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Pediatric Tracheotomy: A Relatively Rare Indication Limited to Pediatric Intensive Care Subjects?

Original Investigation

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Abstract

Objective: To evaluate indications, underlying conditions and outcome in pediatric tracheotomy subjects.

Methods: Between January 2004 and September 2013, pediatric subjects who underwent a tracheotomy operation were included for study. All subjects were under the age of 14. Subjects' primary diseases, indication of tracheotomy, age, gender and type of complications were recorded.

Results: Forty five subjects were identified. The mean age of subjects was 26.3 months (range between 2 to 140 months). Twenty one (46.6%) subjects were under the age of 1 year. In 34 (75.5%) out of 45 subjects, tracheotomy indication was prolonged intubation. In the remaining 11 (24.4%) subjects, tracheotomy indication was upper respiratory tract obstruction. Thirteen (n=13-28.8%) out of 45 experienced early complications and 2 (n=2-4.5%) out of 45 subjects experienced late complications. One tracheotomy related death occurred in the immediate period. Eight (18.1%) of subjects died during the study period from underlying conditions. Decannulation was successfully performed in 13 (36.1%) subjects. In the remaining 23 (63.8%) subjects, decannulation could not be done.

Conclusion: All tracheotomies in this report were performed on pediatric intensive care subjects on an elective basis. No tracheotomy was performed for acute upper airway obstruction. Even when planned and elective tracheotomy is performed it still has significant mortality and morbidity.

Key Words: Pediatric, tracheotomy, intensive care, complication

Introduction

Pediatric tracheotomy is an infrequent procedure performed for access to the upper airway. Apart from emergency conditions and upper respiratory airway obstruction, it was also done for assisted ventilation or to ease the pulmonary washout (1). The first description of tracheotomy goes back to 100_{BC} to Asclepiades (2). The first successful tracheotomy in the pediatric age was reported in 1766 by Caron who performed tracheotomy for foreign body removal (3).

In 1997, in a national study, Lewis et al. (4) reported the rate of tracheotomy as 6.6 children per 100.000 children. In spite of its relative rarity, tracheotomy has greater morbidity and mortality rates when performed on newborn and infants (3). Despite the improvements in health care, high complication rates were noted between 22% and 77% in different series (5). In the past 20 years indications as well as tracheotomy technique have been changed. This report presents our experience for the past 7 years.

Methods

This study was performed at ENT Clinic Bakırköy Dr. Sadi Konuk Training and Research Hospital Between January 2004-September 2013. Pediatric subjects who underwent a tracheotomy operation were included for study. All subjects were under the age of 14 years. The subjects' primary diseases, indication of tracheotomy, age, gender and type of complications were recorded.

All tracheotomies were performed by otolaryngology specialists in the operating theatre under general anesthesia. A shoulder roll was used for neck extension. For all subjects, a vertical incision was per-

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formed on the skin in the midline. After deep dissection the thyroidal isthmus was retracted and tracheal rings were identified (Figure 1). A tracheal incision was made between rings 3 and 5 in the vertical fashion. The tracheal wall was sutured to skin in both sides with 0 Prolene suture (Figure 2) and a patent tracheotomy was performed (Figure 3). Subcutaneous fat was not removed. An appropriate diameter tracheotomy tube was inserted. The tube was secured with stay sutures and circumferential tapes were used across around the neck. No horizontal incision was used and no tracheal ring was removed.

Results

Thirty five subjects were identified. The mean age of the subjects was 26.3 months (range between 2 to 140 months). Twenty one (46.6%) subjects were under the age of 1 year.

In 34 (75.5%) out of 45 subjects, the tracheotomy indication was prolonged intubation. In the remaining 11 (24.4%) the tracheotomy indication was upper respiratory tract obstruction (Table 1). In all the subjects, tracheotomy was carried out as an elective tracheotomy. During the study period no tracheotomies were performed as an emergency. Underlying diseases were presented in table 2.

Thirteen (n=13-28.8%) out of 45 subjects experienced early complications including intraoperative bleeding, early postoperative bleeding, subcutaneous emphysema, pneumothorax accidental decannulation and tracheotomy related death (Table 3). One tracheotomy related death was observed. Tracheotomy related death was due to accidental decannulation.

Two (n=2-4.5%) of 44 subjects experienced late complications including stomal granulation and tracheocutaneous fistula. Eight (18.1%) out of 44 subjects died during the study period from underlying conditions.

Neither intraoperative bleeding nor postoperative bleedings were clinically important since they were rapidly controlled. Two subjects experienced pneumothorax. One of the subjects needed chest tube replacement, however the other subject's pneumothorax resolved with observation.

