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Analysis of tracheotomy indications in children treated in the Department of Pediatric Otolaryngology of Medical University of Warsaw between 2015-2020

Analiza wskazań do tracheotomii u dzieci leczonych w Klinice Otolaryngologii Dziecięcej Warszawskiego Uniwersytetu Medycznego w latach 2015-2020

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Keywords

tracheostomy, indications, age, children

Summary

Introduction. Tracheostomy is the opening enabling breathing without the larynx, throat and mouth, which aims to restore and sustain airway patency. Indications of this intervention have changed over the years. The selection of patients for this procedure, as well as the moment, when it has to be performed are still not clearly defined. Those require a multidisciplinary approach and a standardized protocol. More analyses are necessary to create widely available guidelines.

Aim. Analysis of tracheotomy indications in children performed between 2015-2020 in the Department of Pediatric Otolaryngology, Medical University of Warsaw.

Material and methods. During the 5-year period (2015-beginning of 2020) 64 children with tracheostomy were treated in the Department of Pediatric Otolaryngology. Groups of tracheotomy indications were separated after a retrospective overview of the 64 cases from our clinic and after manual and electronic search through medical databases for indications for tracheotomy in previous years. Then patient's data (age at the time of surgery, concomitant diseases and/or disabilities) was collated, which allowed to present the characteristics of children and compare the tracheotomy indications in previous years with the results of this research.

Results. Tracheotomy was performed among 64 children. The median patients' age was 0.5 year and the average age was 4.26 years. Our patients were affected by many various conditions. We divided them into 8 main groups: congenital malformation syndromes, trauma, vocal folds palsy, perinatal complications, infection, autoimmune diseases, oncological and post-intubation subglottic stenosis. Currently, congenital malformation syndromes turned out to be the most common indication for tracheotomy.

Conclusions. 1. Tracheotomy indications in children have changed over the years. 2. There is increasing number of tracheotomies due to various congenital defects. 3. New groups of tracheotomy indications among children are autoimmune diseases and injuries; those groups have the highest average of age. 4. The result of effective pharmacological treatment of laryngeal hemangiomas is the lack of tracheotomy performed in this indication. 5. The number of tracheotomies performed due to post-intubation stenosis has decreased. 6. Vocal cords palsy as an indication for tracheotomy in children is most often a complication of cardiac surgery due to congenital heart defect; this group of patient's is the youngest among all. 7. Viral infections are still the tracheotomy indication among children.

Słowa kluczowe

tracheostomia, wskazania, wiek, dzieci

Streszczenie

Wstęp. Tracheostomia to otwór w tchawicy umożliwiający oddychanie z pominięciem krtani, gardła i jamy ustnej, mający na celu przywrócenie i utrzymanie drożności dróg oddechowych. Wskazania do jej przeprowadzenia zmieniały się na przestrzeni lat. Zarówno wybór pacjentów do tej procedury, jak również moment, w którym należy ją wykonać, wymagają multidyscyplinarnego podejścia i nadal nie są jednoznacznie określone. Potrzebne są wystandaryzowane procedury, które ułatwią podjęcie decyzji. Konieczne są analizy, które umożliwią stworzenie ogólnodostępnych wytycznych.

Cel pracy. Analiza wskazań do tracheotomii u dzieci wykonanych w latach 2015-2020 w Klinice Otolaryngologii Dziecięcej Warszawskiego Uniwersytetu Medycznego.

Materiał i metody. Przeanalizowano wszystkie przypadki dzieci, u których w okresie 5 lat (2015-początek 2020) wykonano tracheotomię w Klinice Otolaryngologii Dziecięcej. Po elektronicznym i manualnym przeszukaniu medycznych baz danych wyodrębniono kilka grup wskazań do tracheotomii. Następnie zestawiono kolejne dane dzieci (wiek w momencie wykonania zabiegu, choroby towarzyszące, obciążenia) i stworzono charakterystykę naszych pacjentów, co umożliwiło porównanie z wynikami uzyskanymi w latach poprzednich.

