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Tracheostomy in childhood: new causes for an old strategy

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Abstract. – INTRODUCTION: A review of the available literature has shown that the indications, epidemiology, and complications for tracheostomies are changing, and that no definite guidelines have been established. In the 1970s, the most common indication for tracheostomies in children was acute inflammatory airway obstruction. Modern neonatal intensive care units (ICU) have turned long-term intubation into an alternative to a tracheostomy. Currently, long-term intubation has become the most important indication for tracheostomies in children.

PATIENTS AND METHODS: We present our series involving tracheostomies performed in paediatric patients between 2004 and 2008 at our hospital. Sixteen patients underwent tracheostomies for respiratory failure and upper airway obstruction.

RESULTS: The total complications rate was 37.5%. In children < 1 year of age, the complications rate was 25%, while in children > 1 year of age, the complications rate was 12.5%.

CONCLUSIONS: Long-term intubation and its sequelae have now become one of the most important indications for tracheostomies in the paediatric age group.

Key Words:
Paediatric tracheostomies, Complications, Airway, Children.

Introduction

The data obtained from the literature suggest that in the last 30 years the role and indications for tracheostomies in children have changed considerably, probably reflecting the substantial increase in the demand for prolonged respiratory assistance to keep children alive, children that in the past who would have had no chance of survival for severe immaturity, congenital malformations, severe lung disease, and neuromuscular disorders.

Previous reviews have clearly shown a higher rate of mortality and morbidity in childhood than adults[1]. Therefore, to perform a tracheostomy in a pediatric patient is more difficult than in an adult, mainly because of the limited surgery in this context, the reduced size of the upper airway, a smaller laryngo-tracheal cartilage scaffolding, greater mobility laterally and in the depth of the trachea, and a stoma more sensitive to injury, infections, and ischemia[6].

In the 1970s, the most common indication for tracheostomies in children was represented by acute obstructive inflammation of the upper airways, such as acute epiglottitis, croup, and diphtheria. The use of vaccines against *Haemophilus influenzae* and *Corynebacterium diphtheriae*, combined with modern treatment protocols in the neonatal intensive care unit (ICU), have certainly limited the use of tracheostomies. However, in infants requiring ventilatory support for several weeks or months, there is still the need to perform tracheostomies to facilitate pulmonary toilet, and to reduce possible injuries, such as glottal-subglottal stenosis or tracheomalacia. Therefore, prolonged intubation with its sequelae is currently the leading indication for tracheostomies in the pediatric population[4-16]. We present our series between 2004 and 2008, analyzing pediatric patients with tracheostomies in terms of the clinical and therapeutic indications and complications, and comparing our data to the data of the literature[17,18].

Patients and Methods

We performed a retrospective analysis of children undergoing tracheostomies in the Department of Medical and Surgical Specialties, U. O. of Otolaryngology, of the University of Catania, Italy, between January 2004 and December 2008. During this period, children from the Departments of Pediatrics, and ICU received a tracheostomy for the management of various problems involving the respiratory tract. Parameters related to claims, complications, and mortality

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were assessed. A total of 16 (6 females and 10 males) of 585 children from the above-mentioned Departments had indications for tracheostomies. All tracheostomies were performed electively under general anesthesia using the same surgical procedure. In all cases, there was a main indication for the tracheostomy, and in some cases the indications were multiple.

The standard procedure provided for the patient in the supine position with the neck extended and the head stabilized by a special ring. The neck was extended to a moderate degree, as cervical hyperextension affected the performance of a tracheotomy if too low. The skin incision was transverse and always under the cricoid cartilage. It is very important at this stage to dissect the cervical connective tissue as little as possible to avoid changes in the vasculature that may damage the trophism of the tracheal wall. Upon reaching the anterior wall of the trachea, a horizontal incision was made between the 2nd and 3rd rings, and then performing a tracheotomy under the isthmus. Having dissected carefully, we must also expose the least possible area of the tracheal wall, and depending on the age of the child and, therefore, the length of the cervical trachea and the cervical trachea relationship to the thoracic trachea, choose an appropriate level for the tracheal incision (also for the appropriate length of the cannula). One should not worry about what the tracheal rings, rather the proportions between the trachea and the cervical thoracic trachea, and the distance from the jugular cricoid and the length of the cannula to be used.

Four points of tension, two upper and two lower fixed edges of each window, facilitate the introduction of the cannula and prevent the subsequent changes of the cannula creating false roads. Other techniques, such as percutaneous and translaryngea, have never been used. All patients were monitored in the pediatric ICU after surgery. Laryngoscopies, pre-and post-operatively, were performed routinely to assess the anatomy of the airways, prolonged intubation outcomes, and to confirm the correct positioning of the tube.

The average age of the patients was 25.5 months, with a range from 30 days to 14 years; 50% of the patients were below the first year of age, and 60% were within 3 years old of the age at the time of surgery. The main indication for tracheostomies was respiratory failure with ventilation dependence in 11 cases (68.7%), while 5 cases (31.3%) had obstruction of the upper airway (UAW) (Table I).

