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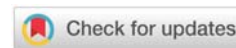
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Research Article

Tracheotomy in Children: Experience from a Sub-Saharan Pediatric Hospital

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Abstract

Introduction: Pediatric tracheostomy is a crucial surgical procedure that ensures airway patency in children suffering from a variety of respiratory pathologies. In recent decades, this procedure has gained importance, particularly due to significant advances in neonatal and pediatric intensive care.

Objective: The aim of the study was to describe the epidemiological, clinical features, complications, indications, and sequelae of tracheotomies in children at the ENT Department of National University Hospital of Fann and Albert Royer Children's Hospital in Dakar, Senegal.

Patients and method: We performed a retrospective analytical multicenter and descriptive study at ENT Department of Fann teaching and neonatal services at Albert Royer Hospital in Dakar, Senegal, over a period of 4 years (from January 1, 2019 to December 31, 2022), including the records of children of both sexes, aged 0 to 15 years and hospitalized in NHN's ENT and. Data was entered on World and Excel 2016, data processing and analysis on the Sphinx software (e.g., chi-square, t-test, etc.).

Results: We recorded Thirty-five (35) cases of tracheotomy. The average age was 6.50 years with 8-day and 15-year extremes. The sex ratio was 1.7. The highest number of tracheotomies was recorded in 2022 with 12 cases. Laryngeal dyspnea was the most frequent reason for consultation with 70.6%, followed by the laryngeal stridor with 23.5%. The clinical examination found signs of struggle in 33% of cases and Stage 3 and 4 dyspnea as per Chevalier Jackson and Pineau classification. In the indications of tracheotomy, acquired tracheal stenosis was more frequent with 22.8% of cases and malignant tumor pathologies with 20%. Emergency tracheotomy was performed in 25 patients (71.4%). The scheduled tracheostomy was performed in 10 patients, or 28.6%. General anesthesia was used in 71% of cases and local anesthesia in 29%. The cutaneous incision was vertical in 29 patients, 82.9% and transverse in 6 patients, 17.1%. In the tracheotomy, 9 patients (25.7%) had complications. For 9 patients tracheotomized (25.7%), the evolution was towards death. De-cannulation was achieved in 10 patients (28.6%). The average decannulation time is 34 days with extremes of 1 day and 210 days. Nine patients or 25.7% of the cases died with their cannulas still in place.

Conclusion: Regardless of the indication, tracheotomy is a life-saving procedure whose utility and effectiveness are well-established. Mastery of the technique, rigorous monitoring, and postoperative care are the key factors in minimizing the risk of complications.

Introduction

Tracheotomy in children is a surgical procedure that has garnered increasing interest due to its essential role in managing obstructive airway conditions. This procedure, although delicate, is sometimes indispensable for ensuring the survival and well-being of young patients suffering from complex respiratory pathologies [1]. The indications for and consequences of pediatric tracheotomy have changed over the years. Tracheotomy in children is more challenging than in

adults due to anatomical differences and the proximity of vital organs [2], and it is associated with higher morbidity rates. In children, the most common cause of death associated with tracheotomy is cannula obstruction, followed by improper cannula placement and accidental decannulation [3]. The development and dissemination of vaccines, combined with the increasing use of endotracheal intubation, have reduced the number of indications for tracheostomy based on infection, particularly in our local context. The progress in intensive care and anesthesia increased the use of intubation, and intubation,

especially when prolonged, involves a risk of obstructive dyspnea due to subglottic stenosis, requiring tracheotomy if primary stenosis [4].

In this review, we discuss our experience with surgical tracheotomy in children, covering epidemiology, clinical aspects, the timing of tracheostomy placement, procedural techniques, complications, and optimal decannulation protocols in the pediatric population, along with a comprehensive literature review. The complexity of pediatric tracheotomy patients presents both challenges and opportunities to optimize their quality of care. Recent quality improvement efforts and their impact on tracheostomy outcomes are specifically addressed.

Patients and methods

This is a multicenter, retrospective, descriptive, and analytical study conducted over 4 years (from January 1, 2019, to December 31, 2022), including medical records of children of both sexes, aged 0 to 15 years, hospitalized in the ENT departments of FANN and the neonatology department at Albert Royer. The parameters studied included age, sex, indication for tracheotomy, underlying pathologies leading to tracheotomy, type of anesthesia, surgical technique (type of skin incision, type and location of tracheal opening), postoperative outcomes (from day 0 to decannulation and closure of the tracheostomy site). Data were entered into Word and Excel 2016, and processing and analysis were performed using Sphinx software.