Wyniki. Tracheotomię wykonano u 64 dzieci. Mediana wieku pacjentów wyniosła 0,5 roku, a średnia wieku 4,26 roku. Pacjentów podzielono na 8 grup w zależności od wskazań do zabiegu: wady wrodzone, urazy, porażenie fałdów głosowych, powikłania okołoporodowe, choroby autoimmunologiczne, infekcje, zwężenie pointubacyjne. Najczęściej wykonano tracheotomię u dzieci ze złożonymi wadami wrodzonymi.

Wnioski. 1. Wskazania do tracheotomii u dzieci zmieniają się na przestrzeni lat. 2. Rośnie liczba tracheotomii wykonywanych z powodu złożonych wad wrodzonych. 3. Nowymi grupami wskazań do tracheotomii u dzieci są choroby autoimmunologiczne oraz urazy; w tych grupach średni wiek pacjentów jest najwyższy. 4. Skuteczne leczenie farmakologiczne naczyniaków krtani spowodowało brak tracheotomii wykonywanych w tym wskazaniu. 5. Zmniejszyła się liczba tracheotomii przeprowadzanych z powodu zwężeń pointubacyjnych krtani. 6. Porażenie fałdów głosowych jako wskazanie do tracheotomii u dzieci najczęściej jest powikłaniem zabiegu kardiochirurgicznego wrodzonej wady serca; średni wiek pacjentów w tej grupie jest najniższy. 7. Infekcje wirusowe są nadal wskazaniem do tracheotomii u dzieci.

Introduction

Tracheotomy is the medical term for surgical incision in the trachea, while tracheostomy stands for the opening enabling breathing without the larynx, throat and mouth (1). In combination, they aim to restore and sustain airway patency. Although tracheotomy is a well-known surgical procedure for centuries, it has been performed in the pediatrics population only since the twentieth century (2, 3). Tracheotomy in children is performed less frequently than in adults (4). Indications of this intervention have changed over the years. Before the vaccination against *Haemophilus influenzae* and *Corynebacterium diphtheriae* became widely distributed the most common cause leading to tracheostomy were acute infections: epiglottitis and diphtheria (5). Recently upper airway obstruction due to prolonged ventilator dependence, vocal folds dysfunction, hypotonia secondary to neurologic impairment, and trauma are considered to be the main indications of tracheotomy (2, 6). Owing to the improved quality of neonatal and pediatric intensive care, raised survivability of children with congenital abnormalities and chronic diseases is being observed (6). Tracheostomy is no longer only an acute live saver, but it is also used as an ancillary therapy in treating children with protracted illnesses therefore tracheostomies became long-term (6, 7). The selection of patients for this procedure, as well as the moment, when it has to be performed are still not clearly defined. Those require a multidisciplinary approach and standardized protocol (4). More studies are necessary to create widely available guidelines (8). That is why, we need to continue our research.

Aim

Analysis of tracheotomy indications among children performed between 2015-2020 in the Department of Pediatric Otolaryngology, Medical University of Warsaw.

Material and methods

We analyzed all cases of children who had tracheotomy in the Pediatric Otolaryngology Department at the Children's Hospital of Medical University of Warsaw over a 5-year period (2015-early 2020). A retrospective overview of all cases in our clinic reveals the indications and age for pediatric tracheotomy and the characteristics of our patients were created. For the purpose of clarity we divided the indications for the procedure into 8 main groups: congenital malformation syndromes, trauma,

vocal folds palsy, perinatal complications, infection, autoimmune diseases, oncological and postintubation subglottic stenosis.

Results

Tracheotomies were performed in 64 children from our clinic, the median patient age during the 5-year period was 0.5 year and the average patient age was 4.26 years (tab. 1). Two youngest patients were 1 day old and congenital arteriovenous malformation of a tongue was the indication for tracheotomy; 4 oldest patients were 16 years old and in 3 cases communication trauma was the indication. The age distribution is shown in figure 1 where it is visible that children after injury and with autoimmune diseases are the oldest and the ones with congenital malformations and vocal folds palsy are the youngest.

