Pediatric tracheotomy: comparison of indications and complications between children and adults

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SUMMARY: Süslü N, Ermutlu G, Akyol U. Pediatric tracheotomy: comparison of indications and complications between children and adults. Turk J Pediatr 2012; 54: 497-501.

The aim of this study was to demonstrate the differences between adult and pediatric tracheotomies in terms of indications, early and late complications and decannulation time. A total of 136 (53 children, 83 adult) patients who underwent tracheotomy between 2006 and 2011 were studied. Prolonged intubation was the most common indication in children (84.9%), whereas in the adult group, upper airway obstruction (45.8%) was the main indication. Early and late complication rates in children were 22.6% and 5.7%, respectively. Complication rates (early 19.3%, late 4.8%) in adults did not differ statistically from those in children. Similar decannulation success was observed in children (34.6%) and adults (40.2%). Mean decannulation times after tracheotomy were 317 and 69 days in children and adults, respectively, and the difference was statistically significant (p=0.040). Pediatric and adult tracheotomies differ in terms of indication and decannulation time, but complications are similar.

Key words: tracheotomy, pediatric, indication, complication.

The term tracheotomy, from the ancient Greek, means 'cut or section of the trachea'[1]. Tracheotomy is a surgical procedure for various indications in all age groups, such as ventilator dependence and airway obstruction. Tracheotomy has been performed in children since the 17th century. In adults, the indications for tracheotomy have been clearly described and established, but in the pediatric population these indications have been evolving over the last decades. A significant decrease in the incidence of infectious diseases, such as diphtheria and epiglottitis, reduced the need for tracheotomies to overcome infectious airway obstructions[2]. In the last decades, the most common indication has been prolonged intubation due to the significant improvements in the medical management of many conditions (e.g. prematurity, severe congenital anomalies). Although tracheotomy is a potentially life-saving procedure, preventing complications such as subglottic stenosis, early reports in the literature have suggested that the associated risks are significantly higher in children than in adults[3].

The aim of the study was to identify the differences between adult and pediatric tracheotomies performed at our tertiary center in terms of indications, complications and decannulation time.

Material and Methods

We reviewed retrospectively the records of patients in whom tracheotomy was performed at Hacettepe University Hospital between 2006 and 2011. From our database, hospital records of 136 (53 children, 83 adult) patients were available for analysis. All of the patients' records were analyzed in terms of indication of tracheotomy, early and late complications and the time of decannulation. Early complications were defined as those occurring within the first week of the tracheotomy procedure, whereas late complications indicated those occurring beyond one week after the tracheotomy.

All of the tracheotomies were carried out by ear, nose and throat (ENT) surgeons under general anesthesia. The patient was placed on a shoulder roll for ideal exposure of the laryngeal and tracheal cartilages. The standard tracheotomy procedure at our institution consists of a horizontal midline skin incision, converted to a vertical one in lower skin layers to better protect large vessels of the thyroid

plexus and thyroid gland. After the trachea is exposed, the surgical technique varies between adults and children. In adults, once the trachea is exposed, a horizontal incision is made along the anterior tracheal wall and two horizontal silk stay sutures, which are left long until the first tracheotomy tube change, are placed on either side of the incision; then, a small oval window centered on the trachea is removed. In children, only a vertical incision is made; no tracheal cartilage window is removed. The tracheotomy tube is inserted after applying anterolateral traction on the stay sutures. Postoperative care consisted of frequent endotracheal aspiration, monitoring of tracheal tube cuff volume, and daily examination to prevent occlusion by clot - debris or thick mucus. The first cannula change was performed seven days after the surgical procedure in both adults and children.

Results

During the five-year study period, 53 children (40% boys, 60% girls) and 83 adults underwent tracheotomy. The median age of children at the time of tracheotomy was 36 months (range: 7 days - 156 months).

Indications

In the pediatric group, prolonged intubation was the most common indication (n=45, 84.9%). The primary causes for prolonged intubation were respiratory failure (n=24, 45.3%), neuromuscular diseases (n=11, 20.8%), postoperative period following major surgery (n=8, 15.1%) and infection/sepsis-related diseases (n=2, 3.8%). Tracheotomy was performed for upper airway obstruction in 8 (15.1%) children. The most common cause for upper airway obstruction was craniofacial anomaly, which was detected in 6 children.

In the adult group, the most common indication for tracheotomy was upper airway obstruction. Head and neck malignancy was the most frequent cause for airway obstruction (32.5%), followed by laryngotracheal stenosis (12%), bilateral vocal fold paralysis (8.4%), and craniofacial anomaly (1.2%). Table I shows the indications of tracheotomy in the pediatric and adult groups.

Complications

In the pediatric patients, early and late complication rates were 22.6% and 5.7%, respectively. Accidental decannulation was identified as the most common early complication (13.2%), whereas tracheocutaneous fistula was the only late complication, and occurred in 3 children.

In the adult group, early and late complication rates were 19.3% and 7.2%, respectively. Postoperative hemorrhage from the surgical wound was the most common early complication in the adult group (9.6%). Tracheocutaneous fistula was identified as the most common late complication, and occurred in 4 adult patients (4.8%) Although in the adult group, we found a decrease in the early and late complication rates, the statistical analysis revealed no significant difference ($p=0.636$, $p>0.999$, respectively). Table II demonstrates the specific types and prevalences of these postoperative complications.

Decannulation

Similar decannulation success was observed in children (n=18, 34.6%) and adults (n=33, 40.2%). Mean decannulation times after tracheotomy were 317 and 69 days in the pediatric and adult groups, respectively, and the difference was statistically significant ($p=0.040$).

