middle ear procedure
- 31297 – Balloon dilation of sphenoid sinus
Discussion – Review of observations with laser and balloon tuboplasty

- Variable dilation of cartilaginous ET valve
- Reduced mucosal inflammation - scores reduced from averages 2.91 → 1.73 (p=0.003)
  - Restoration of pseudocolumnar epithelium
  - Restoration of cilia
- Reduced submucosal inflammation
  - Fibrosis
  - Reduced lymphocytic infiltrate & lymphoid follicles
- Improved middle ear aeration in majority
Balloon dilation precautions

- New surgical anatomy
- Respect ICA
- Protect mucosa gentle insertion
- Pre op CT for dehiscence
- No guidewire
  - Open catheter
  - Avoid middle ear
- Avoid bony ET!
- Continued medical Rx as indicated
Conclusions

- The ET orifice and valve contains lymphoid tissue similar in histological appearance to adenoid
- ET inflammation is closely associated with otitis media
- Surgical manipulation of the ET lumen (stripping of the mucosa & stripping or compression of the submucosa) appears to:
  - Reduce local inflammation
  - Improve tympanogram and otoscopic findings
- Obstruction of patulous ETs results in chronic OME without progressively deteriorating chronic disease
Discussion – Hypotheses for benefits of tuboplasty

- Reduced mucosal inflammation
  - ? Stripping of the superficial mucosa allowing for healthy regrowth of epithelium, removal of biofilms?
  - ? Stripping or compression of irreversibly injured submucosal lymphocytic infiltrate and follicles, replacement with fibrosis?

- Mucosal/submucosal tears may heal by ingrowth of fibrosis yielding wider lumen – seen in endovascular dilation
  (van den Brand M et al, Br Heart J 1992)