

ISSN: 2340-3438

Edita: Sociedad Gallega de  
Otorrinolaringología.

Periodicidad: continuada.

Web: [www.sgorl.org/revista](http://www.sgorl.org/revista)

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**SGORL PCF**  
Sociedad Gallega de Otorrinolaringología  
y Patología Cervicofacial



# Acta Otorrinolaringológica Gallega

## Artículo Original

### **Traqueotomía pediátrica: la experiencia de un centro terciario en Portugal**

### **Pediatric Tracheostomy: the experience from a tertiary center in Portugal**

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Recibido: 25/8/2017 Aceptado: 16/10/2017

### Abstract

**Background:** A tracheostomy in a pediatric patient is a very different procedure from the one in an adult patient and is associated with specific risks in this age group. In the past, acute inflammatory airway obstruction was the main indication. Nonetheless, nowadays, the most common indication for this procedure is prolonged ventilation. The age group in which the procedure is most frequently performed also changed, with a peak incidence in patients under 1-year-old, according to the most recent studies.

**Methods:** We retrospectively analysed all clinical data from patients under 15 years of age who had the need for a tracheostomy at our institution - a tertiary care centre - between January 2009 and December 2016.

**Results:** Fifteen children submitted to tracheostomy in this period were identified and studied. Eleven (73%) were done in infants. The procedure was elective in 10 patients (67%). The main indications of tracheostomy were prolonged mechanical ventilation in 9 cases (60%) and airway obstruction in 6 cases (40%). Six patients (40%) were totally dependent on mechanical ventilation and five (33%) used non-invasive

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sleep ventilations postoperatively. No intraoperative complications were observed. Postoperative complications occurred in 47%. There were 2 deaths, one of them related to a late complication from the procedure. Five children (33%) were successfully decannulated.

Conclusions: In the last years there were changes in pediatric tracheostomy indications. The decision to perform a tracheostomy remains very complex. This is a safe procedure when performed with an appropriate technique, experienced surgeons and good postoperative care.

**Keywords:** tracheostomy; airway obstruction; pediatric patient

### **Resumen**

Introducción: Una traqueotomía en un paciente pediátrico es un procedimiento muy diferente al de un paciente adulto y está asociado con riesgos específicos en este grupo de edad. Hoy en día, la indicación más común para este procedimiento es la ventilación prolongada. El grupo de edad en el que se realiza el procedimiento con más frecuencia también cambió, con un pico de incidencia en pacientes menores de 1 año.

Métodos: Se analizaron retrospectivamente todos los datos clínicos de pacientes menores de 15 años que tuvieran necesidad de una traqueotomía en nuestra institución - un centro terciario - entre enero de 2009 y diciembre de 2016.

Resultados: Se identificaron 15 niños sometidos a traqueotomía en este período. Once (73%) se realizaron en lactantes. El procedimiento fue electivo en 10 pacientes (67%). Las principales indicaciones de la traqueotomía fueron ventilación mecánica prolongada en 9 casos (60%) y obstrucción de la vía aérea en 6 casos (40%). Seis pacientes (40%) dependían totalmente de la ventilación mecánica y cinco (33%) utilizaron ventilación no invasiva durante el postoperatorio. No se observaron complicaciones intraoperatorias. Las complicaciones postoperatorias ocurrieron en el 47%. Hubo 2 muertes, una de ellas relacionada con una complicación tardía del procedimiento. Cinco niños (33%) fueron decanulados con éxito.

Conclusiones: En los últimos años hubo cambios en las indicaciones de la traqueotomía pediátrica. La decisión de realizar una traqueotomía sigue siendo muy compleja. Este es un procedimiento seguro cuando se realiza con una técnica adecuada, cirujanos experimentados y buen cuidado postoperatorio.

**Palabras Clave:** traqueostomía; obstrucción de la vía aérea; paciente pediátrico

### **Introduction**

Tracheostomy is one of the most frequent emergency or therapeutic surgical procedures in critically ill patients. In children it is a more difficult procedure with specific difficulties and risks<sup>1,2</sup>.

Children may require tracheostomy due to many different health disorders. The general indications for tracheostomy are relieve upper airway obstruction, prevent complications of prolonged intubation, reduce anatomical dead space and/or allow suction toilet of trachea. Nevertheless, in practice, tracheostomies in

children are almost always performed to relieve upper airway obstruction or to allow or assist with mechanical ventilation. The heterogeneity and complexity of the pediatric tracheostomy population makes them challenging to study.

In the past, the commonest indication for use of tracheostomy in children was acute inflammatory airway obstruction but recently, prolonged intubation has become the commonest indication<sup>3,4</sup>. Some patients undergo tracheostomy without a well-defined prognosis, while others have a disease with an uncertain future. Many of these children also require long-term ventilation<sup>5</sup>. The underlying conditions leading to the need for a definitive airway include neurological and neuromuscular disease, lung disease and heart disease, among others.

The age group in which the procedure is most frequently performed also changed, with a peak incidence in patients under 1-year-old, according to the most recent studies<sup>6</sup>.