Results

A total of 35 children underwent tracheotomy in the ENT department of CHNU FANN and the neonatology department of CHN Albert Royer between January 2019 and December 2022. The number varied from year to year (Figure 1), with 34% of tracheotomies performed in December 2022. There were 22 boys (62.9%) and 13 girls (37.1%), yielding a sex ratio of 1.7. The children's ages ranged from 8 days to 15 years at the time of tracheotomy, with a mean age of 6.5 years (Table 1). Children aged 0 to 5 years represented 48.6%, those aged 6 to 10 years represented 22.9%, and those aged 11 to 15 years represented 28.5% of the cohort. The indications for tracheotomy were laryngeal dyspnea in 68.5%, inability to intubate the patient in 14.3%, and prolonged intubation in 17.2%. Prolonged intubation was due to cases of cerebral malaria, meningitis, and tetanus. Underlying pathologies included tumors in 37% ($n = 13$), acquired laryngotracheal stenosis in 22.8% ($n = 8$), congenital malformations in 17% ($n = 6$), and laryngotracheal foreign bodies in 11.5% ($n = 4$). Table I summarizes the distribution of tracheotomy indications and underlying pathologies (Table 2).

Among the 35 patients, 25 underwent emergency tracheotomy (71.4%). Elective tracheotomy was performed in 10 patients (28.6%) Figure 2. The procedure was performed under sedation with mask ventilation in 23% of cases ($n = 8$), under general anesthesia in 71% of cases ($n = 25$), and under local anesthesia in 5.7% of cases ($n = 2$). The skin incision was vertical in 29 patients (82.9%), transverse in 6 patients (17.1%), and sub-isthmus in all patients (Figures 2,3).

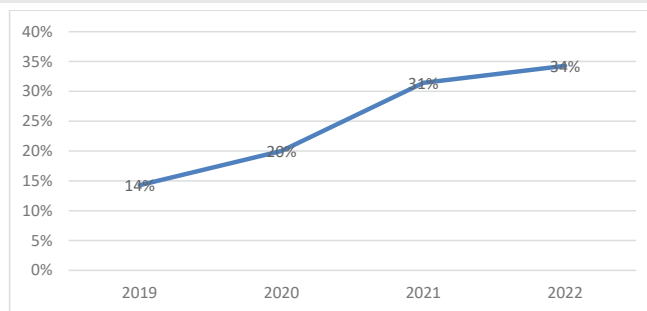


Figure 1: Evolution of the proportion of patients who underwent tracheotomy by year.

Table 1: Distribution of tracheotomized patients by age group.

Age group	Number of cases	Percentage %
<= 5	17	48,6
5 – 10	8	22,9
10 – 15	10	28,5
Total	35	100,0

Table 2: Underlying Pathologies

Underlying pathologies	Affections	Number of cases
Malignant tumors	Nasopharyngeal tumor	4
	hypopharyngeal tumor	3
	oropharyngeal tumor	2
Benign tumors	Laryngeal Papillomatosis	1
	Cystic Lymphangioma	2
	Thyroglossal Duct Cyst	1
Traumatic Pathologies	Penetrating Neck Injury	1
	Closed Neck Trauma	1
Congenital malformations	Congenital Laryngeal Stenosis	3
	Laryngomalacia	1
	Laryngeal Web	1
	Congenital Supraglottic Cyst	1
Acquired Tracheal Stenosis	Post-intubation Tracheal Stenosis	6
	Post-tracheotomy Tracheal Stenosis	2
Foreign Bodies	Upper Airway Foreign Body	4
Others	Perinatal Asphyxia	1
	supraglottitis	1
	Axonal Motor Polyneuropathy with Diaphragmatic Involvement	1



Figure 2: Sub-isthmus tracheotomy in a child with laryngeal stenosis after prolonged intubation.



Figure 3: Sub-isthmus tracheotomy in a child with hypopharyngeal tumor.

Postoperative outcomes were uncomplicated in 30 patients (85.7%) and complicated in 5 cases (14.3%). Complications included one case of subcutaneous emphysema and four cases of pneumothorax. Five tracheotomized patients (14.3%) died, with three deaths due to cardiorespiratory arrest, one due to mucus plug obstruction, and one due to the progression of nasopharyngeal cancer. Decannulation was successful in 10 patients (28.6%), with a mean decannulation time of 34 days (range: 1 to 210 days), and was impossible in 7 cases (21.87%).

