Laryngospasm

R3 王智弘
Introduction

• A protective reflexive glottic closure → prevent aspiration
• Its exaggeration impedes respiration
• Self-limited mostly: prolonged hypoxia and hypercapnea abolish the reflex
• If sustained, morbidity (e.g. cardiac arrest, PE, etc.) and mortality ensue
Epidemiology

• Inversely related with age
  – The overall incidence: 0.87%
  – <10 y/o: 1.74 %
  – 1~3 m/o: 2.82 %

• Most occurs during anesthesia
  – Emergence 48%, induction 28%, maintenance 24%

• The incidence of resultant morbidity
  – Oxygen desaturation 61%
  – Bradycardia 6%
  – Cardiac arrest 0.5%
  – Pulmonary aspiration 3%
  – Postobstructive negative pressure PE 4%
Anatomy

Intrinsic Muscles of Larynx
Superior View

- Transverse and oblique arytenoid muscles
- Posterior cricoarytenoid muscle
- Lateral cricoarytenoid muscle
- Cricothyroid muscles
- Thyroarytenoid muscle
- Thyroid cartilage
- Vocal ligament
- Vocalis muscle
- Vocal process of arytenoid cartilage
- Muscular process of arytenoid cartilage
- Cricoid cartilage
Anatomy

Nerves of Larynx
Right Lateral Views

- Superior laryngeal nerve
- Internal branch of superior laryngeal nerve
- Externarl branch of superior laryngeal nerve
- Inferior pharyngeal
- Cricopharyngeus muscle (part of inferior pharyngeal)
- Posterior cricoarytenoid muscle
- Cricothyroid muscle
- Anterior and posterior branches of
- Aryepiglottic muscle
- Transverse and oblique artenoid
- Anastomosis
- Sensory branches to larynx
- Thyroepiglottic muscle
- Thyroarytenoid muscle
- Vocalis muscle
- Lateral cricoarytenoid muscle
- Cricoarytenoid articular facet
- Recurrent laryngeal nerve
- Thyroid cartilage lamina removed
Physiology

- A multitude of mechanoreceptors, chemoreceptors and thermoreceptors are throughout the larynx.
- The density is greatest around the laryngeal opening.
- The posterior aspect of the true vocal folds has greater density than the anterior.
- Stimulation of these receptors induce short-lived glottic adduction to protect from aspiration.
Mechanism

• Afferent fibers within the internal branch of the SLN
• Spasmodic dysphonia: involuntary spasms in the laryngeal muscles during speech production
  - Neuroimaging(20:20) and postmortem histopathology(20:3)
    • ↓ Axonal and myelin content in the genu of internal capsule
    • Mineral depositions in parenchyma and vessel walls of the post. limb of the int. capsule, putamen, globus pallidus and cerebellum
• Efferent response to the entire vagus ➔ apnea, bronchoconstriction, bradycardia, peripheral vascular tone change
• There is a speculation: such a response leads to sudden infant death, possibly in reaction to LPR
Risk Factor

- Patient-related
  - Young age
  - Anxiety
  - GERD
  - URI or active asthma
    - 2~10 folds the risk
  - Chronic smoker
  - Airway anomaly
- Surgery-related
  - T and/or A
  - LMS
  - Thyroid surgery
    - SLN injury
    - Hypoparathyroidism
  - Esophageal procedure
    - Distal afferent nerves
- Anesthesia-related
  - Insufficient depth of anesthesia during induction
  - i.v. induction agents
    - Barbiturate
    - Ketamine → saliva ↑
  - LMA > ETT > face mask
  - Airway irritation
    - Volatile anesthetics
    - Mucus or blood after extubation
  - Children supervised by less experienced anesthesiologist
Prevention

- Identify patients at risk is the most important
- Nonirritant inhalational anesthetic, e.g. sevoflurane
- Deep anesthesia before intubation
- Extubate while the lungs are inflated by positive pressure
  - ↓ Adductor response of laryngeal muscle
  - Artificial cough
- 5% CO₂ inhalation for 5 min before extubation → CO₂ exhalation drive > the laryngospasm reflex
- Acupuncture
Prevention

• Drugs
  – Premedication with oral BZD $\rightarrow$ ↓ upper airway reflex during induction
  – Anticholinergics $\rightarrow$ ↓ secretion
  – Lidocaine
    • Spray to larynx at 4 mg/kg (1 mL 10% lidocaine for a 25 kg pt)
    • 30 min in duration
Intravenous Lidocaine

- Gilbert first used i.v. lidocaine as an adjunct to general inhalation agents in 1951
- Controversial in preventing laryngospasm
- Some said i.v. at 1 mg/kg 5 min before extubation → fairly effective as topical use
Deep versus Awake Extubation

- Controversial
- Awake extubation
  - Protect the airway from aspiration
- Deep extubation
  - Less likely to cough and strain, which can cause bleeding ➔ throat irritation ⬇
Clinical

