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Percutaneous tracheostomy boundaries revisited☆

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ABSTRACT

Objectives: As percutaneous tracheostomies (PCTs) which have various contra-indications (CI) are increasingly performed by non-otolaryngologists, the otolaryngologist's role is reviewed. The ability of tracheal palpation was the single criteria to perform PCT.
Study design: Retrospective chart review.
Methods: A retrospective study analyzing adult PCTs performed by otolaryngologists at 2011–2012 were reviewed. All PCTs were performed using the Ciaglia blue-rhino-tracheostomy kit and Shiley's tracheostomy cannulas. Most procedures were performed with the same anesthesiologist.
Results: A total of 60 PCTs were identified with subject ages 18–91. None were converted to open tracheostomy. No bronchoscopic guidance was used. PCT was performed for the following CI: two bleeding disorder, four goiters, four cervical rigidity (surgical, traumatical and constitutional), five emergent tracheostomies, one head and neck cancer and nine short necks. Complications recorded were one wound bleeding and one pneumomediastinum both controlled locally. Pertinent anatomy revealed that the intubation tube was withdrawn to the level of 14 cm and 16 cm from incisor level in women and men respectively.
Conclusions: PCT is a safe procedure. When performed by an otolaryngologist, even the relative CI can be overcome. Tracheal palpation and experienced anesthesiologist are mandatory for the procedure's success. The otolaryngologists' advantage is a better anatomical understanding with the ability to convert the procedure to a formal tracheostomy as needed and avoidance of hypercarbia due to a bronchoscope use. Otolaryngologists should be the first line providers in any tracheostomy.
Level of evidence: 2c.

Introduction

Tracheostomy is one of the most commonly performed surgical procedures in intensive care unit (ICU) patients. As many as 10% of the patients who need at least 3 days of mechanical ventilation will eventually acquire a tracheostomy for airway support and protracted mechanical ventilation [1]. For many years, the open surgical technique was the only available option for obtaining a surgical tracheostomy. Percutaneous techniques were first described in 1957 by Shelden and Pudenz [2,3] and have since gained in acceptance as a routine procedure, owing to the development of commercially available kits. In 1985, Ciaglia and colleagues described percutaneous tracheostomy (PCT) as a simple, safe, bedside, and cost effective alternative to open tracheostomy [3,4,10]. Since then, many articles have been published debating the potential risks and benefits of the technique as well as the setting in which the procedures are performed (ICU/bedside vs. operating room). For the most part, comparisons of PCT to open tracheostomy have indicated whether no statistical disparity exists between the two or, if anything, lower complications rates are associated with PCT [5–9,11].

Indications for PCT are the same as those for standard open tracheostomy. In general, these include an upper-airway obstruction due to tumor, surgery, trauma, foreign body, or infection, avoiding damage to laryngeal or upper airway structures due to prolonged translaryngeal intubation, facilitating a frequent access to the lower airway for suctioning and secretion removal and providing a stable and reliable airway in a patient who requires prolonged mechanical ventilation or oxygen support (i.e. obstructive sleep apnea) [1,2,5,9]. There are several complications associated with performing a tracheostomy. Those include loss of airway, creation of false passages, intraoperative or postoperative bleeding, airway

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obstruction, bronchospasm, cuff leak, esophageal perforation, gastric aspiration, hypoxemia, infection, pneumothorax and subcutaneous emphysema [1,2,5,9].

Despite its increasing popularity, PCT is known to have some limitations and contraindications. What exactly determines relative contraindications (RCI) and absolute contraindications (ACI) has been the subject of much debate. An earlier number of publications consider cervical injury, coagulopathy and emergency airway necessity as ACI [15,22,23], whereas short, fat neck or obesity with unidentifiable anatomy; enlarged thyroid; and inability to extend the neck including cervical spine injury/neck injury and/or previous tracheostomy as RCI [12,16,18–22]. In our study, we reviewed the experience of performing PCT as viewed by the otolaryngologist in an effort to recognize its true boundaries. As PCT is increasingly performed by non-otolaryngologists, it is essential to review the role of the head and neck specialist as well as the RCI and ACI. The goal of this study was not only to examine the strength of these contraindications but also to evaluate the ability to palpate the patient's trachea as the single and only criterion necessary to perform PCT.

Materials and methods

A retrospective study was performed.

Ethical considerations: an IRB was obtained for chart review in the period of 01/2011–01/2013 (SLR IRB 13-022x).