The purpose of this study is to review our experience with pediatric patients submitted to tracheostomy. We evaluate pediatric patients warranted tracheostomy, regarding their indications, associated comorbidities, complications and decannulation rates and discuss this experience in the light of the relevant literature.

### **Materials and Methods**

All pediatric patients under 15 years of age undergoing tracheostomy at Centro Hospitalar do Porto between January 2009 and December 2016 were retrospectively reviewed and the medical records were analysed. Patients were excluded if they had incomplete medical records. The main parameters we studied were the age at the time of tracheostomy, gender, comorbidities, primary indication for tracheostomy, procedure type (emergency vs. elective), surgical technique, complications, need for mechanical ventilation and mortality. The data collection was carried out by the patients' electronic medical records. We also obtained information from surgical reports. The recording of complications was obtained based on post-surgical inpatient diary.

All tracheostomies were performed by pediatric otolaryngologists as an open procedure in the operating room under general anaesthesia.

A standard procedure technique was applied, with horizontal or vertical skin incision just below the level of the cricoid and a vertical incision in the trachea centred on the third and fourth cartilaginous rings. The appropriate sized tracheostomy tube was then inserted and, after adequate control of ventilation was achieved through the tube, the endotracheal tube was withdrawn. To secure tracheostomy, the flanges of the tube were sutured to the skin and tapes tied securely around the neck. The skin incision around the tube was approximated with a few sutures.

Postoperatively, all patients were admitted to the neonatal or pediatric intensive care units where they stayed until after the first tracheostomy change. Patients who had tracheostomies for long term indications, were discharged with the tube *in situ*.

After collecting the information, the database has been built and patient demographics and clinical characteristics were summarized by frequencies with percentages.

## Results

Between January 2009 and December 2016, fifteen children evaluated by the Otorhinolaryngology Department of our hospital required a tracheostomy. Eight patients (53%) were male and seven patients (47%) were female. The age at the time of the procedure ranged from 4 days to 15 years. Eleven patients (73%) were under one year of age at the time of the procedure (table 1).

**Table 1:** Age distribution of patients who had tracheostomy.

Age (years)	Frequency	Percentage (%)
0-1	11	73
2-10	1	7
11-15	3	20
<b>Total</b>	15	100

The procedure was elective in 10 patients (67%) whereas in 5 (33%) it was performed in emergency context.

The main indications of tracheostomy were prolonged mechanical ventilation in 9 cases (60%) and airway obstruction in 6 cases (40%).

The primary causes of prolonged mechanical ventilation were neuromuscular disease (n=5; 33%). Craniofacial anomalies, metabolic disease and infection/sepsis-related disease are responsible for the remaining cases (table 2).

**Table 2:** Causes of prolonged mechanical ventilation.

Cause of prolonged mechanical ventilation	Number of cases (%)
Neuromuscular disease	5 (33%)
Craniofacial anomaly	2 (13%)
Metabolic disease	1 (7%)
Infection/sepsis related diseases	1 (7%)

The commonest causes of airway obstruction requiring tracheostomy was laryngomalacia and subglottic stenosis. Other causes included vocal fold palsy and glossoptosis (table 3).

Some children had more than one indication for tracheostomy.

**Table 3:** Causes of airway obstruction.

Cause of airway obstruction	Number of cases (%)
Laryngomalacia	2 (13%)
Subglottic stenosis	2 (13%)
Vocal fold palsy	1 (7%)
Glossoptosis	1 (7%)

The majority of children (n=12; 80%) had comorbidities. Five children (33%) had at least one comorbidity and 7 children (47%) had two or more comorbidities. Only 3 children (20%) had no parallel health conditions. The main comorbidities are listed on table 4.

**Table 4:** Comorbidities.

<b>Comorbidity</b>	<b>Number of cases (%)</b>
Neuromuscular disease	5 (33%)
Cleft palate	4 (27%)
Pierre Robin sequence	2 (13%)
Congenital cardiac disease	2 (13%)
Pneumopathy	1 (7%)
Chromosomal changes	1 (7%)
Prematurity	1 (7%)
Endocrine disorder	1 (7%)

Regarding surgical technique, vertical skin incision was employed in 12 cases (80%) and horizontal skin incision was used in 3 cases (20%).

Six patients (40%) were totally dependent on mechanical ventilation and five (33%) used non-invasive sleep ventilation postoperatively.

No intraoperative complications were observed. Postoperative complications occurred in 7 children (47%). The postoperative complications seen were tube obstruction, pneumothorax, haemorrhage and accidental decannulation (table 5).

**Table 5 :** Postoperative complications.

<b>Complication</b>	<b>Number of cases (%)</b>
Tube obstruction	4 (27%)
Accidental decannulation	1 (7%)
Pneumothorax	1 (7%)
Haemorrhage	1 (7%)

Five children (33%) were successfully decannulated. Mean decannulation times after tracheotomy ranged from 3 months to 2 years. No post-decannulation problems were encountered.

