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Percutaneous tracheostomy by Griggs technique under rigid bronchoscopic guidance is safe and feasible in children

Gulnur Gollu [a,*], Ufuk Ates [a], Ozlem S. Can [b], Tanil Kendirli [c], Aydin Yagmurlu [a], Murat Cakmak [a], Tanju Aktug [a], Hüseyin Dindar [a], Meltem Bingol-Kologlu [a]

[a] Department of Pediatric Surgery, Ankara University Medical Faculty, Ankara, Turkey
[b] Department of Pediatric Anesthesiology, Ankara University Medical Faculty, Ankara, Turkey
[c] Department of Pediatric Intensive Care, Ankara University Medical Faculty, Ankara, Turkey

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ABSTRACT

Objective: The aim of this study is to report prospective data of pediatric cases that underwent percutaneous tracheostomy (PT) to show that PT is a safe and feasible procedure in children even in small infants.
Patients and methods: PT was done in 51 consecutive patients. Demographic data, indications, complications and outcome were recorded prospectively. Initial 6 PT was done by Giaglia technique whereas the Griggs technique was used in the consecutive 45 patients.
Results: Fifty-one patients with mean age of 38 ± 54 months (1 month–17 years) and, mean weight of 12.4 ± 13 kg underwent PT. The only major complication was perforation of esophagus ($n = 1$, 2%) which was recognized early and immediately repaired by cervical approach. This complication occurred in the 6th case done with the Giaglia technique. After conversion to the Griggs technique no major complication was encountered in the consecutive 45 procedures. The mean period of follow up was 21 ± 13.7 months. Narrowing of the stoma site requiring simple dilation was developed in 3 (5.8%) patients.
Conclusion: PT is a safe and easy procedure and a less invasive alternative to surgical tracheostomy even in small infants. We strongly recommend PT done by Griggs technique in children. It is important that it should be done in an operating room setting and under rigid bronchoscopic guidance.

Tracheostomy is a standard procedure usually used to provide stable and easy access to the lower airway in patients requiring long-term ventilation or having upper airway obstruction owing to trauma, tumor, foreign body or surgery [1–4]. It is the one of the most common procedures in adult intensive care units as ventilation via tracheostomy tube improves airway security, reduces airway resistance and work load of breathing, provides better airway toilet, reduces the need of sedation and increases patient comfort [1–4]. Although it is not as common as in adult practice tracheostomy has been increasingly used for children with chronic and complex conditions in pediatric intensive care units and especially for patients with neurological disorders, neuromuscular conditions, and requiring long term home ventilation [5–8].

Percutaneous tracheostomy (PT) has replaced the traditional surgical tracheostomy in adults owing to the facts that it is safe and an easy bed side procedure that does not damage tracheal cartilages and has better cosmetic results [1–4,9]. Five different techniques of PT have been used in adults. In 1985 Ciaglia et al. described the first technique with sequential dilatations [10] and Griggs et al. introduced another technique in which a separating forceps is advanced over a guide wire in 1990 [11]. Later a modification of classical Ciaglia PT, called Ciaglia Blue Rhino technique which involves single step dilation by means of a hydrophilic coated curved dilator was described [12]. In 1997 Fantoni introduced a translaryngeal technique, in which a tracheal cannula is pulled outwards through the oral cavity, larynx and trachea [13]. The last developed and relatively new technique is the PercuTwist method in which a controlled rotating dilator is used [14].

In contrast to adults PT is still rarely used in children as a matter of the fact that experience is much more limited and there are concerns about the safety of this procedure, especially in young children and infants. Previously the smaller and pliable airway of children was regarded as a contraindication for this procedure [2,15,16]. Only a small series of children older than 10 years old, undergoing PT has been reported [16,17]. Large published series describing the appropriate technique and equipment and revealing the potential risks and benefits of this procedure in children are lacking. Therefore, we aimed to report a prospective data of 51 consecutive children who underwent PT to show that it is a safe and feasible procedure in children even in small infants. To our knowledge this is the largest series of pediatric patients undergoing PT.

* Corresponding author at: Department of Pediatric Surgery, Ankara University Medical Faculty, 06100, Dikimevi, Ankara, Turkey. Tel.: +90 312 595 8435, +90 5055025697 (GSM); fax: +90 312 5955823.
E-mail address: drggollu@yahoo.com (G. Gollu).

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1. Patients and methods

The study was performed in adherence to the Declaration of Helsinki. A written informed consent was signed by the legal guardians of each child. Between 2012 and 2015, PT was done in 51 consecutive pediatric intensive care unit (PICU) patients. Age, gender and weight of the patients, indications of PT, additional procedures, complications and outcome were recorded prospectively. Initially 6 PTs were done using the Ciaglia technique under flexible bronchoscopic guidance. We used hydrophilic-coated pediatric percutaneous nephrostomy dilators since pediatric size PT dilators were not available in the market. After occurrence of a major complication (esophageal perforation), we converted our technique to the Griggs technique under rigid bronchoscopic guidance in 45 consecutive patients [11]. We designed a pediatric size version of sharp-tipped separating forceps, with a channel for the guide wire (Bahadir Company, catalog no: G72301, Samsun, Turkey) which was originally developed by Griggs for children (Fig. 1) [11].

