Tracheostomy

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Abstract

The records of all children who had a tracheostomy performed over a 10 year period from January 1979 were reviewed. Altogether 142 patients aged 1 day to 24.8 years received a tracheostomy, 70 in the first year of life. The conditions necessitating tracheostomy were trauma (n=21), acquired subglottic stenosis (n=21), subglottic haemangioma (n=16), Guillian-Barré syndrome (n=14), Pierre Robin syndrome (n=9), craniofacial disorders (n=9), micrognathia (n=5), and others in 47. In patients successfully decannulated the median period of tracheostomy was 104 days (range 3 days to 9.0 years) and in 25 patients the tracheostomy is still in situ. Eighty four patients (60%) were discharged from hospital with their tracheostomy in situ and no patient was kept in hospital because of a tracheostomy beyond four weeks. There were two tracheostomy related deaths in hospital. Both patients had severe acquired subglottic stenosis secondary to ventilation for lung disease of prematurity. There were no tracheostomy related deaths at home; complications included tracheal granulomas and polyps (n=19). After removal of the tracheostomy 13 children had a fistula requiring surgical closure and four required revision of the tracheostomy scar.

Tracheostomy is well tolerated in small children, with few complications and can be managed safely in the home by the family.

Tracheostomy has been practised for 2000 years.¹ The use of tracheostomy is well established in children,^{2,3} although recently its indications and safety have come under scrutiny.^{4,5} Despite many improvements tracheostomies are still associated with significant morbidity and mortality.⁶⁻⁹ The purpose of this review of 142 consecutive tracheostomies performed at the Royal Children's Hospital over a 10 year period was to identify the current indications and morbidity associated with tracheostomy in infants and children.

Patients and methods

The patient records of all children in whom a tracheostomy was performed at the Royal Children's Hospital, Melbourne between 1 January 1979 and the 1 January 1989 were analysed. The Royal Children's Hospital is the main paediatric hospital in the state of Victoria, Australia, serving a population of approximately one million children (0-16 years).¹⁰

During the period studied the technique of tracheostomy remained fairly standard and is still employed. Our routine procedure for elective tracheostomy has involved the placement of an endotracheal tube if one is not already in situ. A sandbag is placed beneath the shoulders to fully extend the neck and head. A transverse skin incision is made 1-2 cm below the cricoid, depending on the size of the child. The subcutaneous tissue and platysma are divided in the line of the incision, and the fascia between the strap muscles divided in the midline. Lateral retraction of the strap muscles exposes the pretracheal fascia. Sometimes the isthmus of the thyroid needs to be retracted superiorly, or divided. Two 3/0 stay sutures are inserted below the second tracheal ring on either side of the midline.

Between the stay sutures a midline vertical incision is made extending through the second, third, and occasionally the fourth tracheal rings using a scalpel. As the endotracheal tube is slowly removed the stay sutures are lifted forward to open the tracheostomy and enable the tracheostomy tube to be inserted. Where applicable, the trochar of the tracheostomy is removed before the tube is connected to the anaesthetic tubing. The tracheostomy tapes are secured around the neck and after closure of the lateral edges of the skin wound, the stay sutures are taped to the anterior chest wall. If accidental displacement and removal of the tracheostomy tube occurs, traction on the stay sutures will facilitate safe reintubation. Postoperatively the patients are nursed in the intensive care unit until the first tube change has been performed on the fifth postoperative day.

When a child is discharged with the tracheostomy in situ, the family becomes primarily responsible for his or her care. Support is offered by a clinical nurse specialist who is based at this hospital and educates the family in tracheostomy care, including recannulation, before discharge and provides a telephone support service. The patients also have regular medical outpatient review. The parents are issued with a portable Laerdal suction unit,

Table 1 Indications for intubation before tracheostomy

Diagnosis	No of patients (n=97)	Median duration of intubation (days)
Subglottic stenosis	21	15
Head injury	17	10
Guillain-Barré syndrome	14	6
Prematurity	10	76
Pierre Robin syndrome	5	9
Subglottic haemangioma	5	4
Others	25	

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which is capable of generating -66.7 kPa (-500 mm Hg) with a free air flow of 32 l/minute and a time constant of 4 seconds. It has a rechargeable battery back up power supply. They use an intercom to monitor the child while it is asleep. Although this responsibility places a heavy burden on the family, this approach allows children to be managed safely in their home environment.

Results

Tracheostomies were performed on 142 patients (82 male, 60 female). Their age ranged from the first day of life to 24.8 years (median age 14 months). The median (range) duration of symptoms before admission was four days (1–1620 days) and before tracheostomy 20 days (1–1626 days). The smallest infant had a weight of 2500 g at the time of tracheostomy. Tracheostomies were performed for congenital airway anomalies in 64 (45%) and for acquired lesions in 78 (55%) of patients.

