Diagnosis and treatment of Cricopharyngeal dysfunction

“"A bolus walks into a bar”"
Outline

- Normal swallow review
  - Anatomy
  - Physiology
- Cricopharyngeal dysfunction
  - Cricopharyngeal spasm
  - Zenker’s diverticulum
- Evaluation of dysphagia
- Treatments
Normal swallow

- Rapid, coordinated neuromuscular event
  - Passage of food bolus to stomach
  - Protection of the airway

- Voluntary and involuntary events
- Complex sensory and motor coordination
Normal Swallow

Voluntary Phases

- Oral Preparatory Phase
  - Increased salivation, Mastication, prepare bolus
  - Requires tongue movement, coordination

- Oral Phase (1.0-1.5 sec)
  - Project bolus from oral cavity to pharynx
Normal Swallow

Involuntary Phases

• Pharyngeal phase (1 sec) - Most important phase
  • CN 9 and 10 (SLN) triggered by bolus
  • Medulla coordinated

• Velopharyngeal Closure
• Tongue base retraction
• Pharyngeal contraction (tongue and lateral walls contact)
• Airway protection
• Upper esophageal sphincter relaxation
Normal Swallow
Involuntary Phases

- Esophageal phase (8-20 sec)
  - Past upper esophageal sphincter
  - Involuntary, coordinated peristalsis
Upper esophageal sphincter

- Inferior Constrictor muscle
- Upper fibers of the esophagus
- Cricopharyngeus Muscle
  - 2 cm height
  - Sling attaching to lateral boarder of cricoid cartilage
- Striated muscle
- Innervation by vagus
Cricopharyngeus

- Tonic contraction at rest
  - Prevents air from entering esophagus with inspire
  - Prevents fluid from refluxing into pharynx
  - UES pressure 55-60 mmHg AP, 30 mmHg lateral (Broniatowski, 1999)
- Relaxation 0.1 sec before bolus arrives
- Passive opening as larynx elevates superior and anterior
  - Strap muscles elevate thyroid cartilage
    - Total laryngectomy needs UES myotomy
CP reflex arc

- Detection of food bolus
  - Laryngeal / Pharyngeal sensation
  - Glossopharyngeal (CN9) and Vagus (CN10)
- Nucleus tractus solitarius in medulla
- Inhibitory signals to CP muscle fibers
  - Pharyngeal branch of vagus nerve

- Pharyngeal plexus
  - Glossopharyngeal, Vagus, Sympathetic
Pharyngeal Anatomy
Dysphagia

- “Feeling of difficulty passing food or liquid from the mouth to the stomach” (Spiegel)

- Globus pharyngeus- sensation of a foreign body in throat
Causes of Dysphagia

- Mechanical Dysphagia - physical blockage
  - Intrinsic vs Extrinsic
- Neuromuscular Dysphagia
  - Poor coordination of swallow
- Sensory deficits
- Aging-
  - Decreased sensation (Aviv, 1995)
  - Concurrent medical problems
  - Pill dysphagia
Cricopharyngeal Dysfunction

- Any disruption of neuromuscular coordination
  - Stroke, ALS, polio, iatrogenic nerve injury
  - Idiopathic, myopathy
- Failure of muscle to relax
  - Chronic stimulation (i.e. reflux)
- Failure to dilate due to reduced compliance
  - Chronic stimulation with histologic changes
  - Loss of elasticity of muscle, poor relaxation
  - Inflammatory induced sclerosis
CP Dysphagia Symptoms

- Food stuck in throat
- Slow swallow
- Cough undigested food
- Wet voice
- Chronic cough
- Recurrent pneumonia
- Weight loss
Reflux

- Cricopharyngeal muscle spasm linked to GERD (Koufman, 1991)
- Distal esophageal acid increased UES pressure
  - No change in pH at the upper esophagus
  - Symptomatic globus sensation (Tokashiki, 2010)
- UES contraction with liquid reflux and supine
  Relaxation with air or upright (Babaei, 2010)
- Other studies show no change in UES with reflux
Reflux (cont)

