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CLOSURE OF PAEDIATRIC TRACHEOCUTANEOUS FISTULA: SURGICAL TECHNIQUE

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A tracheocutaneous fistula (TCF) is an epithelial-lined communication between skin and trachea that persists after decannulation (removal) of a tracheostomy tube. TCF rates are higher in paediatric patients. It is a recognised complication of long-standing tracheostomies and has been linked to longer duration of tracheostomy dependence [1].

Complications associated with a persistent TCF include skin irritation; inadequate glottic closure causing a weak cough and airway compromise; poor phonation; poor cosmesis; increased risk of aspiration during swimming, bathing *etc.* [2]. Addressing a persistent TCF avoids delays with integration into society and mainstream schooling.

TCF is due to squamous epithelialisation of the tracheostomy lumen. Closure is achieved by excising the fistula followed either by primary closure or allowing for healing to occur by secondary intention. Although primary closure provides immediate resolution of the fistula and better cosmesis, it may be associated with life-threatening complications, regardless of the treatment center [3]. Allowing healing by secondary intention minimises such potential complications. It may however be perceived as "inconvenient" for the patients.

It is however the authors' preference to allow healing by secondary intention, safety in the immediate postoperative period being the primary reason.

Preoperative evaluation

1. **Patient selection is as important as timing of surgery:** We employ the following eligibility criteria based on aetiological and patient factors and use them as a guide for timing of surgery:
   - The original reason for the upper airway obstruction that necessitated the tracheostomy has resolved/been reversed
   - The child has been successfully decannulated for >1year; this sees the child through 1 winter season
   - Typically, children are >4 years old, weigh >15kg and have no central neurological deficits or cardiovascular compromise *e.g.* after cardiac surgery or pulmonary disease
   - If the surgery is done on a 2- 4-year-old child weighing >15kg, it is advisable to insert a tracheostomy tube for the 1st 24hrs immediately postoperatively
   - Diagnostic assessment of the upper airways is routinely performed before any decision is taken about surgery. Anatomical and physiological factors are discussed later

2. **Flexible nasendoscopy:** This is typically done in the clinic with the child awake. The nasopharynx, oropharyngeal inlet, base of tongue (BOT), supraglottis and vocal cord mobility are carefully assessed.

3. **Overnight sleep study / Overnight oximetry:** This is useful to assess children with reported sleep disordered breathing. The TCF is covered while asleep to assess for proximal airway obstruction.

4. **Direct laryngoscopy, tracheoscopy and bronchoscopy**
   - During induction of anaesthesia, the patient must breathe spontaneously and cope well with bag mask ventilation. The TCF can be covered with a dressing

- Flexible bronchoscopy is then done through a laryngeal mask
    - Confirm cord mobility
    - Spray the larynx with topical lignocaine
    - Perform dynamic assessment of upper airways, especially in cases of tracheomalacia and bronchomalacia
    - When aspiration is a concern, a broncheoalveolar lavage (BAL) is also done
- Perform rigid laryngoscopy +/- suspension
    - Assess all levels of the airway *i.e.* oropharynx, BOT, vallecula, epiglottis, supraglottis, false and true cords, subglottis, trachea (proximal to stoma), peristoma, distal trachea down to carina
    - If any pathology is identified, a staged approach with initial surgical correction required before the TCF can be addressed *e.g.* removing a suprastomal granuloma, addressing persistent subglottic stenosis *etc*
    - Record the size of the airway using appropriate-sized endotracheal tubes. A child of 4 years must admit at least a 4.5 ETT with a leak at 20cm H_20. If older, use a size uncuffed ETT of (Age/4) + 4.

If the child is considered eligible for closure of the TCF, then proceed to surgery

Surgical procedure to close a TCF

- Administer a single dose of prophylactic antibiotics (Kefzol), and a single dose of intravenous steroids
- Intubate the airway with an appropriate-sized cuffed (0.5 size smaller to accommodate a cuff) north-facing endotracheal tube *(Figures 1ab)*
- Position the child supine with a shoulder roll to extend the neck *(Figures 1ab)*
- A head ring may be required to maintain the head in a neutral position

Figure 1a: Child placed supine with neck extended and north facing ETT

Figure 1b: Patient with a prominent occiput positioned without a head ring

- Infiltrate the skin around the TCF with local anaesthetic (Lignocaine with adrenaline). Do not exceed the maximum safe dose *(Figure 2)*

Figure 2: Infiltration with local anaesthetic

- After cleaning and draping, identify the midline structures as tracheostomy sites typically are in a paramedian position and the TCF may be further from the midline than expected *(Figure 3)*

