Laryngology seminar

Tracheostomal stenosis

R3 黃姿穎
Introduction

- 1873 Billroth laryngectomy
- Tracheostoma
  - 1. not require a permanent stent
  - 2. clear secretions and allow respiration
  - 3. to occlude for speech production

Cause of tracheostomal stenosis:
  - 1. benign scar contracture at the junction of skin and mucosa
  - 2. persistent tumor or recurrent tumor
Introduction

- No good definition of tracheostomal stenosis
- *Wax et al.*
  - requires a stent for longer than 3 months after surgery
  - requires tracheostoma revision for any reason

- Incidence of tracheostomal stenosis: 4~42%
- A small stoma: drying, crusting, and pulmonary infection from a failure to clear secretions
- Size alone is not the only consideration
- <50% diameter, patients with chronic lung disease: respiratory compromise
Classification

- 1962 Montgomery (according to the shape)
  - 1. *vertical slit* (∵ compression from the sternal heads of the SCM muscle)
  - 2. *concentric* (∵ scar contraction)
  - 3. *inferior shelf* (∵ redundant skin folds)

- Yonkers and Mercurio, *Wax et al.*
  - 4. *superior shelf-type* (∵ excessive fat in the superior flap resulting in overhang)
Patient factors

- Fat neck (overhang of the upper flap)
- Enlarged thyroid
- Bulky SCM muscle heads
- Defective or absent tracheal rings
- Steroid treatment
- Irradiation
- Sex
- Keloid formation
- Poor nutritional status
- Infection (wound complication)
- Previous tracheostomy
- Pre-op chemotherapy
Patient factors

- **Radiation**
  - Some authors: no association
  - **Myers and Gallia, Loewy and Laker**
    - RT: contribute to stenosis
  - **Yonkers and Mercurio, Griffith and Luce**
    - post-op RT stenosis > pre-op RT

- **Kuo et al.**
  - RT: not a determinant of stenosis
  - ∴ RT >> obliterative vasculitis and ischemia >> poor wound healing
Patient factors

- **Female sex** (∵ tracheal diameter is smaller)
- Lam *et al.* and Kuo *et al.* no sex difference
- Wax *et al.* women were significantly more likely to develop stenosis

- Langenbrunner and Chandler
  45% (9 of 20) of black patients developed stenosis
  (↑ tendency to keloid formation)

- Wax *et al.*
  no relation between stenosis and keloid formation or steroid use
Patient factors

- Loewy and Laker
  5/6 developed tracheostomal stenosis had previous tracheostomy

- Postoperative wound infection:

- Kuo et al.
  a higher incidence of tracheostomal stenosis in patients who had a tracheostomal infection

- Infection:
  Formation of granulation tissue healing by secondary intention

- Pre-op chemotherapy: no association
Surgical techniques and influence

A. How the trachea is divided
   - Straight transection of the trachea
   - Beveling the trachea
   - Plastic or flap construction technique

B. Where the stoma is sited
   - Within the main incision
   - In a separate incision

C. Primary tracheoesophageal puncture

D. Use of a laryngectomy tube

E. Concurrent neck dissection

F. Pectoralis major muscle flap
A. How the trachea is divided

1. Straight transection of the trachea
   - Complete tracheal ring helps support the stoma and prevent stenosis
   - Vlantis et al.
     260 patients: 6% stenosis rate

• Dividing the trachea ring: good mucosal cover for the first remaining ring that was sutured to the angle of the skin (stent the stoma open)
A. How the trachea is divided

2. Beveling the trachea

- The cross-sectional area of the stoma is larger
- Beveling the trachea: two or more loose pieces of exposed cartilage
- Cartilage: no support and are at risk of developing perichondritis (scar tissue formation)

- Griffith and Luce
  stenosis rate: straight 29%, bevel 15%
A. How the trachea is divided

3. Plastic or flap construction technique

Lam et al.

X-shaped incision >> creating four triangular skin flaps >> trachea was transected horizontally and four slits divided trachea >> skin flaps were sutured into the slits

4% stenosis in 25 patients

Kuo et al. 213 patients (8-years): 13% stenosis

Wax et al. no stenosis in 25 patients (6 months) skin flap was inserted into the ant. tracheal wall
Fig. 1. **A**, After the skin of the lower cervical flap is defatted, an oblique incision is made. **B**, Trachea is divided through the rings anteriorly. **C**, Tip of the skin flap is rotated and advanced. It is inset into the V formed by the separation of trachea.
### A. How the trachea is divided

**Table 2. Incidence of postlaryngectomy tracheal stenosis and the effect of closure at the time of initial surgery**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>No. of patients</th>
<th>Circle (%)</th>
<th>Bevel (%)</th>
<th>Plastic (%)</th>
<th>Overall stenosis rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Griffith and Luce</td>
<td>1982</td>
<td>99</td>
<td>56 (71)</td>
<td>20 (15)</td>
<td>13 (8)</td>
<td>22</td>
</tr>
<tr>
<td>Yonkers and Mercurio</td>
<td>1983</td>
<td>107</td>
<td></td>
<td></td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>Lam et al.</td>
<td>1983</td>
<td>141</td>
<td></td>
<td>116 (31)</td>
<td>25 (4)</td>
<td>26</td>
</tr>
<tr>
<td>Balle and Bretlau</td>
<td>1985</td>
<td>36</td>
<td>36 (55)</td>
<td></td>
<td></td>
<td>55</td>
</tr>
<tr>
<td>Kuo et al.</td>
<td>1994</td>
<td>207</td>
<td></td>
<td></td>
<td>207 (13)</td>
<td>13</td>
</tr>
<tr>
<td>Wax et al.</td>
<td>1994</td>
<td>105</td>
<td>9 (75)</td>
<td>70 (33)</td>
<td>26 (0)</td>
<td>28</td>
</tr>
</tbody>
</table>
B. Where the stoma is sited
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1. Within the main incision
   - Nigam et al.
     - Separate: 16/35 (42%)
     - within the main incision: 1/26
   - stoma in the main incision: larger stoma (190mm² vs. 98mm²)
   - contraction of the incision
     - lateral pull on the trachea
     - widening the stoma

