

Description of the patients with tracheostomy discharged from the Intensive Care Service of the National Children's Hospital. (January 1996 – December 2007)

(Descripción de los pacientes con traqueostomía egresados del Servicio de Cuidado Intensivo Neonatal del Hospital Nacional de Niños (enero 1996 - diciembre 2007))

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Abstract

Aim: Tracheostomy is a surgical procedure used in the management of the airway in pediatric and neonatal patients. The aim of this study was to describe the epidemiological characteristics, clinical indications and complications of tracheostomized children discharged from the Neonatal Intensive Care Service of the National Children's Hospital "Dr. Carlos Sáenz Herrera" (HNN).

Methods: We made a retrospective review, with the clinical records of all those children who underwent tracheostomy and were discharged from the Neonatal Intensive Care Service of HNN in the period between January 1996 and December 2007.

Results: During the study period, 48 patients were discharged with a tracheostomy. The average number of tracheostomy performed per year was 3.9. The average birth weight was 2192 g. The average age at which the tracheostomy was performed was 44 days. The main indication for tracheostomy was prolonged mechanical ventilation because of bronchopulmonary dysplasia in 23 patients. The tracheostomy-related complications occurred in 40.4% of cases. A total of 29 patients (61.3%) were discharged alive and 18 died (38.8%).

Conclusions: Most patients who underwent tracheostomy were preterm (61.7%) and with a birth weight less than 2500 g (57.44%). The main indicators for tracheostomy were bronchopulmonary dysplasia, myopathies, subglottic stenosis, hemangioma, craniofacial anomalies and malacia. The main early complications were cannula obstruction, accidental decannulations and wound complications. The most common late complications were granulomas and cannula obstruction. No study patient had complications associated with tracheal tube that could cause his death.

Key words: Tracheostomy, neonates, neonatal intensive care complications, neonatal

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Abbreviations: HNN: National
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Sáenz Herrera", NICS: Neonatal
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There is one published study about tracheostomies in Costa Rica, but with an adult population. This study found that the majority of the studied population was from the male gender (80%). The main complications during the proceeding were: transitory desaturation (7,14%), tracheal ring fracture (4,2%), bronchial puncture (4,2%), unplanned extubation (2,85%), and minimal bleeding (2,85%). There wasn't any mortality associated with the procedure.¹

At an international level, there are few publications referring to neonatal and pediatric tracheostomy. The populations studied in these published articles are very heterogeneous, which make them difficult to compare.²⁻⁵

Tracheostomy is one of the aiding surgical procedures for advanced airway management in pediatrics and neonatology.² It was first described for diphtheria management during the XIX century.² In the last 30 years, the role and indications for tracheostomy in children has changed considerably.⁶ Infections were the main indications for performing a tracheostomy during these years; diphtheria and epiglottitis were the most common amongst them, but they had a significant decrease after specific vaccination against *Corynebacterium diphtheriae* and Type B *Haemophilus influenzae*, respectively. Other important indication was chronic pulmonary disease, which has decreased with improved techniques and management at Neonatal Intensive Care Services (NICS).^{2, 3, 6}

Scientific advances in junction with a better understanding of the pulmonary system's pathophysiology have lowered the need for tracheostomies in NICS patients.³ This is why more recent studies report a frequency decrease for this procedure from 2,7% in 1978, to 0,55% in 2001.⁷⁻⁹

The objective for this study was to describe the epidemiological and clinical characteristics, the indications and complications for the discharged

tracheostomized children at the NICS of the National Children's Hospital "Dr Carlos Sáenz Herrera" (HNN).

Methods

This study is designed to obtain information in a retrospective and descriptive way. We reviewed the universe of records from patients discharged from NICS at the HNN, which had undergone a tracheostomy, between January 1996 and December 2007. For data collection, a list of patients who fulfilled the inclusion criteria was asked to the Information and Statistics Office of the HNN.

Inclusion criteria take into account every child discharged from the NICS, who underwent tracheostomy between January 1996 and December 2007. Exclusion criteria refer to incomplete information in the record.

The data analysis was made with Epiinfo, and statistic measures were determined with this software, such as the mean (average), mode, skewness, variable cross tabulation and others. The study protocol fulfilled the requirements from HNN's Ethical- Scientific Committee. One patient was excluded from the study because of incomplete record information.

Results

According to the HNN's statistical registry, between January 1st 1996 and December 31st 2007, 48 patients were discharged with a tracheostomy from the NICS (representing 0,46% of patient discharges).

An average of 3,9 tracheostomies were conducted during the study period. The year with the most number of procedures was 1997.

The average gestational age at which tracheostomized patients were born was 34,3 weeks (25-41 weeks range), with a 23,4 variance (Table 1). 61,7% of patients had a preterm birth (29 cases), and 38,3% (18 cases) were at term. The average birth weight was 2192g (756-4360g range).