Ninety seven patients were already intubated before tracheostomy, the indications for which are given in table 1.

About half (70) of the tracheostomy tubes used were Great Ormond Street (J G Franklin and Sons Ltd), 50 were Portex (Portex Limited), seven were Shiley (Shiley Incorporated), and three were metal tubes. In 12 patients (8%) the type of tube could not be determined.

Table 2 Indications for tracheostomy ($n=142$)

	No of patients
Acquired subglottic stenosis:	
Premature infants	11
Others	10
Head injury	17
Subglottic haemangioma	16
Guillain-Barré syndrome	14
Craniofacial anomalies	9
Pierre Robin syndrome	8
Vocal cord paralysis	6
Micrognathia	5
Croup	5
Laryngomalacia	4
Laryngeal trauma	4
Brain tumour	4
Cardiorespiratory arrest	3
Tracheomalacia	2
Cystic hygroma	2
Obstructive sleep apnoea	2
Others	20

Table 3 Outcome

	No of patients	Deaths	Decannulation of survivors		
			Successful	Failed	Not attempted
Subglottic stenosis:					
Acquired	21	2*	14	1	4
Congenital	1	0	0	0	1
Head injury	17	3	12	0	2
Subglottic haemangioma	16	0	14	0	2
Guillain-Barré syndrome	14	0	14	0	0
Craniofacial anomalies	9	3	4	2	0
Pierre Robin syndrome	9	1	8	0	0
Micrognathia	5	0	5	0	0
Bilateral vocal cord palsy	6	1	1	3	1
Croup	5	0	5	0	0
Laryngomalacia	4	0	3	0	1
Laryngeal trauma	4	0	2	0	2
Malignancy	7	5	1	1	0
Others	24	4	15	2	3
Total	142	19	98	9	16

*Tracheostomy related deaths (accidental decannulation).

After insertion of the tracheostomy 102 patients received oxygen treatment (median duration five days; range 1–300 days) and 36 patients were ventilated (median 12 days; range 1–316 days). Thirty seven patients received continuous positive airway pressure (CPAP) (median two days; range 1–150 days) with 14 receiving CPAP alone. Of those who were ventilated 14 had Guillain-Barré syndrome and nine required ventilatory support for intracranial trauma, infection, or hypoxia.

The indications for tracheostomy are given in table 2. Ninety six patients (68%) had upper airway obstruction and 45 patients (32%) needed long term ventilation. Of the five patients with croup the median duration of endotracheal intubation before the tracheostomy was 6.5 days (range 1–10 days). Only one tracheostomy was performed as an emergency procedure and no patients have needed a tracheostomy for croup since July 1984. No patients with epiglottitis were managed with a tracheostomy.

There were no significant perioperative complications and no patient was kept in hospital because of the tracheostomy beyond four weeks. Eighty four patients (60%) were discharged with the tube still in situ. Of the 123 survivors 107 (86%) were successfully decannulated with 87 patients (70%) decannulated at the first attempt; 25 patients still have their tracheostomy. In 16 patients decannulation has not been attempted: these patients have a severe head injury, craniofacial anomalies, tracheomalacia, vocal cord paralysis, or congenital or acquired subglottic stenosis awaiting formal surgical correction. The outcome of all patients is shown in table 3.

In the patients who have been successfully decannulated, the median duration of cannulation was 105 days (range 3 days–9.0 years). In those with the tube still in situ the median duration of cannulation (as of 30 April 89) was 2.7 years (range 0.74–9.4 years). In the premature infants who have been successfully extubated the median duration of cannulation was 396 days (range 114–812 days) and of those with the tube in situ the median duration of cannulation was 2.6 years (range 0.8–5.6 years).

Patients aged over 12 months with acquired subglottic stenosis are given laser treatment if the area of stenosis is a circumferential mem-

Table 4 Laser treatment

Diagnosis	Decannulation		
	Successful	Failed	Not yet attempted
All patients with acquired subglottic stenosis (n=21)			
Laser	4	3	3*
No laser	7	0	4*
Total	11	3	7
Premature infants with acquired subglottic stenosis (n=11)			
Laser	2	1	3*
No laser	1	0	4*
Total	3	1	7
Subglottic haemangioma (n=16)			
Laser	6	0	1
No laser	8	0	1
Total	14	0	2

*One patient died with the tracheostomy in situ. All patients who failed decannulation were successfully decannulated after laser treatment.

brane no more than 1 cm in depth. Patients with subglottic haemangiomata are given laser treatment if their tracheal lumen is inadequate at 18 months of age and the haemangioma has not showed signs of resolution. The outcome of these patients is shown in table 4.

Five (63%) of patients with the Pierre Robin syndrome failed to achieve an adequate airway after the insertion of nasal tubes or a lip tongue anastomosis, or both. Four (44%) of the patients with craniofacial anomalies subsequently had craniofacial surgery and three are now decannulated. Both patients with tracheomalacia had a tracheo-oesophageal fistula that had been surgically repaired. One patient subsequently had a tracheopexy that allowed decannulation.