We have classified the indications for tracheotomy in 8 groups which have been shown in table 1. Congenital malformation syndromes were the most common indications for tracheotomy in 29 children (45.31%). In this broad group of very complex developmental defects we can distinguish several cases to approximate the characteristics of patients. As one subgroup we can differentiate 6 patients who had tracheostomy due to congenital central nervous system defects (NTDs), 2 patients had the procedure because of congenital arteriovenous malformation of the tongue, 2 patients had congenital craniofacial anomaly including Pierre Robin; tracheostomy in the case of 2 other was due to tracheoesophageal fistula (TEF) associated with tracheomalacia. Among 8 patients from this group, congenital heart disease was present, including one case of Bland-White-Garland syndrome (BWGS), and one case of hypertrophic cardiomyopathy (HCM). It is worth pointing out the single cases of laryngeal cyst, craniofacial teratoma and spinal muscular atrophy (SMA).

The second most common indication was trauma. In this group we have 9 patients (14%). We differentiate 5 cases after traffic accident and 2 cases being a result of child abuse. We can single out trauma caused by activities: 1 case of trauma during horse riding and 1 case of tetraplegia due to drowning.

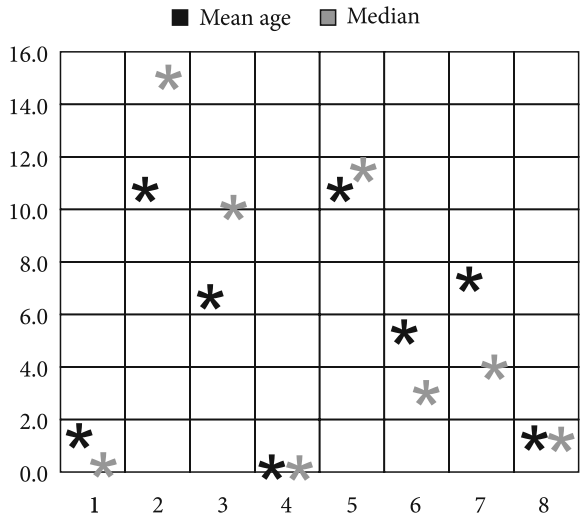

Fig. 1. Indications for tracheotomy with mean and median patient's age

Tab. 1. Correlation of tracheotomy indications as well as mean and median age of patients and percentage for each indication

Indication	Total patients	Mean (SD)	Median (range)	Percentage for each indication
Congenital malformation syndromes	29	1.4 (3.25)	0.25 (0.003-16)	45
Trauma	9	10.6 (6.72)	15 (0.166-15)	14
Perinatal complications	7	6.7 (5.77)	10 (0.166-15)	11
Vocal folds palsy	7	0.2 (0.15)	0.17 (0.083-0.5)	11
Autoimmune	4	10.5 (4.15)	11.5 (4-15)	6
Infection	4	5.4 (5.68)	3 (0.583-15)	6
Oncological	3	7.3 (4.71)	4 (4-14)	5
Postintubation subglottic stenosis	1	1.3 (0)	1.25 (1.25-1.25)	2
Total patients	64	0.5	4.26 (0.003-16)	100

In the group of tracheotomized patients with vocal folds palsy we have 7 children (11%) out of whom 4 had paralysis after cardiac surgery due to congenital malformation, 2 had idiopathic paralysis of the vocal folds. This group also included one case of vocal folds palsy in the course of congenital Arnold-Chiari malformation (ACM).

In 7 patients (11%) tracheotomy was performed as a result of perinatal complications.

In the group of 4 patients (6%) where indication for tracheotomy was infectious disease in 3 cases the etiological factor was the influenza virus and in 1 case it was recurrent respiratory papillomatosis (RRP) due to HPV infection.

It should be noted that autoimmune diseases also make important group of patients with tracheostomy. In this group there are 4 patients (6%); there are case of Guillain-Barre syndrome (GBS), ANCA-associated vasculitis (AAV), autoimmune encephalitis (AE) and diabetic encephalopathy (DE).

The oncological group was also created mainly because of statistical significance in our work. This group included 3 cases – 2 with acute lymphoblastic leukaemia (ALL) and 1 with testicular tumor.

In table 1, as a summary, the indications for tracheotomy were calculated as a percentage of the 64 tracheostomies.