Discussion

Tracheotomy, a procedure practiced since antiquity, often improves the prognosis of patients with severe respiratory disorders. While advances in intensive care have reduced its frequency and indications in developed countries, it remains a crucial intervention in our regions to prevent or manage acute or subacute respiratory failure. During this study, the highest number of tracheotomies was recorded in 2022. Based on medical records and surgical reports, we identified 35 cases of tracheotomy over 4 years, averaging 8.75 tracheotomies per year. Unlike studies by C. Nassif [4], which noted a decline in tracheotomy rates attributed to reduced acquired stenosis due to advances in neonatal intensive care, our findings reflect the challenges in developing countries with limited medical resources.

Among the 35 tracheotomized children, there was a male predominance (62.9%). This male predominance has been reported by several authors [5–7], likely due to boys' greater activity, curiosity, and risk-taking behavior, which increase their exposure to airway foreign bodies and traumatic injuries. The mean age in our study was 6.5 years, with a range of 8 days to 15 years [3]. Children under 5 years represented 48.6% of our cohort, similar to studies in Niger and Côte d'Ivoire [7,8]. In contrast, Western studies report that 75% of children were under 1 year, and 56% were under 6 months [4,9,10], as well as in Japan [5]. The predominance of tracheotomy in children under 5 years may be explained by benign tumors, polymalformative syndromes, and airway foreign bodies.

The primary indications for tracheotomy were laryngeal dyspnea (68.5%), followed by prolonged intubation (17.2%) and inability to intubate (14.3%). These findings align with studies by Illé, et al. [8] in Niger, where severe laryngeal

dyspnea was the main indication (55%), followed by impossible intubation (25%) and prolonged intubation (20%). In countries with advanced healthcare systems and intensive care units, prolonged intubation is the leading cause of pediatric tracheotomy, as observed in India [1,4] and the United Kingdom [11]. Prolonged intubation often leads to tracheotomy due to complications such as granulomas and post-intubation stenosis, which are challenging to manage.

In our study, tumors accounted for 37% ($n = 13$), dominated by nasopharyngeal cancer and laryngeal papillomatosis, followed by acquired laryngotracheal stenosis (22.8%, $n = 8$), congenital malformations (17%, $n = 6$), and laryngotracheal foreign bodies (11.5%, $n = 4$). Unlike African studies [7,12], where foreign bodies were predominant, our region shows a lower incidence, likely due to better emergency management and preventive measures.

In pediatric intensive care units, percutaneous tracheotomy is preferred over surgical tracheotomy due to shorter procedure times and fewer infectious and cosmetic complications [13,14]. However, despite these advantages, surgical tracheotomy remains the standard in our facility. The skin incision was vertical in 29 patients (82.9%), primarily due to emergency tracheotomies, which accounted for 71.4% of cases. This type of incision is preferred by many authors to avoid complete tracheal transection [12,15]. Postoperative outcomes were uncomplicated in 30 patients (85.7%) and complicated in 5 cases (14.3%), including one case of subcutaneous emphysema and four cases of pneumothorax. These results are consistent with studies by Watter, et al. [13], who reported complication rates of 15% – 19%, and Mizuno, et al. [5].

Decannulation was achieved in 10 patients (28.6%), with a mean decannulation time of 34 days (range: 1 to 210 days). In 7 cases (21.87%), decannulation was not possible. Studies show decannulation rates ranging from 35% to 75% [6], with higher rates in studies where airway obstruction was the primary indication. Lower decannulation rates are typically observed in patients with neurological, cardiovascular, or malignant conditions, as seen in our study.

Conclusion

Tracheotomy in children remains a critical surgical intervention, particularly in resource-limited settings where advanced medical infrastructure is lacking. This study highlights the challenges involved. It also emphasizes the complexities associated with pediatric tracheotomy, including the predominance of emergency procedures, higher complication rates, and the influence of underlying pathologies such as tumors, congenital malformations, and acquired stenosis. In conclusion, tracheotomy in children requires a multidisciplinary approach, tailored to the specific needs of each patient. Advances in surgical techniques, intensive care, and preventive measures are essential to reduce complications and improve the quality of life for pediatric patients. Further research and collaboration are needed to establish standardized protocols and enhance the management of tracheotomy in children, particularly in developing countries.

Authors' contributions

Niang F Fall F, B Loum, F blanc , B K Diallo Study design, data collection and analysis, writing of the manuscript.

I having obtained the patient's informed consent for the study and its publications (data and images).

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