Figure 3: Occasionally, the TCF lies off the midline

- Mark the skin around the stoma in an elliptical shape *(Figure 4)*

Figure 4: Mark the skin around the TCF as an ellipse

- Incise the skin along the elliptical markings around the TCF
- Elevate the two ends and grip them using a tissue forceps *(Figure 5)*
- Dissect the soft tissue circumferentially around the stoma using cautery and blunt dissection

Figure 5: Skin incision, elevating the edges and grasping skin with tissue forceps

- Stay close to the TCF and expose a 10mm margin of trachea *(Figure 6)*
- Avoid dissecting into trachea *(Figure 6)*

Figure 6: Excision of tract, down to trachea

- Enter the trachea close to the TCF using an #11 blade, and circumferentially excise the TCF, removing as little tracheal tissue as possible (+/- 5mm) *(Figure 7)*

- Avoid a large defect by not excising too much of the anterior tracheal wall as it will take longer to close *(Figures 7, 8)*
- Ensure that there is no remaining skin in the tract as this will prevent closure

Figure 7: Resected TCF

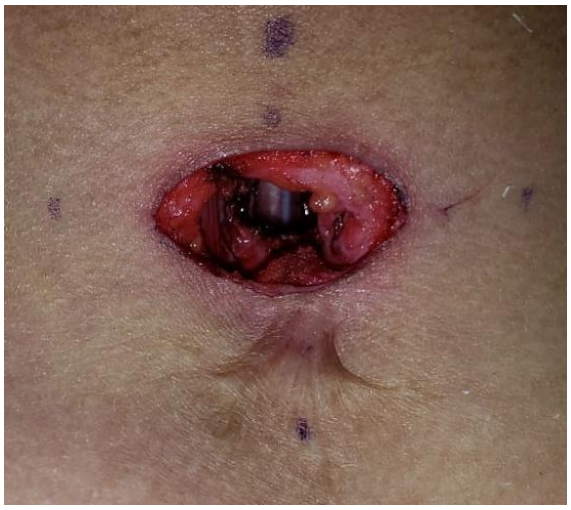

Figure 8: Defect following resection of TCF

- Oppose the skin with *steristrips (Figure 9)*
- Cover the defect with a pliable dressing that allows for a reservoir of air with the child's breathing *(Figure 10)*

Figure 9: Approximate wound edges with steristrips

Figure 10: Cover the defect with a pliable dressing

Postoperative care

- The surgeon must accompany the child from the operating room to the recovery room with an unopened appropriately sized paediatric tracheostomy tube to be kept at the bedside
- Once fully recovered, the child must be nursed in a high care ward
- For the first 24 hours, continuous monitoring of oxygen saturation, respiratory rate and heart rate, and watching for signs of respiratory distress, is paramount
- Sedation and good analgesia are recommended as crying and coughing increase the risk of surgical emphysema

- Immediately remove the dressing if there is any breathing difficulty, and reinsert a tracheostomy tube
- The child is transferred to a general paediatric ward for 24-48 hours
- Give strict instructions to the caregiver to avoid water around the revised stoma
- Change the dressing if it becomes soggy
- If secretions are copious, it is preferable to keep the stoma uncovered
- The child is reviewed at 1 week post-operatively
- The stoma is typically healed by then *(Figure 11)*

Figure 11: Stoma healed by secondary intention 1-week postoperatively

Complications

Immediate / 1st 24hrs

- Respiratory distress from
  - Pneumothorax *(Figure 12)*
  - Pneumomediastinum
- Surgical emphysema
  - As a result of air escaping from the trachea into surrounding tissues
  - May be forced into the mediastinum causing a pneumomediastinum
  - Immediate management requires prompt reinsertion of the tracheostomy tube and oxygen supplementation

Delayed

- Failure of TCF to close
- Peristomal granulation tissue
- Suprastomal (anterior) tracheal collapse
- Tracheomalacia
- Tracheal stenosis

Figure 12: Acute pneumothorax

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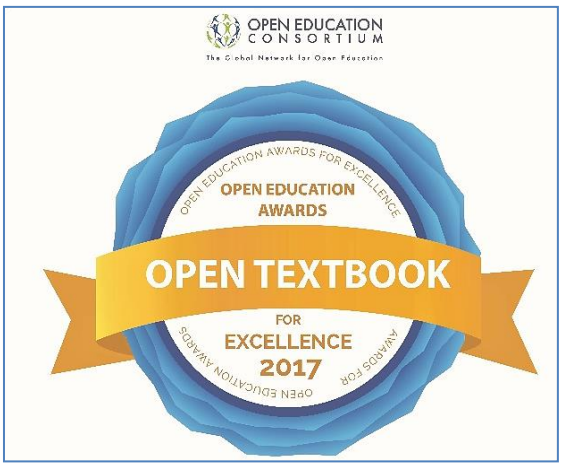

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