Clin Chest Med 24 (2003) 409–412

CLINICS IN CHEST MEDICINE

Percutaneous tracheostomy—special considerations

Armin Ernst, MD[a,*], Jonathan Critchlow, MD[b]

[a]*Pulmonary and Critical Care Division, Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Avenue, Boston, MA 02215, USA*

[b]*Department of Surgery, Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Avenue, Boston, MA 02215, USA*

Tracheostomy is one of the most frequently performed procedures in critically ill patients. It is associated with improvement in comfort, advancement of oral nutrition, better communication and transfer of patients out of the ICU setting [1]. Recent reports also indicate that the placement of a tracheostomy tube may decrease work of breathing in these critically ill patients [2].

Until the 1980s, tracheostomy was usually performed in the operating room as an open surgical procedure. Since the mid 1980s [3], the percutaneous approach to establish a tracheostomy at the bedside has become increasingly popular and in many institutions is now the standard of care. Several studies have demonstrated a low complication rate for percutaneous tracheostomy (PT), its safety in the hands of intensivists, and comparable outcomes to the open surgical procedure [4]. Additionally, it does not require patient transport and there may a significant cost advantage. Details of the technical aspects of PT and comparisons between surgical and percutaneous approaches are reviewed extensively elsewhere in this issue.

Success of this procedure is related to the level of expertise of the operator, as well as to patient selection (indications and contraindications) and technique. Indeed, when reviewing suggested contraindications for PT, one can generate a long list, which leads to the exclusion of approximately 25% of patients in most critical care units from consideration for PT. Many of these suggested contraindications and some guidelines as to performance of the procedure are not adequately supported by data, but are merely suggestions. As these perceived contraindications and guidelines potentially exclude a significant number of patients from the benefit of undergoing PT, some of these issues are reviewed in more detail in this article.

Morbid obesity

Patients admitted to intensive care units who are morbidly obese face a number of adverse conditions relating to their size, and, as a population, frequently do not fare as well in their ICU courses as patients with more normal weights. Problems relate to skin care, vascular access, malnutrition, assessment of volume status, and also to the delay in the shift from translaryngeal intubation to tracheostomy in the case of prolonged respiratory failure. Hesitation to perform tracheostomy may lead to higher rates of endotracheal–tube-related laryngeal injury, delays in transfer of patients out of the ICU, and delay in better communication ability. Open surgical tracheostomy in the morbidly patient is difficult, and it has been suggested that it should be combined with cervical lipectomy [5]. Percutaneous tracheostomy has been considered contraindicated since the introduction of the technique, mainly for fear of inability to predictably identify all landmarks before the procedure. This was never supported by any trials, but rather thought to be a situation that is technically too difficult and risky for these patients.

This view has recently been challenged by the publication by Mansharamani et al [6]. In 13 consecu-

* Corresponding author.
E-mail address: Aernst@caregroup.harvard.edu (A. Ernst).

0272-5231/03/$ – see front matter © 2003 Elsevier Inc. All rights reserved.
doi:10.1016/S0272-5231(03)00045-5

Fig. 1. Patient with morbid obesity and respiratory failure in need of a tracheostomy. No neck landmarks are identifiable.

tive patients with a body mass index (BMI) of 28 to 62, PT was performed. The technique was similar to conventional PT, with a skin incision followed by blunt dissection of the tissues to the level of the trachea. A vertical skin incision was often used to allow for the change of level of entry into the trachea without the need for reincision. Once the cricoid cartilage and tracheal rings were identifiable by palpation, the needle was inserted, a guide wire placed and the stoma dilated. Routinely, a tracheostomy tube with extra horizontal length was placed to accommodate the difference in anatomy. All procedures were performed with anesthesia standby at the bedside. There were no complications or any particular technical difficulty and there was no failure to place the planned tracheostomy tube (Figs. 1–3).

Fig. 2. Comparison of a standard tracheostomy tube (*top*) and a tracheostomy tube with extra horizontal length (*bottom*). The extra length accommodates patients with morbid obesity and added neck diameter.

Fig. 3. The same patient as in Fig. 1 after percutaneous tracheostomy. The procedure went uncomplicated. Note that the tube flanges and sponge are hardly visible.

The experience in this study confirmed that anatomical landmarks in most obese patients are not difficult to determine and can be discerned with adequate neck flexion. Much of the fat is often located under the chin, rather than over the actual neck structures. Incision through the skin and blunt dissection of the subcutaneous fat greatly facilitates identification of tracheal landmarks. It should also be noted that the procedure can be abandoned and converted to open tracheostomy, even though in our experience this has never been necessary. As it is relatively easy to perform in contrast to a standard open tracheostomy in this patient population, this experience has led PT to be our preferred method of placing a tracheostomy in morbidly obese patients. This approach has allowed for appropriately timed decisions when a tracheostomy is performed

Repeat tracheostomy

Previous tracheostomy is frequently cited as a contraindication for PT if a patient requires a new tracheostomy [7–9]. Interestingly, these recommendations are also listed in the tracheostomy tube manufacturers' guidelines (Sims Inc, Keene, NH). As with PT in obese patients, there are no published data supporting this claim, and few reports deal with this issue. Several case reports describe the successful placement of PT in patients with a partially closed site [10] or multiple placements in a single patient [11,12]. The largest study to date performed by Meyer et al [13] addressed this issue by performing PT in 14 consecutive patients who had undergone

previous tracheostomy between 8 days and 10 years before the repeat procedure. In all patients the stoma had completely healed without any identifiable opening. All patients underwent standard PT. Specifically, the previous scar was reincised and the needle was placed through the tracheal defect, followed by dilation and tracheostomy tube placement (7 and 8 mm tracheostomy tubes). There were no complications except an accidental late decannulation and the procedure was judged as technically easy in all patients.

