Surgical Outcomes of Tracheal Tumors

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Disclosures

• Scientific Advisory Board for Spiration, Inc.
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OUTLINE

I. ANATOMY

II. COMMON MALIGANT TRACHEAL TUMORS

III. OPERATIVE TECHNIQUES

IV. POST-OP CARE AND COMPLICATIONS

V. POST-OP EMERGENCIES
TRACHEAL ANATOMY

Cricoid cartilage to the carina

Average length 10-11 cm

18-22 cartilaginous C rings
(2 rings/cm)

Average diameter 2.3 cm lat
1.8 cm AP

Esophagus posterior

Azygous, recurrent laryngeal nerve lateral to trachea
Blood Supply

- Segmental Arterial Supply
- High risk for ischemia with dissection
- Minimize skeletonization (5-7 mm)
Tracheal Tumors

• 2% of upper airway tumors
• Account for < 0.2% of all respiratory tract malignancies¹
• Rarely are they benign (<10% in adults)
  – Papilloma, chondroma, fibroma, lipoma, schwannoma, neuroendocrine carcinoid
• Malignant lesions account for 90% in adult
  – 10-30% of tumors are malignant in children²

Squamous Cell Carcinoma

- Most common primary malignancy of the trachea
- Male predominance (1:3 ratio)
- Universally associated with smoking
- Usually arises in lower 1/3 of the trachea
- Frequently unresectable at presentation

Macchiarini P. Primary Tracheal Tumors. Lancet Oncol 2006; 7:83-91
Adenoid Cystic Carcinoma

• In 1859, Bilroth first described the clinical and pathologic features and initially coined it “CYLINDRINOMA”.

• Equal distribution between men and women
• Most common in patients in their 4th and 5th decades
• Slow growing, low grade malignancy
• No association with smoking
• Universally invasive
  – Intact mucosa
  – Submucosal and perineural invasion
• 10% with LN involvement, mets to brain, lung or bone
## Comparative Symptoms of ACC vs. SCC of the Trachea

<table>
<thead>
<tr>
<th>Symptom</th>
<th>ACC</th>
<th>SCC</th>
<th>X²</th>
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<tbody>
<tr>
<td>Dyspnea</td>
<td>65</td>
<td>50</td>
<td>0.014</td>
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<tr>
<td>Cough</td>
<td>55</td>
<td>52</td>
<td>NS</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>29</td>
<td>60</td>
<td>&lt;0.001</td>
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<tr>
<td>Wheeze</td>
<td>44</td>
<td>27</td>
<td>0.003</td>
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<tr>
<td>Stridor</td>
<td>21</td>
<td>27</td>
<td>NS</td>
</tr>
<tr>
<td>Hoarseness</td>
<td>10</td>
<td>13</td>
<td>NS</td>
</tr>
<tr>
<td>Dysphagia</td>
<td>7</td>
<td>7</td>
<td>NS</td>
</tr>
<tr>
<td>Fever</td>
<td>7</td>
<td>4</td>
<td>NS</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>14</td>
<td>NS</td>
</tr>
</tbody>
</table>

Diagnosis

• Bronchoscopy
  – Gold standard
  – Diagnose with biopsy
  – Stage
    • Extent of disease
    • Length of airway involved
  – Add EBUS for depth of invasion
Management

• In almost all cases of tracheal and bronchial tumors: Surgical Resection
  – Both benign and malignant
    • Including stenosis
  – Endoscopic resection is usually inadequate
    • Papillomatosis is only tumor treated this way
  – Occasionally need to compromise margins
    • Due to length that needs to be resected
Management

• Determine if the airway is compromised
  – Yes – emergent rigid bronchoscopy
    • Stabilize airway
  – No – CT scan with 3-D reconstruction
    • Rigid/flex bronchoscopy with evaluation of tumor
      – Measure proximal and distal margins from carina and from cords
      – Eval depth of invasion
      – Assess for satellite lesions
      – Remove impending obstructing lesions
3-D Reconstruction
Virtual Bronchoscopy
Surgical Principles

• Always measure with rigid bronchoscope and rigid telescope
  – Determine exact extent of tumor
  – Location in relation to both carina and cords

• Can remove about ½ of tracheal length
  – Usually 6 cm or 12 rings
  – Will be less in older patients
Surgical Principles

• Reconstruct through healthy trachea
  – May need to accept microscopic +margin
• Define area to be resected
  – Use bronchoscopic identification after dissection of anterior trachea
• Mobilize only 0.5 – 1.0 cm of trachea circumferentially
  – More will compromise blood supply
• Tension free anastomosis
  – Use release maneuvers
• Interrupted absorbable suture
• Check integrity
  – Water in wound with 20-30 mmHG of pressure
• Chin Stitch
Surgical Principles

• Collar incision
  – Cervical and upper mediastinal lesion
  – May extend into manubriotomy

• Sternotomy may be required
  – Mid to lower part of the trachea
  – Require significant amount of dissection
Surgical Principles

• Distal 1/3 of trachea or carinal resections
  – Via a right thoracotomy
  – Mediastinoscopy
    • Allows for mobilization of proximal trachea
  – Left sided lesions via a left thoracotomy
    • Then extend into a clamshell
  – May use a sternotomy for limited carinal resection
  – Cover with vascularized flaps
Patient Positioning

• Cervical Incisions
  – Shoulder roll to extend neck
    • Need to be able to remove at end of case
  – Prep and drape in entire neck, chin and sternum
    • Be ready to extend incision
Operative Exposure

Cricoid

Divided Thyroid

Stenosis

Trachea
Anastomosis

- Absorbable suture
  - PDS or Vicryl
- Tension Free
  - Use release maneuvers
- Preserve blood supply
- Cross-field and Jet ventilation
Anastomosis
Anastomosis

Total parenchymal sparing

Partial parenchymal sparing

Carinal pneumonectomy
Anastomosis

- Resection to normal airway
- Tension-free anastomosis

"Balance the benefit of complete resection with negative airway margins against the risk of excessive tension at the anastomosis. If in doubt, decide in favor of a secure anastomosis."