Subjects were divided in two groups according to their age at admission: less than 28 days, 41 patients (87,3%), and older than 28 days, 6 patients (12,8%). Tracheostomy indications were as follows: prolonged mechanical ventilation with bronchopulmonary dysplasia in 23 patients (43,4%); congenital craniofacial abnormalities in 14 patients (26,4%); malacia in 9 patients (17%); acquired airway lesions in 5 patients (9,4%); laryngeal hemangioma in 1 patient (1,9%); and 1 patient with myopathy type neuromuscular disorders (1,9%). Six patients had more than one indication.

Regarding the respiratory condition before tracheostomy, 76,5% of the patients (36 cases) had mechanical ventilation. The average intubation time until tracheostomy was 41,2 days (1-108 days range). Out of the 36 patients intubated before tracheostomy, 4 (11,1%) were immediately extubated after the tracheostomy was made, and 32 (88,9%) continued with intubation during a mean of 8,4 days (0-77 days range). The distribution of these patients, according to their tracheostomy indication, and intubation time after the tracheostomy was made, was as follows: in the patient with an hemangioma, 0 days; in craniofacial abnormalities, 0,6 days (0-4 days range); in subglottic stenosis, 3,6 days (0-13 days range); in malacia, 5,7 days (0-22 days range); in bronchopulmonary dysplasia, 14,6 days (0-77 days), and in the patient with myopathy, 28 days.

All patients who didn't require mechanical ventilation received supplementary oxygen (nasal cannula, 4 patients; nasopharyngeal tube, 2 patients; mayo cannula, 1 patient; oxygen head hood, 2 patients; nasal CPAP (Continuous Positive Airway Pressure), 1

patient, and T-tube, 1 patient).

The mean age at which the tracheostomy was performed was 44 days, (0-135 days range). Tracheostomy was made at different moments, according to its indication: in craniofacial abnormalities after 15 days (1-28 days range), in the patient with hemangioma at 18 days, in patients with malacia at 34 days (16-54 days range), in subglottic stenosis after 37 days (18-57 days range), in the patient with congenital myopathy at 42 days, and in bronchopulmonary dysplasia it was realized at a mean of 68 days (31-135 days range).

A 40,4% (19 cases) of patients presented a tracheostomy related complication. These were classified as early when they occurred in the following 7 days after the intervention, and late after 7 days. A total of 13 patients presented early complications (68,4%): 4 wound complications, 6 cannula obstructions, 4 accidental decannulations, 1 hemorrhage, 1 pneumomediastinum and 2 pneumothorax (Table 2). Late complications occurred in 6 patients (31,6%): 4 granulomas, 2 cannula obstructions, 1 tracheal stenosis and 1 pneumomediastinum. Some patients presented more than one complication.

Preterm birth newborns had early complications in 58% of cases and 42% had late complications, while term newborns just had early complications.

Table 1. Tracheostomized patients distributed by gestational age (weeks), at moment of admission to the Neonatology Service at HNN, from January 1996 to December 2007

GE	Frequency	Percentage
<30	12	25,5%
30-34	10	21,3%
35-37	8	17,1%
>38	17	36,1%
Total	47	100,0%

Table 2. Main early and late complications present in tracheostomy patients

Main Complications	Early (≤7 days)	Late (>7 days)
Wound complications	4	0
Hemorrhage	1	
Granuloma	0	4
Pneumomediastinum	1	1
Pneumothorax	2	0
Cannula obstruction	6	2
Accidental decannulation	4	0
Tracheal stenosis	0	1
TOTAL	18	8

After the tracheostomy placement, posterior bronchoscopy was performed to 15 patients (31,9%), with the following findings: laryngotracheomalacia (8 patients), postintubation granuloma (5 patients), subglottic stenosis (1 patient) and a laryngeal cord mass (1 patient). A total of 29 patients were discharged alive (61,3%) and 18 died (38,8%). The mean deaths each year was 1,5 patients (0-2 patients range).

Out of discharged patients, 100% of patients with myopathy died, as well as 56,5% of patients with bronchopulmonary dysplasia, 21,4% of the ones with craniofacial abnormalities, 20% of patients with malacia and no patient with hemangioma or subglottic stenosis as a main indication died.

Out of 9 patients with less than 1000g, 4 died (44%), 3 out of 7 between 1000-1500g (43%), 5 out of 11 between 1500-2500g (45%), 3 out of 15 between 2500-3500g (20%) and 3 out of 5 with more than 3500g (60%).

Death patients were distributed by gestational age as follows: less than 30 weeks: 6 out of 12 patients (50%), between 30-34 weeks: 4 out of 10 (40%), between 35-37 weeks: 4 out of 8 (50%), and more than 38 weeks: 4 out of 17 patients (23%). The average hospital stay was 54 days (1-135 days range). The mean stay, after tracheostomy was realized was: in the hemangioma patient, 11 days; in subglottic stenosis, 14,6 days (3-38 days range); in craniofacial anomalies, 15 days (1-40 days range); in malacia, 22,7 days (14-44 days range); in bronchopulmonary dysplasia, 26,3 days (3-94 days range), and in the patient with myopathy, 28 days.

