The Aging Voice
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Lecture Goals
- Understand the anatomy of the voice box (larynx)
- Understand the development of the human larynx
- Understand several basic concepts in the production of the human voice
- Describe the changes that occur to the aging larynx
- Understand the impact of neurological disease on the aging larynx

The Throat: Basic Anatomy
- Throat contains one common chamber that divides into two
  - Larynx (voice box)
  - Pharynx (food passage)
- Air moves through the larynx
- Food and liquid move through the pharynx into the esophagus

The Larynx: The Voice Box
- Speech producing organ
- Swallowing
- Breathing
- Coughing
- Lifting
- Quality of Life

The Complex Larynx
- 8 cartilages
- 9 muscles
- 2 true vocal cords
- 2 false (extra) vocal cords
- 2 major motor nerves
- 2 major sensory nerves
Cartilages

Cricoid and Arytenoids

Vocal Ligament

Intrinsic Musculature

- Abductors
- Adductors
- Tensors

Laryngeal Nerves: Recurrent and Superior
Normal Functions
- Closing (speaking)
- Opening (breathing)
- High pitch (falsetto)
- Low pitch
- Whisper
- Cough

Vocal Cord = Vocal Fold

Mechanism of Phonation
- Inhalation of air
- Glottic closure

Mechanism of Phonation
- Exhalation increases subglottic pressure until vocal folds displace laterally

Mechanism of Phonation
- Vocal folds return to midline
  - Decrease in subglottic pressure
  - Elastic forces in vocal fold
  - Bernoulli effect of airflow

The Vocal Tract: Resonance
- Everything above the vocal cords to the lips
- Concentrates harmonics
- Resonance
- Variable/adjustable
Why we sound the way we sound

Lungs (air pressure) + Brain → Larynx ← Hearing + Vocal tract (tongue, mouth, palate)

• Larynx develops from two branchial arches
  – 4th → supraglottis
  – 6th → glottis/subglottis
### Differences between infants and adults

<table>
<thead>
<tr>
<th>Infants</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid cartilage flat</td>
<td>Pointed</td>
</tr>
<tr>
<td>Arytenoids large</td>
<td>Proportionately smaller</td>
</tr>
<tr>
<td>CT membrane slit</td>
<td>Space</td>
</tr>
<tr>
<td>Epiglottis furled</td>
<td>Paddle configuration</td>
</tr>
</tbody>
</table>

**Presbyphonia: Stereotypic Aged Voice**

- High pitched
- Breathy
- Hoarse
- Soft
- Tremulous

**Vocal fold: Atrophy**

- Mucosa thins
- Atrophy of the lamina propria
- Edema within the lamina propria in females
Cartilage: Ossification

Muscle: Atrophy

- Loss of muscle mass
- Dennervation
- Strap muscles of neck atrophy and sag

Neurologic

- Upper motor neuron disease
- Parkinson’s disease
- Amyotrophic lateral sclerosis

Decreased Lung Capacity: Decreased Flow
Secretions: Thicken

- Decreased mucous production
- Thickened mucous
- Decreased saliva
- Phlegm and globus

Overall Impression

- Larynx descends (neck looks sagged)
  - Voice pitch higher in men
  - Voice pitch lower in women
    - Breathy
    - Hoarse
  - Vocal folds appear bowed

Vocal Cord Paralysis

- Injury to one or both of the vocal cord nerves
- Often following an infection
- Painless
- Symptoms vary

Vocal Cord Paralysis

- Occasionally caused by a tumor somewhere in the neck
- Patient may be unaware until the vocal cord becomes paralyzed
- Need to perform a scan in order to rule this out

Reinke’s Edema

- Classically occurs in smokers
- Typically both sides but may be one-sided
- Looks like a polyp
- Benign
- Hoarse, husky voice
- Must stop smoking or will recur

Reinke’s Edema
Leukoplakia (White patch)

- May be precancerous
- Typically seen in smokers
- Can be mistaken for fungal infections
- Surgical removal is the treatment of choice
- Need to follow up regularly and re-biopsy if it comes back

Cancer of the Larynx

- 10,000-12,000 new cases per year
- Most common site in head and neck cancer
- 4200 deaths per year from laryngeal cancer

Cancer

- Laryngeal cancer the most common cancer of the head and neck area
- Least common cause of hoarseness
- Difficulty swallowing
- Coughing up blood
- Sore throat
- Ear pain

Cancer

- Can occur on one vocal cord
- Can get a good estimate of the true extent in the operating room

Cancer

- Can involve both vocal cords

Treatment

- What components of speech mechanism are involved?
- Presbyphonia?
- Removal of part of tongue, palate?
- Stroke with neurological injury?
- Removal of lung or treatment for lung cancer?
Treatment

- Voice therapy
- Lee Silverman Voice Therapy (LSVT)
- Particularly helpful in Parkinson’s disease
- Goal of therapy is to make the person loud
- Intense therapy given over several weeks

Hearing

- Assess hearing
- Patient may be embarrassed to discuss
- May be dismissed by patient as minor factor
- Consider audiogram/hearing aids

Therapy

- Growth factors?
- Estrogen?
- Testosterone?

Surgery

- Goal is the restoration of glottic competence
- Variety of methods
- Often voicing becomes easier, more efficient while the voice itself may not change very much

Surgery

- Preop
- Postop
Direct Laryngoscopy

- General anesthesia
- Jet ventilation
- Spontaneous
- Microlaryngeal tube 5.0
- Paralysis
- Outpatient

Materials - Fat

- Fat
  - Excellent viscoelastic properties
  - Temporary vs. permanent
  - Injecting complete cells with attached fibrovascular support probably critical to survival

Collagen

- Collagen (Zyplast, Cosmoplast)
  - Recommendation for skin testing up to 4 weeks prior to injection
  - $250.00 per cc
  - No skin testing required with Cosmoplast ($350.00/cc)
  - Persists up to 3-6 months
  - Less endurance with each subsequent injection?

Acellular dermis

- Acellular human dermis (Cymetra)
  - Need to reconstitute in office
  - Requires 10-15 minutes
  - Reconstitution product “lumpy”, increases difficulty of injection
  - Results last clinically 6 – 9 months
  - Long term effects of “biointegration” unknown
  - $400.00 per cc

Calcium hydroxylapatite

- Calcium hydroxylapatite
  - White paste – easy to visualize
  - Particle size 75 to 125 microns vs. 25 to 45 microns
  - Calcium spherules may be replaced by fibrous tissue ingrowth, preserving augmentation

Calcium hydroxylapatite

- Expensive - $500.00/cc
- Exact long term benefit remains to be seen
- Extrusion of material at injection site
- Degree of reabsorption undetermined
Summary

• Larynx is a complex organ, and the vocal fold itself is layered
• Voice is not a property of laryngeal function alone – much more goes into voice production than vocal fold vibration
• Consider the person as a whole when assessing a voice problem

Summary

• Presbyphonia due to many factors:
  – Calcification of cartilage
  – Muscle atrophy
  – Loss of lamina propria
  – Thinning of mucosa
  – Thickening/drying of secretions

Summary

• Treatment geared to situation at hand
  – Hearing aids
  – Voice therapy
  – Injection laryngoplasty
  – Thyroplasty