J.D.C. Bennett
Carinal Resection: Exposure
Carinal Resection
Carinal Resection: Double Barrel Anastomosis
Sleeve Lobectomy
Sleeve Lobectomy
Sleeve Lobectomy
Sleeve Lobectomy
Sleeve Lobectomy
Tracheal Release Maneuvers

Pretracheal Plane dissection

Laryngeal Release

- Suprathyroid (infrahyoid) – detach hyoid bone from thyroid cartilage
- Suprahyoid – separate hyoid from superior attachments

Hilar Release

- Inferior pulmonary ligament
- Pericardial reflexion on PA, inferior and superior pulmonary veins

Neck Flexion
Divide the supraphyoid laryngeal suspensory attachments
Drops the larynx for a total laryngeal inferior advancement of 2.5 cm
Less postoperative swallowing dysfunction than the infrahyoid laryngeal release
Neck Flexion

- Guardian or “Grillo” stitch
- Maintain 15-20° of flexion
  - Can be as much as 35°
- Gain about 2 cm extra of tracheal distance
- Allows for tension free anastomosis for most resections <5 cm
Complications

Granulation tissue (<2%, vicryl)
Anastomotic edema
Restenosis (< 10%)
Dehiscence (1%, w/ over 50% mortality risk)
Laryngeal dysfunction +/- aspiration (< 5%)
    – up to 40% patients w/ hyoid release
Hemorrhage – innominate artery (rare)
Infection – wound or pneumonia
Complications

Increase risk of complications:
- Length of resection $p<0.001$
- Need for laryngeal release $p<0.001$
- Laryngotracheal / Carinal Resection $p<0.001$
- Histology (Squamous Cell 3 times higher) $p<0.05$

Regnard JF, Fourquier P, et al.
- 208 patients from 26 institutions
  - Leak 12%
  - Pneumonia 6%
  - Aspiration 14%
  - Mortality 10.5%
Post-operative Care

Upper tracheal Resections

– Guardian stitch stays for 5-7 days
  • Depends on length of trachea resected
  • Does not induce hyperflexion (15-20° at most)
– NPO for 24-48 hours
– Swallow eval for aspiration
  • Not much of an issue for more distal resections
  • High risk for Laryngeotracheal resections.
– Should be ambulating POD#1
Post-operative Care

Distal Tracheal and Carinal resections
- No Guardian Stitch
  - Flexion does not help at this level
- Thoracotomy incision
  - Usually larger than standard lobectomy
- Higher complication rate
  - Very high risk for severe and deadly complications
- Require aggressive rehab
  - Ambulating POD#1
Post-operative Care

For all resections:
- ICU stay for 24-48 hours
- Humidified air is helpful
- Often will place on standing albuterol nebs
- Racemic Epi nebs for the first 24 hours
  - More often used for upper resections
- Avoid steroid use after immediate post-op period
  - Increases dehiscence rate
Post-op Emergency

Call surgeon immediately
– Avoid reintubation
  • If you must, #6 or smaller, uncuffed if possible
  • Better if done with bronchoscopic guidance

Sit patient up and lean forward
– Try to calm the patient
– Slow their breathing

Racemic Epi nebs

Avoid deep suctioning
– Bedside bronchoscopy to eval anastomosis and clear any inspissated secretions
Unresectable Disease

Goals of Care
- Restore Airway
- Slow Progression of Tumor

Mediastinal Radiation
- 5400 to 6000 cGy
- Definitive treatment for patients with good performance status

Endoscopic therapy
- N:YAG Laser
- Cryotherapy
- Brachytherapy
- PDT
- Argon beam Coagulation

Palliative Surgical Therapy
- Tracheostomy
- T tube Placement
- Self expanding stents
Unresectable Disease

Mechanical Debridement

– Rigid bronchoscopy always
  • Can use to core out the tumor
  • May cause tears in posterior membrane
– Cold and hot biopsy forceps
  • Both can cause significant bleeding
  • Injecting base of tumor with epi before debridement will decrease the amount of bleeding
– Tumor impaction
  • May need to remove rigid scope with tumor at the same time
  • Do not let it occlude the only good airway
    – Hold ventilation until you have control of the tumor
Unresectable Disease

Stenting
- Self expanding
  - Covered and uncovered
- Silicone
- Y-stents

Sometimes cause more problems than they fix
- Should rarely, if ever, be used in benign disease
Tracheal and Bronchial Resection

Careful planned airway / anesthetic management
- evaluate and manage in operating room

Meticulous operative technique
- 3 principles of technique:
  - minimal skeletonization laterally
  - resection to normal airway
  - tension-free anastomosis

Careful postoperative care
- careful monitoring
- fluid restriction, racemic epi, short steroid usage
- Aggressive Rehab
Questions?
Unresectable Disease

Laser Therapy
- Depth of penetration depends on wattage and length of treatment
- Can go straight through airway wall
- Doesn’t control bleeding very well

Cryotherapy
- Depth of penetration depends on length of freeze and number of applications
- Helps control bleeding
  - Decrease in vascularity
- Minimal loss of tissue
  - Must mechanically debride after freezing
  - Tumor “shrinkage” occurs almost immediately
Cryotherapy and Stenting