There were two patients with obstructive sleep apnoea. One patient with Down's syndrome and severe failure to thrive still had significant upper airway obstruction after adenotonsillectomy. He was successfully decannulated after 18 months when he had achieved normal growth. The second patient with a repaired cleft palate developed obstructive sleep apnoea after a pharyngoplasty and required a tracheostomy, which is still in situ 34 months later.

Complications during cannulation were seen in 19 (13%) patients and included tracheal granulomas (n=14), tracheal polyp (n=1), tracheal diverticulum (n=1), and a paratracheal abscess (n=1). One patient developed bilateral pneumothoraces during replacement of a blocked tube. None of these complications resulted in long term morbidity. A further patient has no tracheal lumen after ignition of anaesthetic gases in his trachea during laser treatment for severe acquired subglottic stenosis.

After successful decannulation tracheostomy related complications occurred in 19 (13%) patients and included surgical closure of a tracheal fistula (n=13), revision of the scar (n=4), tracheal stenosis (n=1), and significant tracheomalacia (n=1). These were significantly more common in patients who had been cannulated with the Great Ormond Street tube (p<0.001). These tubes, however, were more commonly used in the younger children.

All the premature infants who required a tracheostomy had upper airway obstruction.

Eleven of the 16 patients had acquired subglottic stenosis, three had subglottic haemangiomata, one had a tracheo-oesophageal fistula with tracheomalacia, and another a laryngeal web. The incidence of complications during cannulation was 31% (tracheal granulomas) and the incidence after tracheostomy was 12.5% (tracheocutaneous fistula requiring surgical closure).

Of the 19 patients who died (table 3), 11 died with the tracheostomy tube in situ. Only two deaths were related to accidental decannulation and both occurred in hospital. Both patients had severe acquired subglottic stenosis secondary to ventilation for lung disease of prematurity. One patient also had cri du chat syndrome. There have been no tracheostomy related deaths at home. The most common causes of death of the other patients were malignancy and severe head injury. There were no deaths of patients with Guillian-Barré syndrome, subglottic haemangioma, obstructive sleep apnoea, croup, or laryngomalacia.

Discussion

The reduction in the incidence of diphtheria since the introduction of a vaccine in 1940,⁵ and the greater use of prolonged nasotracheal intubation for the management of croup and epiglottitis, have lead to a decrease in the need for tracheostomy in acute laryngeal infections. Improvements in paediatric intensive care have increased the survival of critically ill children, including premature infants, and therefore there has been an increase in the incidence of tracheostomies in children requiring prolonged intubation. This trend has previously been described.^{5 6 8 9 11 12}

The incidence of successful decannulation at the first attempt was 70%, similar to other studies.^{6 7 9} Swift and Rogers report a 60% success rate with 46% undergoing surgical excision of the tracheostomy stoma at the time of decannulation.⁷ In 22% of these patients post-operative stridor occurred, which was relieved by reopening the stoma in half the patients. In our institution patients are decannulated on the ward after bronchoscopy has been performed to ensure an adequate airway exists. The tracheostomy is not occluded before attempted decannu-

lation nor is the stoma surgically excised. The patients are observed for a further 24–48 hours before discharge. Our results indicate that surgical excision of the stoma is unnecessary as the incidence of successful decannulation is no greater and the postoperative upper airway obstruction is avoided.

In this study the complication rate during cannulation was 13%, lower than reported by other authors.^{6–9 13} After decannulation the incidence of complications is comparable with other studies.^{6 7 9} Over the last decade, prolonged survival of premature infants (gestation <37 weeks) who may require lengthy periods of mechanical ventilation has resulted in an increase in acquired subglottic stenosis.¹⁴ These infants have an increased duration of intubation before tracheostomy and an increased duration of tracheostomy compared with the rest of the study population. This may explain the higher incidence of tracheal granulomas during cannulation. Premature infants with acquired subglottic stenosis have a disappointing rate of successful decannulation despite the use of laser treatment (table 4).

The incidence of tracheostomy related deaths is comparable with other studies that also describe an incidence of about 2%.^{7 8} Both tracheostomy related deaths in this study were due to accidental decannulation, which occurred despite the tube being tied in position. No deaths were due to tube blockage and no deaths occurred at home.

The patients who were discharged with their tracheostomy in situ were discharged from hospital within four weeks of tracheostomy unless there were other conditions that required

ongoing inpatient management. The major difficulties experienced by parents were the frequency of suction and finding qualified people to provide relief care for their child. All children of school age who were neurologically normal were able to attend a normal school with the assistance of an integration aid who was trained by the parents with the support of the clinical nurse specialist.

Tracheostomy is well tolerated in small children, with few complications, and most patients can be safely managed in the home by the family.

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