Discussion

Tracheotomy is performed on children with mechanical (anatomical) airway obstruction or respiratory insufficiency, originating from various reasons, most of which are congenital malformations (including craniofacial malformations), conditions requiring prolonged intubation, muscular hypotonia secondary to neurological disorders and trauma (4, 5, 9, 10).

Division of patients into groups due to tracheotomy indications differs among assays (4, 11, 12). Indications are generally divided into: neurological, cardiovascular, upper airways obstruction, craniofacial anomalies and craniofacial injuries. Grouping is contractual and often inhomogeneous because of a frequent coexistence of pathologies, what regards especially to patients with congenital malformation syndromes. Cardiovascular malformation which requires cardiac surgery may be complicated by postoperative vocal folds palsy. Besides visible phenotypic abnormalities, complex congenital defects are often accompanied by neurological disorders. Preterm birth can be an effect of congenital defects. Immaturity of child can also be the reason of breathing disorders, hypoxia and neurological impairment.

In the analysis of the group of patients who underwent tracheotomy at the Paediatric Otolaryngology Department of the Medical University of Warsaw for the last 5 years (from 2015 to the beginning of 2020) we distinguished 8 groups depending on the reason of inability to independent breathing.

The most numerous group was represented by 29 children with congenital defects, which is 45% of all cases. A huge diversity of congenital defects among our patients is noteworthy. In the majority of cases (19 from 29) congenital malformations are complex and involve several systems: cardiovascular, central nervous system or craniofacial anomalies. Due to the inability to breathe independently, in these cases, prolonged intubation and further tracheotomy was required. Tracheotomy was performed in distinct moments. Two earliest procedures were performed on children with arteriovenous malformation of the tongue already on their first day after birth. Other patients required respiratory support with tracheostomy after a few years of living, for example two 4-year-old patients with degenerative congenital malformations of CNS, one 3-year-old patient with spinal muscular atrophy (SMA). In the majority of children (24 out of 29) with congenital malformations, tracheotomy was performed between 1 and 14 month of life. The average age of patients in the moment of tracheotomy from congenital defects is 1.42 years.

One of the indications for tracheotomy in children are injuries, however in the cited literature they are not the most common cause (9, 13). In our material, trauma is the second most frequent indication. Tracheotomy was performed on 9 children (14% of all cases) for this reason. This group consists of patients, who suffered from multiorgan trauma, craniocerebral trauma or intracerebral haemorrhage caused by unfortunate events (most often traffic accidents). In previous analysis of cases from Paediatric Otolaryngology Department of the Medical University of Warsaw none of tracheotomies were performed after trauma (14). The average age of patients, who endured serious accidents, stands at 10.63 years. Most of them are adolescents over the age of 15 years. They move independently, use available means of transport, do sports: cycling, horse riding, swimming and not always take precautions such as using helmets or seatbelts what can increase the risk of serious injuries (15).

The next frequent indication for tracheotomy is vocal folds palsy, diagnosed in 7 children, which is 11% of all our patients. Two children from this group with idiopathic vocal folds paralysis had the history of perinatal hypoxia, probably the reason of this pathology. They were assigned an APGAR score from 5 to 6 points, and no other defects were found. Patients with vocal fold paralysis form the youngest group with an average age of 0.21 years when tracheotomy was performed. Young age in this group of patients comes from the fact that factors damaging vocal cords were active at very early stage of life (surgery for congenital heart defect – iatrogenic factor, possible perinatal hypoxia or congenital CNS malformation). Bilateral vocal folds palsy cause complete airway obstruction and acute respiratory failure requiring immediate respiratory support.

Another group of indications for tracheotomy in our clinic were perinatal complications. Tracheotomy was performed on 7 children (11%) for this reason. In this group we included patients in whom tracheostomy was a consequence of intratracheal intubation performed in management of respiratory failure caused by perinatal hypoxia. Neither congenital defects nor vocal cords palsy were found in this group of patients.

The following indication for tracheotomy that we distinguished are autoimmune diseases. Usually, they are not considered as a separate group of indications in the literature, however, they are worth acknowledging because they were the reason of 6% of tracheotomies performed on our patients. Tracheotomy was performed in the course of these diseases due to choking problems (caused by progressive neurological disorders), respiratory disorders or the support for pulmonary toilet. Average age at the time of tracheotomy in this group stands at 10.5 years. The disease manifested at a later age of the child or had a chronic course.