2. In a separate incision
   - Vlantis et al.
     - 260 patients (10-year)
     - all stomas were created by inserting a horizontally sectioned trachea in a separate incision in the lower skin flap
   - stenosis rate: 6%
B. Where the stoma is sited

- 1. less downward traction by the trachea on the stomal sutures (stoma was placed lower in the neck)
- 2. gentle, even, circumferential, outward traction on the stoma by the natural elasticity of the skin
- 3. the tracheal margin was offered a healthy blood supply
- 4. movement of the neck had less impact

- Lam et al. and Kuo et al. placed the stoma in the lower skin flap with low rates of stenosis: 4 and 13%

- Wax et al. and Watkinson et al. showed that positioning of the stoma to be noncontributory
C. Primary tracheoesophageal puncture

- tracheoesophageal puncture (TEP): Pharyngeal fistula, allows saliva to leak into the stoma
- Ho et al. Kuo et al. Trudean et al.
  (stenosis rate: 19.9%, 20%, 29%)
  higher incidence of stomal stenosis

- Wax et al.
- performed TEP + revision of stenotic tracheostomomas in 10 patients
- None developed a recurrence of stomal stenosis (minimum 2 years' follow-up)
Surgical techniques and influence

D. Use of a laryngectomy tube
- Foreign body at stoma margin
  - pressure necrosis of the edge of the stoma, trap secretion
  - aggravate infection and wound healing

Griffith and Luce
no association between the duration of usage of a cannula

E. Concurrent neck dissection
(Preservation of SCM m.) no significant association

F. Pectoralis major muscle flap
- Kuo et al. 26% stenosis
- Wex et al. 13/106 stenosis
No significant association
Management of tracheostomal stenosis

1. Wearing of a tube or stoma button
2. Repeated dilation of the stoma
3. Carbon dioxide laser: excise the skin and fibrous tissue from the stenosed trachea or lateral border
4. Surgical intervention
Dilation

Fig. 1. Hawkins Ambler uterine dilators, commonly used sizes.

Fig. 2a.

This diagram shows the stoma and the two lateral triangular areas to be ablated.

2 Triangular areas of tissue are ablated

This picture shows a patient with a narrow stoma.

Fig. 2b

This picture shows the two ablated triangular areas immediately after the procedure.

carbon dioxide laser

Fig. 3

This picture shows the healed and contracted wounds two weeks after the procedure. Note that the stoma is wider. 

Fig. 1
Surgical intervention

Principle:

1. break the circumference of the stoma with radial incision
2. interposition skin flap along the tracheal circumference

Z-plasty (Carleton 1970; Trail et al 1986)

V-shaped flap (Clarirmont 1978; Myers and Gallia 1982)

Transposing superior and inferior skin flap into wedge-shaped incision in the ant. and post. tracheal walls
V-Y flap

Z-plasty
Single posterior incision with a flap

Double lateral incisions with flaps
Surgical intervention

- **Maruyama et al. and Takato et al.**
  a five-flap technique (combined two Z-plasties with a V-Y advancement flap)

- **Bretteville et al.**
  1. 4-6 (usually 5) radial skin incisions in a star-shaped fashion and raised the interdigital skin flaps
  2. Tracheal incisions are then made midway between the skin incisions
  3. The skin and tracheal flaps are then interdigitated and sutured in place

- **Giacomarra et al.**
  star-shaped repair
Giacomarra et al.
Surgical intervention

Fenestrated deltopectoral skin flap:
Based on the cutaneous perforating br. of the internal thoracic a.
Surgical intervention

1. Vertical slit: lateral pull on the stomal margin by strait advancement and Z-plasty or double V-Y flap
2. Concentric stenosis: radial incision
3. Inferior shelf stenosis: inverted V-shaped skin flap

- Advancement flaps, single or double Z-plasties, superiorly based flaps, circular incision, swastika-shaped incisions with rotation flaps, and five-flap techniques with Z-plasties and V-Y advancement flaps....

- Operation successful rate: 90%
Surgical intervention

<table>
<thead>
<tr>
<th>Technique</th>
<th>Initial Success</th>
<th>Final Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advancement flap</td>
<td>8/9</td>
<td>8/11</td>
</tr>
<tr>
<td>Z-Plasty</td>
<td>13/15</td>
<td>15/18</td>
</tr>
<tr>
<td>V-Y inset</td>
<td>8/8</td>
<td>12/13</td>
</tr>
<tr>
<td>Other</td>
<td>2/4</td>
<td>3/6</td>
</tr>
<tr>
<td>Dilation</td>
<td>2/7</td>
<td>2/7</td>
</tr>
</tbody>
</table>

Wax et al
no difference success rates between the advancement flap, the Z-plasty, or the V-Y inset
The **timing** of the stomal revision: not well characterized in the literature

- **Bretteville et al.**: 85% repair more than 1 year following their initial procedure
- **Campbell et al.**: a median of 10 months after laryngectomy
- **Wax et al.**: median of 11 months after laryngectomy
Conclusions

- Tracheostomal stenosis: an unfortunate complication that follows total laryngectomy
- Multiple predisposing factors (including patient’s factor and surgical intervention)
- Surgical correction of tracheostomal stenosis: requires the introduction of additional tissue into the circumference of the stoma


Thank You!