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Tracheostomy in children

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Summary Indictions, timing, and interventions to the airway resulting in tracheostomy are poorly characterised. There are no promulgated standards of care for tracheostomy in childrene. This paper addresses the issues associated with decision for tracheostomy, the timing of the intervention, the care for the tracheostomy in both the acute and chronic phase and the necessities for care at home. The paper attempts to describe some of the apparent problems associated with tracheostomy and practical techniques for treatment of the inadvertent complications.

Tracheostomy means, literally, "a hole (ostomy) connecting trachea to outside of body", The first tracheotomy was reportedly performed in Rome in the second century B.C. Antyllus in the second century A.D. further refined the technique. He suggested that the trachea be divided between the third and fourth tracheal rings using a transverse incision. Mabicot is credited with performing the first pediatric tracheotomy in 1620. In contrast to adult literature, it is an interdisciplinary area in pediatrics and pediatric otolaryngology that is changing rapidly, and is not well nor rigidly formulated. Some of the literature included premature babies and newborns or infants only. In reviewing recent (post-1990) literature, 56% of all patients were less than 6 months old, 32% were 6 months until 3 years, and 12% were between 3 and 6 years of age.

Among the indications for tracheostomy, premature birth increased from 28% to 58%, congenital anomalies from 6% to 23%, acquired subglottic stenosis from 2% to 23%, and neuromuscular disease from 9% to 23% (a combination of several indications was possible). At the same time, the indication for infectious diseases declined from 50% to 3%.

In the 1970s it was still recommended that a patient receive a prophylactic tracheostomy if it was foreseeable that the patient would have to be ventilated for more than 8 days. Newer studies recommend that the indication for pediatric tracheostomy also should be decided individually according to clinical and endoscopic findings. The intubation periods in these studies ranged from 2 to 134 days (on average, 31 days) although in 1992 Puhakka quoted an average intubation period of 65 days before performing a tracheostomy.

In one study the indications for tracheostomy were categorized into 3 groups: (1) unsafe or obstructed airway meadin time 59 days, (2) prolonged mechanical ventilation required (median time 4 years), and (3) tracheobronchial toilet or risk of aspiration (median time 10 years). The indications for hospital admission were categorized according to the primary system that was affected; the trauma-category encompassed patients with multiple-system injuries from motor vehicle accidents.

REASONS FOR ADMISSIONS

Respiratory		37
Anatomic upper airway obstruction	26	
Respiratory infection	6	
Respiratory arrest	5	
Trauma		11
Closed head injuries with multiple fractures	11	
Neurologic	8	
Infection of central nervous system	4	
Hypoxic brain injury	2	
Epilepsy	1	
Cerebral hemorrhage from arteriovenous malformation	1	

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Cardiovascular (cyanotic heart disease)		4
Gastrointestinal	2	
Other (malignancy, sepsis)	3	
Total		65

REASONS FOR TRACHEOSTOMY

Unsafe or obstructed airway		36
Subglottic stenosis	13	
Subglottic hemangioma	4	
Vocal cord palsy	4	
Other (craniofacial syndromes, glossoptosis, pharyngeal hypotonia, epiglottitis)		15
Mechanical ventilation		15
Central nervous system abnormality	5	
Cyanotic heart disease	4	
Respiratory failure	4	
Respiratory infection	1	
Sepsis	1	
Tracheobronchial toilet or aspiration risk	14	
Trauma-related head injury		10
Hypoxic brain injury	2	
Intracerebral hemorrhage	1	
Respiratory infection	1	

The median PICU stay was 25 days (range 7–259 days), and a median hospital stay of 52 days (range 5–472 days).

A substantial number of patients still have tracheostomy in place (64% decannulation rate). The majority were those with unstable airway/mechanical ventilation, especially where further surgical intervention was needed. The overall mortality rate was high at 18%; but was usually due to unrelated causes.

The early complication most frequently mentioned in the literature is the development of interstitial air (emphysema, pneumomediastinum, pneumothorax). than 12 months is up to 43%, but is lower in infants less than 12 months, 28%, presumably because the children are less active. The complications that most often result in death are accidental decannulation and cannula obstruction. These may happen immediately after the operation as well as during the entire following period.

Some of the most frequent late complications are the appearance of granulations, laryngeal stenosis, and tracheal stenosis. The complication rate of our patient group was 56%, 36% being caused by granulations, which possibly do not need to be evaluated as a complication.

Cannula obstruction occurs in children older than 1 year at a rate of up to 14%; in premature babies and newborns, however, it occurs at a rate of up to 72%. The much higher rate of cannula obstruction in premature babies and newborns seems to be related to the narrow inner radius of the small tracheostomy cannulas as well as to the fact that almost half of the patients suffer from a bronchopulmonary dysplasia, which goes along with the development of viscous bronchial secretion. Accidental cannula dislocation and decannulation can happen at any time and, unfortunately, often remains unnoticed. This occurs in premature babies and newborns in up to 7% and in older children in up to 16%. MacRae found mortality rates of 24%, 15%, and 10% in the groups greater than 36, 12 to 36, and 6 to 12 months, whereas the mortality rate of children less than 6 months was 33%. All deaths in the first 3 groups were caused by the underlying illness, whereas 11% of the deaths in the group of children younger than 6 months were tracheostomy related. In the same study, almost every second child younger than 3 years had complications, the children older than 3 years, however, only had complications in 15% to 20% of cases.

Tracheostomy tubes are indicated in cases of upper airway obstruction, for children who cannot protect their airway, and for patients with long-term mechanical ventilation. Children usually remain hospitalized until the first tube change, which allows some maturation of the stoma. Optimal tracheostomy care starts with the proper tube of appropriate size and shape to fit the airway without exerting pressure on the tracheal mucosa. It also must fit well enough to prevent aspiration (if that is its primary purpose) or loosely enough to allow translaryngeal air escape for vocalization and mucous clearance. It must have an adequate inside diameter to prevent airflow restriction. This should be tailored to each child's specific circumstances. Standards of care in the hospital should include 24-hour 1:1 care from a provider trained in acute troubleshooting of tracheostomy complications. Complications include accidental decannulation, creating of a false passage, obstruction, infection, hemorrhage, pneumothorax, pneumomediastinum, peritracheal cellulitis, and lower airway infection. Although accidental decannulation and obstruction are the most common overall complications, they are rarely encountered in the inpatient setting. Because of their acuity, they are rapidly addressed by bedside caregivers and rarely impact the hospitalist directly. Peritracheal infection usually can be treated with oral antibiotics and local wound care, but it can lead to mediastinitis if not addressed. Lower respiratory tract infections are common. Children with tracheostomies are colonized with multiple pathogens, including Staphylococcus aureus, Pseudomonas aeruginosa, and Candida albicans. Empiric antibiotic therapy should reflect this. A rare(1%–2%), life-threatening complication is erosion into the innominate artery,

LIST OF POST-OPERATIVE COMPLICATIONS OF PEDIATRIC TRACHEOSTOMY

- Suprastomal collapse
- Tracheal wall granuloma
- Tracheoesophageal fistula
- Depressed scar
- Laryngotracheal stenosis
- Tracheal wall erosion
- Catastrophic hemorrhage
- Tracheomalacia
- Tube obstruction or displacement
- Decannulation failure
- Recurrent tracheitis/bronchitis
- Death