Results

From our study, it was shown that intubation prior to tracheostomy ranged from 1-59 days (mean = 29 days). The total rate of complications in our patient group was 37.5% (6 patients). In children < 1 year of age, there were 2 stomal granulomas and 2 sutures abscess (Table II). In children > 1 year of age, there were a total of 2 complications (a stomal granuloma and subcutaneous emphysema; Table III). No fatal complications (accidental decannulation and/or obstruction of the cannula) were observed in the two groups.

Decannulation was successfully implemented in 10 patients, with an average time of 25 months from the tracheostomy. In children with chronic respiratory problems and/or neuromuscular problems, decannulation was not performed.

Finally, the overall mortality rate of the patients with tracheostomies was 35%. No cases of death were directly related to the tracheotomy.

Discussion

The data obtained from literature, the indications, techniques, and complications in pediatric tracheostomies have changed in recent decades. Analysis of the different series showed that the total number of tracheotomies in children has declined in recent decades[3]. In the 1970s, tracheotomies were commonly performed for involvement of the upper airways by inflammatory diseases in the acute phase. Over the past 30 years, the introduction of endotracheal intubation, vaccination for *Haemophilus influenzae* type B,

Table I. Indication for primary tracheotomy.

	N.	%
Pathologies with respiratory dependence	**11**	**68.7**
• Cerebral neoplasia (2)		
• Encephalopathy (1)		
• Neurologic deficit (2)		
• Guillain Barrè syndrome (1)		
• Neuromuscular impairment (2)		
• Pulmonary malformation (1)		
• Cardiovascular malformation (1)		
• Chronic respiratory insufficiency (1)		
Upper airway obstruction	**5**	**31.3**
• Acquired subglottic stenosis (2)		
• Cranio-facial malformations (Pierre-Robin syndrome) (1)		
• Laringeal diplegia (2)		

Table II. Complication age ≤ 1 years.

	N.	%
Stomal granuloma	2	12.5
Cutaneous abscessed sutures	2	12.5
Total	4	25

and the improvement of care and shelters run by the ICUs, have resulted in a drastic decrease in the number of tracheostomies performed for inflammatory upper airway infections[3,4,16]. There are case reports[2], in which the number of tracheostomies has fallen from 50% to 3%, comparing the period from 1970-1975 with the period from 1980-1985, and several other series have confirmed these data[7]. In our study, no cases of upper airway infectious disease were present. Conversely, among the indications for tracheostomies, there is a tendency towards chronic diseases that require assisted ventilation[12]. For this reason, there is also an increase in subglottical stenosis, certainly due to prolonged endotracheal intubation, which has become the most important indication for tracheostomies in several reports, with rates reported from 28%-36%[3,5,10,15].

Several Authors have suggested a periodic fibroendoscopic review of tracheotomies in children with prolonged intubation in order to avoid the sottoglottic structures[9,17].

The concept regarding the length of intubation before a tracheotomy has also changed in the last 30 years. In 1970, an intubation > 8 days was the threshold, after which a tracheostomy was recommended; today this term is set individually according to clinical and endoscopic parameters, with a range from 2-134 days[8,11]. In our series, the average intubation-to-tracheostomy time was 29 days. The frequency of major complications in children, such as hemorrhage, pneumothorax, pneumomediastinum, emphysema, accidental decannulation, fistula tracheoesophageal, and cervical abscess, has ranged from 5% to 49% in several cases[9,12,18]; our overall rate of complications was 37.5% and was, therefore, comparable to that reported by other Authors. The youngest children (< 1 year of age) had a a higher rate of complications (25%) compared with older children (12.5%), as in other series[5,11,17].

Table III. Complication age > 1 years.

	N.	%
Stomal granuloma	1	6.25
Subcutaneous emphysema	1	6.25
Total	2	12.5

The highest rate seems to be related to the smaller diameter of the trachea and its greater flexibility. The diameter of the airways is approximately 6 mm by 1-4 years of age, 8 mm by 4-8 years of age, 10 mm from 8-10 years of age, and 13 mm in adolescence, so even a small reduction in the diameter endotracheal can potentially obstruct the airway[6]. Moreover, some Authors have noted that in almost one-half of the patients < 1 year of age, there is bronchopulmonary dysplasia, which leads to the development of more viscous and abundant secretions, thus, increasing the risk of early or late complications[9,14].

The increase in the rate of complications could also be correlated, presumably, with the failure to decannulate, especially in patients with neuromuscular diseases, chronic respiratory diseases, and acquired subglottical stenosis[4,5,8].

We have also taken into consideration as a complication the formation of granulation and endotracheal peristomal, but they are so common in patients with cannulas and, thus considered harmless, unless they affect the respiratory dynamics. The same Authors believe that granulomas are more properly considered as sequelae[13,18].

Conclusions

The analysis of our results show that claims for pediatric tracheostomies have evolved over the years, which is in relation to a substantial increase in the requests for assistance to maintain prolonged breathing in children, who living in the past, who would not have had any chance of survival. The old use of tracheostomies for infectious diseases of the upper airway appears today in some way obsolete, as reflected by a reduction in the percentages.

The surgical technique adopted by us is still valid, despite the general trend to find less and less invasive procedures, such as technical expansion in children, which up to now has been used only in adults.

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