There were 2 deaths, corresponding to a mortality rate of 13%. One of them was related to a haemorrhage - a late complication from the procedure.

## **Discussion**

In our series, the majority (73%) of the patients who had tracheostomy was under 1 year of age. This is in line with other reports that state that more tracheostomies were done for patients within first year of life<sup>7</sup>. This could be probably explained by the increasing survival rates among premature and syndromic patients and the higher severity of obstructive problems at this age<sup>8</sup>.

A similarity has been verified in relation to the gender of the patients, with 53% of the tracheostomies being performed in males and 47% in females. Two recent similar studies on pediatric tracheostomy show a little predominance of the male gender, with values of 57% and 59% being reported<sup>9,10</sup>. The reason for that could be the increased susceptibility of males to congenital and acquired disorders.

The commonest indication in our series for tracheostomy was mechanical ventilation (60%). In fact, a recent review from Turkey show that there was an increase in the number of tracheostomies performed for prolonged ventilation during the late period of their 37-year analysis. Besides that, two more recent series also found that more tracheostomies were being performed for prolonged intubation<sup>9,10</sup>.

In comparison with adult population, where indications seem to remain the same over the years, studies recently have shown a historical transition in indications for tracheostomy in children, being prolonged ventilation the most frequent indication<sup>12</sup>. Indications of tracheostomy have, in fact, changed and there is an increased incidence of tracheostomy in children with chronic ventilator dependence, congenital or acquired upper airway anomalies and neurological impairment<sup>13</sup>. Besides that, some children, with craniofacial syndromes may require tracheostomy secondary to severe glossoptosis or macroglossia and/or microretrognathia.

Syndromic patients represented a large number of our tracheostomized children. The obstruction usually found in these conditions can be associated to craniofacial abnormalities leading to anatomical or functional obstructions, as well as a hypotonic status.

Regarding the 2 cases of subglottic stenosis as indication for tracheostomy, recently, the great majority of children evaluated because of acute subglottic obstructive lesions are submitted to endoscopic balloon dilation or other recent endoscopic or microscopic techniques, leading to a consequent decrease in the number of tracheostomies performed.

Additionally, two patients were tracheotomized because of laryngomalacia. Though tracheostomy was the mainstay of surgical management of this entity, today it is reserved for cases in which supraglottoplasty has failed, or in patients with other conditions that warrant a surgical airway.

Concerning the surgical technique, the vertical incision was the most performed and it offers the advantage of facilitate dissection through the neck, running in the line of the trachea. This kind of incision is traditionally associated with worse cosmetic outcome, but after decannulation from a tracheostomy, the orientation of the original incision will not make much difference.

Pediatric tracheostomy is not complication free. Intra and post-operative complications can be encountered with rates as high as 40% being reported<sup>13</sup>. In our series, a complication rate of 48% was recorded. This is in accordance with such reported cases and show that the tracheostomy is not a procedure to be underestimated about its risks and complications. Tube obstruction was the most common complication and oc-

curred in 27% of our patients from dried crusts of mucous secretions. This may be secondary to poor education on tracheostomy care, leading to cannula obstruction. These were managed by suctioning the tubes. Accidental decannulation, occurred in one child. It represents a serious but preventable complication, which can be overcome by rigorous postoperative follow-up.

The overall mortality rate recorded was 13% (2 deaths). In one case, the death was in relation with the underlying disease – a severe sepsis. However, in the other case, the death was tracheostomy related, due to a fatal bleeding - an early complication of the procedure. A study reported overall mortality of 19%, with a 3.6% tracheotomy-related death rate<sup>14</sup>, which is close to the results of our study. Nonetheless, tracheostomy is a safe procedure if it is done in a tertiary hospital setting, with an appropriate technique, experienced surgical team and good postoperative care.

Post-operatively all the children were managed on the neonatal or pediatric intensive care units until the first tube change. We feel these measures are important in keeping early complications to a minimum.

Decannulation was carried out successfully in 33% of our pediatric patients. A study reported a decannulation rate of 34% in 142 children<sup>14</sup>. The decannulation success rate in our institution is therefore in line with those in the literature. In our opinion, this value is due to respiratory failure associated with chronic diseases, younger patients and genetic disease, such as neuromuscular conditions.

The limitation of this study is that it is retrospective from a single centre.

## **Conclusion**

In conclusion, pediatric tracheostomies vary in terms of indication, complications and decannulation time. We have corroborated in our study that in fact there is a decrease in the age group of patients requiring tracheostomy like in other centres in the world.

The most common indication for pediatric tracheostomy in our study was prolonged mechanical ventilation.

Complications following the procedure were similar to those previously reported in the literature. Tube obstruction was the most common postoperative complication in our patients.

Pediatric tracheostomy is overall a safe procedure in the tertiary hospital setting, when performed with an appropriate technique, experienced surgeons and good postoperative care.

**Conflict of interest:** The authors declare that they have no conflict of interest with respect to this article.

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