Parameters reviewed were demographics, conversion rates to standard tracheostomy, contributing factors and complications. All the procedures were amenable to be performed by PCT once the trachea, even if shifted, could be palpated in the neck.

Continuous monitoring, pulse oximetry, EKG, and capnometry were used in each case. An anesthesiologist (for non-emergent cases) was responsible for proper sedation, pain control, paralysis, maintaining airway control and confirming adequate gas exchange. The patients were placed in a supine position with a shoulder roll positioned bilaterally under the scapulae. In cases where neck extension was simply not feasible or contraindicated, this step was skipped. The thyroid notch, the cricoid cartilage, and the sternal notch were marked when palpable. These landmarks were only palpable in 50 patients, and only the sternal notch and chin were palpable in the remaining 10 patients. The surgical field was prepped and draped in standard sterile fashion. In all procedures approximately 6–8 mL of 1% lidocaine was used with 1:100,000 epinephrine injected subcutaneously and down to the level of the trachea. A 3 cm horizontal incision was made and blunt dissection was carried out with a curved hemostat down to the tracheal level. Dissection was kept in the avascular midline to reduce bleeding. The trachea was then palpated and the endotracheal tube was withdrawn superior to the palpating finger (approximately 15 ± 1 cm from the incisal edge of the patient's central incisors). A 15-gauge needle was then inserted into the trachea and placement was ascertained by aspirating bubbles of air into a syringe filled with sterile water. The needle was left until a guidewire was introduced. Serial dilations were performed until the tracheostomy tube could be advanced.

Results

A total number of 60 PCTs were collected and available for review. All PCTs were performed with the Ciaglia Blue-Rhino tracheostomy kit (Cook Critical Care, Bloomington, IN) and Shiley cuffed non-fenestrated tracheostomy tubes (Covidien: Mansfield, MA). Only #6 tubes were used. In all cases, the indication for tracheostomy was either the need for protracted mechanical ventilation or the demand for an emergent airway. Most of the procedures were performed with the assistance of a dedicated anesthesiologist. Age distribution was between 18 and 91 with a mean of 66.4, median of 69 and SD was 14.2 with 33 females and 27 males.

Of the 60 cases, 28 were in conditions previously described as RCI or ACI (Table 1). The procedures were performed at the bedside in the emergency department and in the ICU without bronchoscopic guidance. None were converted to an open tracheostomy. All but two patients were unconscious and informed consents were signed by the appropriate health care proxy prior to procedure.

The circumstances under which the PCTs were carried out are outlined in Table 1. Short, fat neck was defined as a neck circumference greater than 46 cm or with the distance between cricoid cartilage and the sternal notch less than 2.5 cm, and the pretracheal soft tissues deeper than 2.5 cm. Failure to extend the neck or cervical rigidity was determined by either a documented (surgical) or suspected cervical spine injury. Bleeding disorders were defined as a PPT time of greater than 30 s, PT/INR > 2, or platelet count less than 50,000. These patients were managed with FFP, platelets, and by cessation of anticoagulation therapy. Cases were also documented of patients who were noted to have a high innominate artery, goiter, head and neck cancer and necessity of emergent airway. The remaining 32 cases performed throughout this time frame had none of the aforementioned conditions and possessed normal anatomical characteristics and coagulation lab values. A CT performed at a later stage shows one of the PCT performed on a patient with a goiter and tracheal deviation (Figs. 1 and 2).

Overall two postoperative complications occurred. The first was bleeding at the surgical site which was attributed to full anticoagulation hours after the procedure and stopped with pressure and reverse of coagulation. The second complication was pneumomediastinum with a leak identified inferior to the tracheostomy and which was successfully treated with a replacement of a longer (XLT) tracheostomy tube.

Discussion

Tracheostomy is now considered the standard of care for patients requiring long-term mechanical ventilation. The safety of PCT has been well established in a variety of different populations including critically ill patients, trauma patients, cardiothoracic patients, neurosurgical patients, maxillofacial patients, and otolaryngology patients [5–7,9,14,18]. PCT has a comparable complication rate to open tracheostomy; yet to date, there is not a shared consensus as to an accepted set of contraindications for this procedure [5,7,12,20]. Numerous researchers have found patient conditions such as previous tracheostomy, inability to extend the neck, short/fat neck, enlarged thyroid and

Table 1
Contributing factors.

Bleeding disorder	Goiter	High riding innominate	Short neck	Rigidity/non extending	Emergent procedure	Head neck cancer	Normal
2	4	2	10	4	5	1	32