Decannulation was performed in our hospital on an inpatient basis. All subjects were interned. Decannulation was successfully performed in 13 (%36.1) out of 36 subjects. In the remaining 23 (63.8%) subjects, decannulation could not be performed.

Table 1. General indications for tracheotomy

Indications	n	%
Prolonged intubation	34	75.5%
Upper respiratory airway obstruction	11	24.4%
Total	45	100%

Table 2. Underlying diseases of subjects

Underlying disease	n (%)	Underlying disease	n (%)
Spinal muscular atrophy	6 (13.3%)	Bronchopulmoner dysplasia	1(2.2%)
Metabolic disease	5 (11.1%)	Down syndrome	2(4.4%)
Congenital cardiovascular disease	3 (6.6%)	Posttraumatic epidural hematoma	1(2.2%)
Aspiration pneumonia	3 (6.6%)	Caustic ingestion	1 (2.2%)
Trauma	2 (4.4%)	SSPE	1 (2.2%)
Cerebral palsy	3 (6.6%)	Hypoxic ensephalopathy	1 (2.2%)
Myopathy	2 (4.4%)	Arnold-chiari malformation	1 (2.2%)
Subglottic stenosis	1 (2.2%)	Dural venous thrombosis	1 (2.2%)
Tracheomalasia	1 (2.2%)	Intracranial glioblastoma	1 (2.2%)
Macroglossia	1 (2.2%)	Pierre robin sequence	2 (4.4%)
Acut respiratory distress	1 (2.2%)	Foreign body aspiration	1 (2.2%)
Prematurity	1 (2.2%)	Broncopneumonia	1 (2.2%)
Charge sendrom	1 (2.2%)	Epilepsy	1 (2.2%)

Discussion

Pediatric tracheotomy is a challenging subject. In the last decades indications for tracheotomy have changed. The leading cause in the past was acute infections such as diphtheria, epiglottitis and croup (4). The advent of vaccination, increased use of orotracheal intubation and improvement in pediatric intensive care units markedly decreased this indication (2). The incidence of pediatric tracheotomy has also decreased. Recent indications are mostly prolonged mechanical ventilation or upper respiratory obstruction. The change in indications and incidence is related to improved pediatric intensive care and effective medical therapy for previous diseases which were treating with tracheotomy (6). Premature subjects with severe congenital malformations, severe pulmonary and neurological diseases have increased survival today (3). A shift in indications for these subjects occurred. This shift also affects the age at which the tracheotomy was performed. Most of the subjects were under the age of 1 (3, 4, 7, 8). Among our subjects, twenty one (46.6%) subjects were under the age of 1. Underlying severe conditions also affect the outcomes. Higher mortality and morbidity rates are still reported despite the improvements in health care.

Table 3. Complications in pediatric tracheotomy subjects

Complication (Early)	n (%)	Complication (Late)	n (%)
Intraoperative bleeding	3 (6.6%)	Stomal Granulation	1 (2.2%)
Early postoperative bleeding	3 (6.6%)	Tracheocutanous fistula	1 (2.2%)
Subcutaneous amphysema	2 (4.4%)		
Pnomotorax	2 (4.4%)		
Accidental decanulation	2 (4.4%)		
Tracheotomy related ex	1 (2.2%)		
Total	13 (28.8%)		2 (4.5%)

Figure 1. After incision and deep dissection thyroidal isthmus was retracted and tracheal rings were identified

Figure 2. Tracheal incision was made and tracheal walls sutured to skin on both sides

The incidence of indications differs according to pediatric tracheotomy series. Ozmen et al. (2) reported 282 pediatric subjects who underwent tracheotomy between 1968 and 2005. The leading cause was upper respiratory obstruction in 72% of the subjects. In 28% percent of the subjects tracheotomy was performed for prolonged intubation. They also noted a shift towards prolonged intubation after the 1990s. In contrast, Carron et al. reported the results of 10 years experience on 208 subjects. The upper airway obstruction accounts for only 19% of the subjects (9). In a study between 1991 and 2003, Ang et al. (7) reported 48 subjects. The majority of tracheotomies

Figure 3. A patent tracheotomy was formed

were for assisted ventilation. Mahadevan et al. (6) evaluated 122 pediatric subjects who underwent tracheotomy between 1987 and 2003 and upper airway obstruction was the leading cause (70%). The shift of indications to chronic conditions was not observed in this study. In our subjects, prolonged intubation was the leading cause of pediatric tracheotomy.