Discussion

Given the survival increase in newborns, and particularly in premature newborns in the NICS, airway management has suffered some changes. Many of these survivors develop pulmonary damage, such as bronchopulmonary dysplasia, and require ventilation for long periods.

Recent studies have demonstrated a decreasing need for tracheostomies in hospitalized patients ⁷⁻⁹ from a 2,7% in 1978 to a 0,55% in 2001. The low incidence

found in probably caused because this study included all discharges, not taking into account if they had or hadn't mechanical ventilation. Besides, the decrease in tracheostomy need found in other studies, is attributed to improvements in ventilator management, to a reduction in vaccine-preventable laryngeal infections and to other scientific advances. ¹⁰⁻¹²

Coupled to this reduction in the need for tracheostomy at pediatric ages, in the last decades there have been important modifications in its indications, surgical techniques and complications.

Main epidemiological characteristics for these patients were determined in the study. Most of them were preterm and with a birthweight less than 2500g, this can be related to the fact that bronchopulmonary dysplasia, which occurs in preterms, was the main indication for tracheostomy. 87,3% of patients were admitted at the NICS in the neonatal period.

The mean hospital stay, after tracheostomy, was 22,1 days. The average total hospital stay at the HNN was 54 days. A prolonged stay implies an elevated cost to the institution.

Most patients (76,5%) had mechanical ventilation before tracheostomy, and out of these 88,9% continued to be intubated after it was performed, for an average of 8,42 days. It could be inferred that in most cases the ventilator issue wasn't solved with the tracheostomy.

Tracheostomy was performed at an average 44 days, according to its indication. The procedure was performed after one month old in patients with the following diagnoses: bronchopulmonary dysplasia, congenital myopathy, subglottic stenosis and malacia.

In world literature, there has been described an increase in acquired subglottic stenosis, neuromuscular diseases, prematurity and congenital anomalies, as indications for tracheostomy. ¹⁰⁻¹³

The increase in acquired subglottic stenosis has been related with prolonged intubation, which has become the most important cause (between 28 and 38% of cases) for tracheostomy in many reports. ^{10, 11, 14-18}

Despite the fact that prolonged intubation continues to be the main indication for tracheostomy, both in this study as in others published, there is evidence that tracheostomy is avoidable in many cases.^{17, 19-24}

Aiming to avoid some endotracheal intubation complications that could lead to tracheostomy, such as tracheal and subglottic stenosis, some authors suggest weekly assessment with fiber optic endoscopy, for patients intubated for a sustained period. Endoscopic control is the best method for preventing intubation complications and for indicating tracheostomy. Unfortunately, this technique isn't standardized in most NICS.^{5, 25}

In patients with obstructive airway problems associated with considerable difficult breathing, it seems clear the indication for tracheostomy, such is the case for congenital airway abnormalities.

The moment for performing tracheostomy in patients with mechanical ventilation has changed with time. In the sixties, prophylactic tracheostomy was made for patients with mechanical ventilation during 8 days. Now this period is individualized, according to clinical and endoscopic findings.^{24, 25} In this study, time to carry out tracheostomy varied with a 1 to 135 days range and an average of 41,2 days old.

Between indications for tracheostomy in patients with prolonged intubation, bibliography recommends to accomplish at least 2 months on mechanical ventilation or 3 unsuccessful extubations. For tracheostomized patients with bronchopulmonary dysplasia, this recommendation would be fulfilled, since the mean age for this procedure was 68 days old. There is another group of patients for which tracheostomy was held at an average of less than one month old: craniofacial abnormalities and the laryngeal hemangioma. In such cases, prolonged intubation isn't the indication, but an evident cause for airway obstruction that leads to performing tracheostomy and that usually solves their ventilatory issue.

The study found that 40,4% of patients with tracheostomy had any complication. Some other authors

have reported similar complication percentages and in children less than one year up to 47,5%.²⁶⁻²⁸

Some publications have described that almost half of children less than one year old and tracheostomized for bronchopulmonary dysplasia, develop early abundant viscous bronchial secretions, which increases the risk for complications.^{5, 18}

In the study the main early complications were cannula obstructions, accidental decannulations and wound complications. The most frequent late complications were granulomas and cannula obstructions.

Granulomas presented lately in 4 patients in this study. However, other studies suggest that this is present so frequently that it isn't considered a complication but a sequel, given that no technique has proven effective to prevent them. They're just considered complications if they obstruct the airway.^{17, 29}

In the study, preterms had, in relation with term patients, a higher frequency for early (61% against 39%) and late (100%) complications, just as described in world literature. These complications have been associated with a shorter gestational age, low birthweight, and medical comorbidity, more than with the surgical technique *per se*.¹⁹

No patient in the study had deadly tracheal cannula-associated complications.

A 38,8% (18/47) of the studied patients died before discharge from the NICS, but mortality was significantly higher in patients with myopathy (100%) and bronchopulmonary dysplasia (56,5%).

Out of the death patients, 77,7% presented a gestational age less than 38 weeks, and 66,6% had less than 2500g birthweight.

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