During the last 5 years in the Department of Pediatric Otolaryngology WUM 4 patients underwent tracheotomy (6%) due to infection. It should be noted that these are not the same infections that several decades ago were the main cause of tracheostomy in children (epiglottis, diphtheria, or acute laryngitis, tracheitis and bronchitis), but diseases of different etiology. Viral infections are predominant – severe influenza complicated by pneumonia or meningitis and recurrent laryngeal papillomatosis caused by HPV type 6 and 11. Despite the elimination of some diseases through vaccination (against *Haemophilus influenzae* and *Corynebacterium diphtheriae*), infections still remain an indication for tracheotomy, but the etiology of infections and their frequency have changed (5). The average age of patients in this group in our clinic is 5.4 years, however, it is not possible to indicate the most characteristic age range for this group, as children of all ages suffer from the above-mentioned viral infections.

The last group of patients with tracheostomy listed by us consists of 3 patients (5%) in whom temporary tracheostomy was performed during oncological treatment to avoid prolonged intubation or to facilitate airway toilet. There are two 4-year-old children with leukemia and a 14-year-old with a testicular tumor. The average age in this group is 7.3 years.

Previous analysis of indications for tracheostomy in our clinic covering the period of 10 years to 2014 (14) showed a similar number of treatments performed – 124 in 10 years compared to the current analysis 64 in 5 years. The changes concern indications for tracheotomy. In the previous period, the most frequent indication were post-intubation complications (73.3%). In 24.18% of these children congenital laryngeal defect was found, which could have caused prolonged intubation due to airway stenosis. In the analysis of data from the last 5 years, post-intubation complications occupy the last place among indications for tracheotomy, only 2% of cases. Such a large discrepancy in the percentage share of post-intubation complications in the previous analysis in relation to ours (73.3 to 2%) may result from a different division into groups. In our analysis, there is only one patient in this group, with a negative history of other diseases. The most numerous group were children with multiple malformation syndrome. Among the indications for tracheotomy in the previous analysis, laryngeal stenosis caused by infantile hemangioma accounted for 4.8% of cases (14). The tracheostomy was left for several years for a period of spontaneous vascular tumor evolution. In the current material there were no patients in whom laryngeal stenosis due to hemangioma was an indication for tracheotomy. Currently, pharmacological treatment of laryngeal hemangiomas with beta-blocker – Propranolol in appropriately selected doses gives good results (5, 16, 17).

The average age of all patients in our analysis at the time of tracheotomy is about 4.26 years. The oldest patients are those whose indication for tracheotomy was trauma (with an average age of 10.63 years), which is consistent with literature data (9, 11, 13). At a similar age children with autoimmune diseases had undergone a tracheotomy with an average age of 10.5 years. Congenital defects and paralysis of vocal folds occur in the group of the youngest patients because the pathological factor acted the earliest.

Comparing to the previous analysis of data from our clinic, there have recently appeared new numerous groups of indications for tracheotomy such as post-traumatic conditions and autoimmune diseases, in the course of which chronic neurological disorders and respiratory problems requiring respiratory support may occur. In some cases, the tracheostomy remains temporarily for the duration of intensive care, in others it remains for the rest of life and allows to extend the life of chronically ill and disabled patients (4).

Conclusions

1. Indications for tracheotomy in children have changed over the years.
2. The number of tracheotomies performed due to various congenital defects is increasing.
3. New groups of indications for tracheotomy in children are autoimmune diseases and injuries; in these groups the average age of patients is the highest.
4. Effective pharmacological treatment of laryngeal hemangiomas resulted in the lack of tracheotomy performed in this indication.
5. The number of tracheotomies performed due to post-intubation stenosis has decreased.
6. Vocal cords palsy as an indication for tracheotomy in children is most often a complication of cardiac surgery of a congenital heart defect; this group of patient's is the youngest among all.
7. Viral infections are still an indication for tracheotomy in children.

Conflict of interest
Konflikt interesów

None
Brak konfliktu interesów

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