• Harsh breathing sound → exclude other causes of airway obstruction, e.g. tongue drop, blood clot impaction, bronchospasm
• Partial laryngospasm → inspiratory stridor
• Signs of airway obstruction
  – Suprasternal retraction
  – Use of accessory muscles
  – Paradoxical movement of chest and abdomen
• Complete laryngospasm → absence of breath sounds
• Late change
  – Bradycardia
  – Cyanosis
Treatment

- **Partial laryngospasm**
  - Identify and remove the stimulus
  - Apply jaw thrust maneuver
  - Insert oral or nasal airway
  - Positive pressure ventilation with 100% O2

- **Complete laryngospasm**
  - Call for help
  - Deepen the anesthesia level

- **If laryngospasm occurs without i.v. line** ➔ **intraosseous route** offer a faster central circulation than peripheral

- **Lidocaine**
  - SLN block
  - 5 mL of 2% lidocaine + 5 mL NS nebulized by 100% O₂
  - Transtracheal injection of 1~2 mL 4% lidocaine
Superior Laryngeal Nerve Block

Figure 2
Superior laryngeal nerve block (71). (A 25 G needle is used to make contact with the hyoid bone, walking off the inferior margin of the bone and advancing 1–2 mm until it pierces the hyoid ligament).
The Laryngospasm Notch

Figure 1
Laryngospasm notch (located behind the lobule of the pinna of the ear, bounded anteriorly by the ascending ramus of the mandible adjacent to the condyle, posteriorly by the mastoid process of the temporal bone and cephalad by the base of the skull).
A simplified algorithm for treatment of laryngospasm

1. Identification and removal of the offending stimulus such as secretions, mucus or blood
   - Inserting an oral or nasal airway if possible
   - Apply jaw thrust maneuver while firmly pressing on the “laryngospasm notch”
   - Intermittent positive pressure ventilation with face mask
   - If laryngospasm is not relieved, deepen the level of anaesthesia by propofol i.v. 0.25-0.8 mg.kg⁻¹
   - If laryngospasm is not relieved, inject suxamethonium i.v. 0.1–3 mg.kg⁻¹ or i.m. 3–4 mg.kg⁻¹ followed by mask ventilation and/or tracheal intubation
Follow Up

• Assess for the possibility of developing
  – Pulmonary aspiration
  – Postobstructive negative pressure pulmonary edema
Paroxysmal Laryngospasm

- Extremely rare and is diagnosed by history: spontaneous sudden onset of stridulous dyspnea, resolve within minutes
- Frequently have a positional component, may wake the patient
- Extremely distressing, impending doom
- LPR → mucosal hypersensitivity → maladapted reflex arc
- Aggressive elimination of LPR satisfactorily treated the majority of patients
## Patients and Outcomes

<table>
<thead>
<tr>
<th>Patient</th>
<th>Gender</th>
<th>Age (years)</th>
<th>Charlson score</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>44</td>
<td>0</td>
<td>None (avoid precipitants)</td>
<td>Reassured following discussion, declined further treatment</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>70</td>
<td>0</td>
<td>Maximal acid supression, no additional treatment</td>
<td>Reassured following discussion, declined further treatment</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>53</td>
<td>2</td>
<td>Maximal acid supression, no additional treatment</td>
<td>Referred for possible Nissen fundoplication</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>61</td>
<td>3</td>
<td>PPI</td>
<td>Complete response</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>53</td>
<td>0</td>
<td>PPI</td>
<td>Partial response</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>68</td>
<td>4</td>
<td>PPI</td>
<td>Complete response</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>57</td>
<td>0</td>
<td>PPI</td>
<td>Partial response</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>29</td>
<td>0</td>
<td>PPI</td>
<td>Complete response</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>85</td>
<td>0</td>
<td>PPI</td>
<td>Complete response</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>58</td>
<td>0</td>
<td>PPI</td>
<td>Complete response</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>33</td>
<td>2</td>
<td>PPI</td>
<td>Complete response</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>48</td>
<td>0</td>
<td>PPI, amitriptyline</td>
<td>Complete response</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>60</td>
<td>0</td>
<td>PPI, Betnesol® drops</td>
<td>Not tolerated</td>
</tr>
<tr>
<td>14</td>
<td>F</td>
<td>60</td>
<td>2</td>
<td>PPI, botulinum toxin</td>
<td>Complete response</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>55</td>
<td>0</td>
<td>Botulinum toxin</td>
<td>Complete response</td>
</tr>
</tbody>
</table>

M = male; F = female; PPI = proton pump inhibitor

---

An approach to the management of paroxysmal laryngospasm

Reference

- Head & Neck Surgery - Otolaryngology, 4th Edition
- Aerosolized Lidocaine for Relief of Extubation Laryngospasm ANESTH ANALG 2005;101:1563
- Focal white matter changes in spasmodic dysphonia: a combined diffusion tensor imaging and neuropathological study Brain (2008), 131, 447-459
- Intervention steps for treating laryngospasm in pediatric patients Pediatric Anesthesia 2008 18: 297–302
- Laryngospasm in pediatric practice Pediatric Anesthesia 2008 18: 279–280
Thank you for listening