All procedures were done in the operating room under intravenous general anesthesia in the presence of an attending from anesthesiology and pediatric surgery and a senior resident or instructor from pediatric surgery, who is experienced in rigid bronchoscopy. Continuous monitoring of vital signs by pulse oximetry, electrocardiography and noninvasive blood pressure was used in each case throughout the procedure. When patients require additional procedures like gastrostomy tube placement and Nissen fundoplication, these procedures were done before PT by securing airway with endotracheal intubation and PT was done as the last procedure.

1.1. The technique of tracheostomy

The patients were in supine position with a shoulder roll placed under the scapulae to achieve neck hyperextension. The cricoid cartilage, the thyroid notch, and the sternal notch were marked. The surgical field was prepped and draped in standard sterile fashion. Adequate size pediatric rigid bronchoscope (Karl Storz Endoscopy, Tuttlingen, Germany) with a 30-degree telescope (Karl Storz Endoscopy, Tuttlingen, Germany) was inserted into the trachea directly and patients were ventilated with 100% oxygen through the bronchoscope. The entire procedure was visualized through a bronchoscopic telescope which is connected to a video monitor. Utmost care was taken to keep the bronchoscope in the midline position. The bronchoscope was withdrawn to an upper position allowing adequate visualization of the tracheostomy site. Under bronchoscopic vision, trachea was punctured with 18–20 gauge catheter introducer needle between 1st and 2nd cartilage rings, followed by insertion of J type guide wire (Fig. 2a and b). The needle was withdrawn and a transverse skin incision depending on the size of age appropriate cuffed tracheostomy tube (10 to 15 mm) was done leaving the guide wire in the middle of incision. Blunt dissection of the subcutaneous tissue was carried out with a curved hemostat down to the tracheal level. Then separating forceps was advanced over the guide wire and separated to enlarge the tracheal opening to the sufficient size and then preloaded appropriate size cuffed tracheostomy tube (Whisper, Fuzhou, China) according to the patients age was inserted (Fig. 2c and d). When adequate ventilation through tracheostomy tube was assured via bilateral lung auscultation and accurate capnography readings, the tracheostomy tube was secured in a standard fashion.

2. Results

Fifty-one (35 male, 16 female) consecutive PICU patients on long-term mechanical ventilation underwent PT in 3 years. Primary diagnoses of the patients are presented in Table 1. Chronic neurological disease (70%) was the leading underlying pathology followed by neuromuscular condition (14%) and chronic pulmonary, cardiac and metabolic conditions. The mean age of the patients was 38 ± 54 months, the youngest patient being 1 month old and the oldest one being 17-years-old (Table 1). Forty-seven (92%) patients were younger than 10 years and 22 (43%) patients were less than 12 months. The mean weight of the patients was 12.4 ± 13 kg, ranging between 2.7 and 50 kg (Table 1). Laparoscopic Nissen fundoplication and gastrostomy tube placement ($n = 15$) and percutaneous endoscopic gastrostomy ($n = 5$) were the additional procedures done concurrently with PT. Giaglia technique by serial dilatations over guide wire and under flexible bronchoscopic guidance was used in initial six PTs. After occurrence of a major complication, esophageal perforation in the 6th patient, the technique was changed and Griggs technique was used until now. All procedures were completed percutaneously and there were no conversions to surgical tracheostomy. The only major early complication was perforation of the posterior wall of the trachea and the anterior wall of the esophagus that occurred in one patient (2%) which was recognized early during the procedure by bronchoscopic vision. The perforation site was immediately repaired by cervical approach. After conversion to the Griggs technique no complication occurred during the procedure or in the early postoperative period, in the consecutive 45 procedures. The mean period of follow up was 21 ± 13.7 months (4–70 months). Narrowing of the stoma site managed with simple dilation done once in two patients and twice in one patient was encountered in three (5.8%) patients. None of the patients were decannulated until now. During follow up five patients died because of underlying condition.

3. Discussion

PT is one of the most common and well known procedures in adult ICU patients requiring prolonged ventilation [1–4]. The techniques of PT have evolved during the last three decades and became more feasible

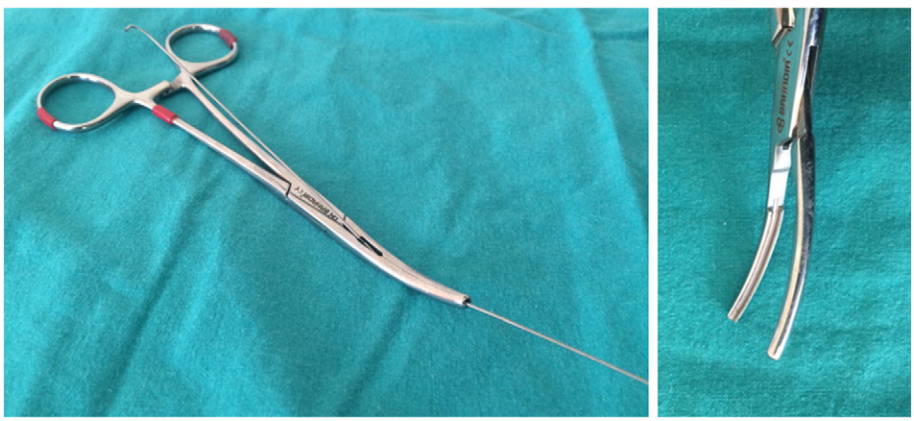

Fig. 1. Specially designed sharp tipped separating forceps for children with a channel for guide wire. It is a smaller version of the adult size, originally developed by Griggs.