Prolonged ventilation is needed in various congenital or acquired diseases including lung disease and pulmonary, cardiovascular or neurological abnormalities leading to respiratory failure (1). Prolonged intubation will cause tracheobronchial damage which will result in subglottic and laryngeal stenosis. Children are more tolerant to tracheotomy than adults. Newborn can tolerate intubation for more than 50 days without tracheobronchial damage (10). However, the description of prolonged intubation requiring tracheotomy is not well established. This is why the tolerance of children to intubation alters according to individual characteristics, including age, birth weight, underlying conditions etc. The previous consensus is to perform tracheotomy on subjects who need mechanical ventilation for more than 21 days (11). Lee at al. (10) reported that children can safely remain intubated for 30 to 60 days. However, the duration of intubation will not predict the need of tracheotomy and the actual timing is based on the clinical decision instead of well established guidelines.

Tracheotomy technique differs from surgeon to surgeon. Both in classical textbooks and literature most tracheotomies are performed through a vertical skin incision (5). A vertical skin incision has several advantages. Incision can easily be prolonged, access to the trachea is easier in the case of an accidental decanulation and it is easy to replace the tracheotomy tube. We prefer to use a vertical skin incision for the above mentioned advantages. The other possibility is to make a horizontal incision which is also reported in different series (2, 6). Although some modifications such as starplasty exist, this technique is not widely used (5, 12). Management of a thyroid

isthmus is also a challenging issue. Retraction, division and suture ligation division with cautery were all used (13). Routine division was done since, in the case of an accidental decanulation, the isthmus can obstruct the incision. Most authors propose a suture that combines the tracheal edges and skin. We prefer to retract the thyroid isthmus and also use sutures to combine the tracheal edges and skin. Subcutaneous fat removal is advised by some authors. They believe that this creates a more patent stoma and keeps the tracheotomy tube in a more central position (5). However we did not remove the fat tissue in our subjects.

Ozmen et al. (2) reported that, before the 1990's, they removed cartilage in order to create a cartilage window. For tracheotomy, removal of a cartilage ring is now changed with a vertical incision. The former technique has a great risk of airway stenosis. After the creation of tracheal access, it is important to secure the tracheotomy tube with tapes. In order to prevent accidental decannulation; intensive care nurses and family need to be instructed, since an accidental decannulation will lead to an undesired complication as seen as exitus among our subjects (1). Mahadevan and Ozmen et al. (2, 6) also reported subjects which died due to accidental decannulation.

The decision for tracheotomy also requires the consideration of risks (10). The previous data indicate that tracheotomy related complications including death did not decrease despite much medical progress. As in our subject, Ozmen et al. (9) also reported an exitus from accidental decannulation in their report. Accidental decannulation accounts for 53% of early complications in a large series. In order to prevent decannulation we also replaced stay sutures.

Overall, the tracheotomy related death rate ranged between 0% and 3.6% according to series (2, 6). Death was also reported due to innominate artery erosion. However,in our series deaths were mainly due to underlying diseases (8). In his review, Davis reported the overall mortality rate as 18%, which usually occurs from unrelated causes (14). Eight (18.1%) out of 44 subjects died during the study period from underlying conditions.

In the last 7 years our center has not performed any tracheotomy for acute upper respiratory obstruction. Whole tracheotomies in this study are performed on subjects who were admitted to pediatric intensive care unit. In our pediatric intensive care unit no percutaneous tracheotomy was done for any subject. A percutaneous tracheotomy will be complicated in pediatric subjects when the small size of the trachea and close relation of vital structures (e.g carotid artery) to the trachea was considered. Even when all surgeries are planned and performed in the operating theatre, an early complication rate as high as 28.8% occurred in the study group.

The underlying disease is chronic in our subjects. These subjects needed tracheotomy for months to years. Successful decannulation ranged between 29% to 42% in different series (2, 8, 9). Among our subjects, in 23 (63.8%) subjects decannulation could not be performed due to their underlying conditions. Successful decannulation was done in 13 (31.1%) subjects.

Conclusion

The indications and incidence of tracheotomy continue to emerge. Our results indicate that pediatric tracheotomy is a relatively rare condition. We have performed no pediatric tracheotomy apart from the intensive care subjects. The underlying conditions are more severe. Even planned when elective tracheotomy is performed, pediatric tracheotomy still has significant mortality and morbidity.

Conflict of Interest

No conflict of interest was declared by the authors.

Peer-review: Externally peer-reviewed.

Informed Consent: Written informed consent was obtained from parents of the patients who participated in this study.

Author Contributions

Concept - K.H.K.; Design - K.H.K.; Supervision - F.T.K.; Funding - E.S.; Materials - Y.Y.; Data Collection and/or Processing - Y.Y.; Analysis and/or Interpretation - Z.M.Y.; Literature Review - A.K.K.; Writing - K.H.K.; Critical Review - F.T.K.

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