- Cricopharyngeal bar-
  - 54% of pts with radiologic reflux
  - 20% of pts without (Brady, 1995)
- Gastric acid exposure may increase muscular sphincter tone by neural reflex-mediated mechanism. No study to prove. (Westrin, 1996)
Zenker’s Diverticulum

- Most common esophageal diverticulum
- Males, 2-3:1  Adults, 70-80s
- Pulsion (secondary to pressure)
  - Full thickness herniation of through musculature
- Killian’s dehiscence- between constrictor and CP muscles
Zenker’s Diverticulum (cont)

- Etiology - unknown
  - Cricopharyngeal dysfunction
  - Dyscoordination of swallow
  - Incomplete relaxation
  - GERD

- Symptoms
  - Dysphagia, belching, neck gurgle, regurgitation of undigested food
Reflux and Zenker’s

- Incidence of GERD and Zenker’s reported
  - 22% (Ellis, 1996) to 95% (Resouly, 1994)
  - Hiatal hernia and Zenker’s - 77% (Feussner, 1992)

- Several studies showed no increased reflux on pH probe studies in pt with globus
Dysphagia Evaluation

- History and Physical Exam
- Bedside evaluation
- Modified Barium swallow
- Functional endoscopic evaluation of swallow (FEES) or with sensory testing (FEEST)
- Esophageal Manometry
- Esophagoscopy- Rigid, Flexible, TNE
FEES

- Speech Language Pathologist + ENT/Pulm/GI
- Flexible laryngoscopy - Eval anatomy + fxn
- Swallow Colored liquid
- Evaluation of pharyngeal stage of swallow
- Advantages - no radiation, similar findings MBSS
- Disadvantages - No eval of esophagus
  - Indirect assessment of swallow, “white out”
Pharyngeal Endoscopic Photo
Modified Barium Swallow

- Considered “gold standard” for dysphagia
- Speech Language Pathologist + Radiologist (possible PA)
- Fluoroscopy during all phases of swallow
- Radio-opaque solid and liquids
- Documentation of CP spasm and diverticula
Cricopharyngeal spasm
Zenker’s Diverticulum
CP dysfunction Treatments

- NPO with PEG- high risk of aspiration
- Behavioral Speech/Swallow therapy
  - Shaker exercises- Elevate head to strengthen straps
- Surgery
  - Stricture dilation
  - BOTOX to cricopharyngeus
  - CP myotomy
  - Zenker’s diverticulectomy vs diverticulopexy
  - Vocal fold injection, Tracheostomy
Treatment Algorithm (Veenker, 2003)

FIGURE 2. Treatment algorithm: cricopharyngeal spasm and Zenker’s diverticulum.
Esophageal Dilation

- Performed under anesthesia with EGD or esophagoscopy
- Improvement of symptoms
- 2 small studies demonstrated improvement in CP dysfunction (Solt, 2001 and Wang, 2005)
- Effect likely temporary unless scarring/fibrosis disrupted
BOTOX

- Botulinum toxin causes non reversible blockage of presynaptic nerve ACH vessicles
- Goal is to weaken CP tonic activity
- Temporary muscle weakness, 3-6 months
- Injection
  - Trans-cutaneous vs endoscopically
  - EMG
- No change to fibrosis, inflammation
CP myotomy

- Vertical posterior division of the circular UES
- Up to 80% success rate
- Open surgery
  - GA, left side approach
  - Dilator or NG tube in esophagus
  - Division of posterior fibers of UES – 4-5 cm
    - Inferior constrictor, CP, upper esophageal fibers
  - Remaining fibers leave persistent dysphagia
  - Intra luminal perforation requires repair, NPO
Open cricopharyngeal myotomy
CP myotomy post-op Recovery

- 1 night hospital stay
- Neck drain removed POD 1
- Barium swallow to rule out perforation/leak
- Liquid diet/Mechanical soft
  - Slow advance
- Suture removal 1 week
CP myotomy Complications