This report suggests that patients should not be excluded for PT solely on the grounds of a previous procedure, but that a repeat PT may actually be an attractive alternative to an open surgical procedure for its technical simplicity.

Bronchoscopic guidance

In the initial descriptions of PT [3,9], bronchoscopic guidance was not suggested as a necessary part of the procedure. Generally, complications in experienced hands were low and paratracheal insertion, the only complication preventable by bronchoscopy, occurred in fewer than 1% of cases and was not associated with any significant morbidity and mortality. Several reports on the use of bronchoscopy raised concern about potential unwanted side effects. With bronchoscopic guidance one may have an increase in pCO_2 leading to measurable increases in internal cranial pressure [14]. Prolonged bronchoscopy can decrease the pO_2 and lead to derecruitment in susceptible individuals, and bronchoscopy generally prolongs the procedure time and may not even be beneficial in avoiding some of the most severe complications (Fig. 4).

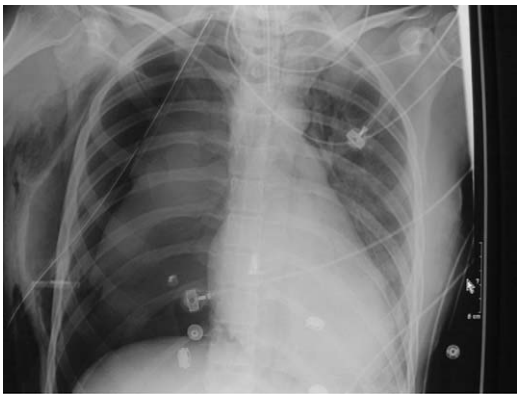

Fig. 4. Right-sided tension pneumothorax after PT attempt. The procedure was performed by surgical house staff under attending supervision. The complication occurred despite the use of bronchoscopy.

Bronchoscopy may provide certain benefits, such as confirmation of needle placement, dilation, and tube placement, which may be helpful when starting out with this procedure. No study so far has examined if the addition of bronchoscopy leads to a decrease in procedural complications. The most commonly quoted studies advocating for the addition of endoscopy are from Barba et al and Marelli et al [15,16]. In Barba's study, 48 patients were randomized to ST and PT for comparison. Twenty-seven patients underwent PT, 15 of which were performed in the operating room. Bronchoscopic guidance was routinely used. Five patients died in the PT group and 4 in the ST group (nonsignificant). No significant periprocedural complications occurred in either group. Those studies were not designed to assess the impact of bronchoscopy, as all PT patients underwent endoscopy. Even though the complication rate was not lower when compared with historical controls, the general use of the bronchoscope was recommended. In contrast, a recent study by Johnson et al [17] compared the multidilator with the single dilator technique of PT. In this randomized trial of 50 patients no significant difference in terms of complications could be found. As a matter of fact, no major complications occurred, even though routine bronchoscopy use was not part of the protocol. Of the minor complications encountered, none would likely been averted with the added use of endoscopy. We agree with these findings, and in our practice bronchoscopy has a role for the novice in selected patients with difficult airways, but generally is not necessary for the accomplished operator. Proficiency and speed without the use of the bronchoscope is a key ingredient if PT is ever to be used as an emergent airway procedure.

Summary

Percutaneous tracheostomy is safe and highly effective in well-trained hands in establishing a long-term artificial airway. Most alleged contraindications and some suggestions on how the procedures should be performed likely stem from early trials when only ''perfect candidates'' were chosen. Most of those contraindications should not be viewed as prohibitions, but as suggestions related to the skill level and training of the operator. We have used this technique in many situations where the small incision and tamponading effect of the tracheostomy tube has been quite beneficial, in selected patients with coagulapathies and severe venous congestion from superior cava syn-

dromes as well as thyroid cancers, and in whom operative approaches would have been difficult.

Knowing one's level of expertise and comfort in choosing and rejecting patients and procedures accordingly is the key to keeping PT a procedure with an excellent safety record. As the experience with PT grows, more and more perceived contraindications will disappear. Studies will address the role of PT in children and as a means of establishing emergent airway access. Also, the exact coagulation limits will need to be established. Few contraindications will most likely remain absolute, such as active infections over the proposed entry site, uncontrollable bleeding disorders and excessive ventilaory and oxygenation requirements. In our institution, taking into account these absolute contraindications, fewer than 5% of patients in need of a tracheostomy in the intensive care unit will undergo a primary open procedure.

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