Discussion

There are three major indications for tracheotomy in children: prolonged ventilatory support, upper airway obstruction, and pulmonary toilet.

Indications, techniques and complications of pediatric tracheotomy have changed over the past decades. Several series have found that the total number of pediatric tracheotomies has declined over the past decades[4-6]. In the 1970s, tracheotomy was commonly performed for an acute upper airway involvement due to infectious diseases. With the introduction of endotracheal intubation and *Haemophilus influenzae* type B vaccine for acute epiglottitis, the indications of tracheotomy for infectious acute diseases declined dramatically. Conversely, prolonged ventilatory support was reported as the most common indication for pediatric tracheotomy in recent studies[4,7]. With the

Table I. Indications of Tracheotomy in Children and Adults

Indications	Pediatric	Adult
Upper airway obstruction		
Craniofacial anomaly	6 (11.3%)	1 (1.2%)
Head and neck malignancy	1 (1.9%)	27 (32.5%)
Laryngotracheal stenosis	1 (1.9%)	10 (12%)
Vocal fold paralysis	0 (0%)	7 (8.4%)
Prolonged intubation		
Neuromuscular disease	11 (20.8%)	5 (6%)
Postoperative period following major surgery	8 (15.1%)	3 (3.6%)
Infection/sepsis-related disease	2 (3.8%)	5 (6%)
Respiratory failure	24 (45.3%)	25 (30.1%)

Table II. Complications of Tracheotomy in Children and Adults

Complications	Pediatric	Adult
Early		
Hemorrhage	0 (0%)	8 (9.6%)
Accidental decannulation	7 (13.2%)	1 (1.2%)
Pneumothorax	3 (5.6%)	4 (4.9%)
Tube/ventilation problem	2 (3.8%)	3 (3.6%)
Late		
Tracheocutaneous fistulae	3 (5.7%)	4 (4.8%)
Suprastomal granulation	0 (0%)	1 (1.2%)
Stomal infection	0 (0%)	1 (1.2%)

advent of improved neonatal care, premature infants can be delivered at younger ages and sustained for longer periods in the setting of chronic lung immaturity. Because of the development of softer polyvinyl chloride endotracheal tubes, infants may be intubated for weeks to months with less risk of airway trauma secondary to prolonged intubation. Tracheotomy is indicated when safe extubation is not possible because of situations such as chronic lung disease or systemic comorbidities.

Upper airway obstruction is another common indication for tracheotomy in children. Subglottic stenosis, tracheomalacia, or bilateral vocal fold paralysis are the main etiologies for debilitating upper airway obstruction in children. Some children with craniofacial syndromes may require tracheotomy secondary to severe microretrognathia, glossoptosis or macroglossia. Neoplastic conditions, such as respiratory papillomatosis and subglottic hemangiomas, are other causes of upper airway obstruction. In our study, prolonged intubation due to primary disease was the most common indication in the pediatric population, in agreement with recent studies[4,7,8].

Tracheotomy remains a treatment with rare but serious side effects. Tissue traumatization, injury of the laryngeal or tracheal mucosa, and forced insertion of the cannula contribute to the development of early (pneumomediastinum, pneumothorax, hemorrhage, wound complication, displacement of the cannula) and late (tracheal stenosis, laryngeal stenosis, tracheocutaneous fistulae) complications. To avoid those complications, an optimal anatomic orientation and access to the trachea are of utmost importance. However, while the use of percutaneous tracheotomy in adults has increased in recent years, it is not yet indicated in the pediatric population. In our institution, we do not perform percutaneous tracheotomy technique because it is a blind procedure, and damage to the carotid artery or other large vessels can occur easily during this procedure.

Although early reports have suggested that

the risks associated with the procedure are significantly higher in children than in adults, recent studies suggest that, with an atraumatic surgical technique and use of advanced materials for tubes, the complication rates in children are not as high as once perceived[9-11]. In the literature, the early complication rate varies between 5.6-15%, but late postoperative rates are considerably variable (7-63%)[9-13].

The most frequent early complications of tracheotomy according to the literature are pneumomediastinum and pneumothorax. The frequency of both complications has been decreasing since the 1970s, which seems to be due to the decline in urgent tracheotomies performed for upper airway infections. The most frequent late complication of tracheotomy has been accepted as tracheal stenosis in many studies[14,15]. Many clinical investigations found that the operation technique (removal or not of a window of tracheal cartilage) was not significantly correlated with the formation of tracheal stenosis[16,17]. In our study, we did not observe any tracheal stenosis in our pediatric patients. We think the absence of tracheal stenosis in children in our series may be related to our making only a vertical incision through the trachea instead of removing a cartilage window.

In our study, the early postoperative complication rate in children was found to be higher than previous reports due to the high incidence of accidental decannulation. Accidental decannulation, due to insufficient intensive care support and lack of experienced personnel (e.g. nurses), is a serious but preventable complication, and can be overcome by improving the intensive care maintenance.

Decannulation was carried out successfully in 34.6% of pediatric patients. Carr et al[18]. reported a rate of decannulation of 34% in 142 children, and Dursun et al[19]. reported successful decannulation in 5 of 30 (17%) children who underwent tracheotomy. Therefore, we can say that the decannulation success rate of our institution is comparable to that of the literature.

In conclusion, based on our experience at Hacettepe University Hospital, pediatric and adult tracheotomies differ in terms of indication and decannulation time. The most common indication for pediatric tracheotomy was prolonged intubation. Complications following tracheotomy were similar in both pediatric and adult groups. Accidental decannulation was the most common postoperative complication seen in children, which can be prevented by increasing the number of intensive care unit beds and experienced personnel.

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