- Esophageal perforation with leak
- Infection
  - Neck Abcess, fistula, mediasteinitis
- Hematoma
  - Urgent airway compromise vs routine
- RLN injury- temporary vs permanent
- Persistent dysphagia- incomplete myotomy
- Worsened Reflux Symptoms- clinical
  - No increase in events by pH probe study (Williams)
Endoscopic Laser CP myotomy

- Endoscope exposure of CP muscle posterior to Cricoid cartilage
- CO₂ laser incision of mucosa and ablation of muscle to buccopharyngeal fascia
- Variable closure- suture, fibrin glue, no closure
- Post op Barium swallow- can be read as leak depending on closure tech (Berzofsky, 2012)
- Comparable outcomes to open (Pitman, 2009)
Zenker’s Diverticulum Treatment

- Management = Surgery vs observation
- Surgery - Open vs Endoscopic
  - Cricopharyngeal myotomy
  - Diverticula management
  - Hospital stay - 1 vs 7 days, NPO x 1 day or 1 week

- Complications -
  - Vocal cord paralysis, recurrence, mediastinitis, bleeding, fistula, stricture, hematoma, death
Open Zenker’s repair

- General anesthesia, 2 hour surgery
- NG tube or Bougie in esoph, Neck incision
- CP myotomy
- Diverticulotomy
  - Hand sewn vs stapler
- Diverticulopexy- invert sac, suture superiorly
- Inversion- purse string, push sac into esoph
Open Zenker’s Surgery
Open Zenker’s Surgery
Endoscopic Zenker’s surgery

- General anesthesia, 1 hour surgery
- Esophagoscopy
  - Weerda vs Hollinger
- Visualize diverticulum and esophagus
  - Party wall in scope under tension
  - Cut wall and cricopharyngeal muscle
- Outpatient vs 1 night stay
- PO intake POD 0/1
- Post op Barium swallow- frequent read as persistent diverticulum, possible leak
Endoscopes

- Weerda
  Adjustable

- Hollinger
  Fixed
Endoscopic Zenker’s surgery

Fig. 127-18. A, A diverticuloscope inserted into the esophagus and diverticulum. B, Endoscopic view of staple lines and a divided cricopharyngeus muscle bridge.
Endoscopic Zenker’s surgery
Endoscopic Zenker’s surgery
GI Stapler
Endoscopic surgery
GI Stapler
Endoscopic surgery
Endoscopic Zenker’s instruments

- Goal - cut muscle and seal mucosa
  - Return to PO intake
- Electrocautery
- GI stapler
- Needle-knife papillotome
- Laser - CO2 vs KTP
- Harmonic scalpel
Harmonic Scalpel vs GI stapler

- Harmonic Scalpel
  - Stepwise division and sealing of mucosa/muscle
  - Smaller diameter, easier to see around

- GI stapler
  - Larger scope, 1 or 2 bites
  - Better sealing of edge
Laser Endoscopic Zenker’s diverticulectomy
Endoscopic surgery
Complications Endo Zenker’s

- Inadequate visualization
  - Neck range of motion, teeth
- Infection, hematoma, Fistula
- Incomplete myotomy – persistent dysphagia
  - Endo Revision- Laser better symp scores (Adam, 2013)
- Vocal fold paralysis- temp vs permenant
- Pneumomediastinum
- Mediastinitis
Conclusions

- Dysphagia and globus pharyngeus can be symptoms of CP spasm and zenker’s diverticulum.
- The cause of CP dysfunction is still poorly understood and may have multiple etiologies.
- Work up with MBSS will confirm diagnosis.
- Treatments are directed by severity of pt symptoms, overall patient health, and anatomy.
Conclusions (cont)

- Surgical interventions include open and endoscopic surgery.
- Surgery is very effective in correcting CP spasm and Zenker’s diverticulum, however there are risks including persistent symptoms.
References (cont)

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