AIRWAY, BREATHING AND CIRCULATION
OUTLINE

• Laryngeal Function
• Laryngeal Anatomy
• Laryngeal Neurophysiology
• Voice Production
Laryngeal Function:

Respiration
Airway protection
Voice
Separation of Respiration and Swallowing

- Shield-like shape of epiglottis, height of aryepiglottic folds
- Lateral diversion of food into piriform fossae
- Elevation of larynx during swallowing
Laryngeal Anatomy

- Cartilaginous
- Ligaments/Fibroelastic Membrane
- Muscular
- Neurologic
- Vasculature
LARYNGEAL SKELETON
SAGITTAL VIEW OF LARYNGEAL CARTILAGE
Cricoid cartilage – Signet ring
LIGAMENTS

- Extrinsic:
  - Thyroid membrane
  - Cricotracheal
  - Hyoepiglottic
Thyrohyoid Membrane

Cough and SLN Injections
LIGAMENTS AND FIBROELASTIC MEMBRANE

- Intrinsic Ligaments
- Quadrilateral Membrane: Aryepiglottic fold to the False Vocal Fold
- Cricothyroid Ligament or Conus Elasticus: Vocal ligament to Cricoid cartilage
SAGITTAL VIEW

Posterior

Quadrangular membrane
Aryepiglottic ligament
Thyroid cartilage
Cuneiform cartilage
Corniculate cartilage
Arytenoid cartilage
Cricoid cartilage
Cricothyroid ligament

Anterior

Epiglottis
Hyoid bone
Thyrohyoid membrane
Laryngeal prominence
Vestibular ligament ("false" vocal cord)
Vocal ligament ("true" vocal cord)
LARYNGEAL JOINTS
LARYNGEAL ANATOMY

• CARTILAGENOUS FRAMEWORK
• LIGAMENTS AND FIBROELASTIC MEMBRANE
• MUSCLES
• NERVE SUPPLY
• VASCULATURE
Musculature

INTRINSIC AND EXTRINSIC
EXTRINSIC LARYNGEAL MUSCULATURE
EXTRINSIC MUSCLES

- Responsible for supporting and positioning the larynx for speech, swallowing, and airway protection.
- Can move the entire vocal complex up or down the distance of one vertebra.
INTRINSIC LARYNGEAL MUSCULATURE
Movement of cricothyroid muscle
## Neurophysiology of Muscular Larynx

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Muscle</th>
<th>Action</th>
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<tbody>
<tr>
<td>Superior laryngeal (external division)</td>
<td>Cricothyroid muscle</td>
<td>Adductor, lengthen</td>
</tr>
<tr>
<td></td>
<td>Thyroarytenoid muscle</td>
<td>Adductor, shortens</td>
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<tr>
<td></td>
<td>Lateral cricoarytenoid muscle</td>
<td>Adductor</td>
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<tr>
<td></td>
<td>Interarytenoid muscle</td>
<td>Adductor</td>
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<tr>
<td></td>
<td>Posterior cricoarytenoid muscle</td>
<td>ABductor</td>
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<tr>
<td>Recurrent laryngeal</td>
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</tbody>
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Neurophysiology of Muscular Larynx
Sensation of Larynx

- Superior Laryngeal nerve (internal branch)
  - Superior border of larynx to true vocal folds

- Recurrent Laryngeal nerve
  - Below true vocal folds
LARYNGEAL INNERVATION & VASCULATURE
Laryngeal Innervation & Vasculature
MICROSCOPIC VIEW OF VOCAL FOLDS
Ventricular Folds (False Vocal Folds)

- Superior and lateral to TVFs

- Space between the TVFs and FVF's called the Ventricle

- Ideally, the FVF's retract as far away from mid-line as possible during phonation to allow maximum vibratory freedom of the TVFs.
MICROANATOMY OF THE VOCAL FOLD
Layered Microstructure

- Epithelium: Non-keratinizing squamous
- SLP: loose fibrous and extracellular matrix; glycoproteins, elastin
- Vocal Ligament: dense collagen
VOCAL FOLD SULCUS
VOCAL FOLD
SULCUS
Laryngeal Anatomy

• FROM FORM ONTO FUNCTION

• ANATOMY TO THE PHYSIOLOGY AND FUNCTIONING OF THE LARYNX
BIOMECHANICS OF PHONATION

- FORCED EXPIRATION
- WHISPER
- PHONATION
- QUIET RESPIRATION
The Biomechanics of phonation

- On quite respiration vocal cords abduct on inspiration and adduct on expiration.
- The larynx descends on inspiration and ascends on expiration.

Biomechanics of phonation can be divided into –
- Initiation of voice
- The vibratory cycle
- Vocal registers: characteristics of vocal fold adduction and vibration
Aerodynamic Myoelastic Theory
Aerodynamic-Myoelastic Theory

- Vertical Phase Difference:
  - Lower lip (elastic in nature) tends to spring back into place as upper margins are still moving away from one another.
  - Lower lip always leads
  - Essential to normal voice production
Cover Body Theory of Fold Motion

• Proposed by Hirano 1974
• The “cover” / epithelium and Superficial lamina propria moves over the stiffer “body /vocal ligament and vocalis muscle
• Cover – pliable and elastic
• Body – Contractile properties of the muscle to adjust stiffness of vocal fold
• Vocal fold tension – dependent on the coupling of cover and muscular body
Ventricle or Supraglottis

Rhima Glottidis

Subglottis or infraglottis
CONCLUSIONS

LARYNGEAL ANATOMY, PHYSIOLOGY AND FUNCTION:

- AIRWAY PROTECTION
- RESPIRATION
- PHONATION

THE LARYNX IS A VERY COMPLEX NEUROMUSCULAR ORGAN
THANK YOU