

Can Intensive Care Physicians Safely Perform Percutaneous Dilational Tracheostomy? An Analysis of 207 Cases

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Abstract

Background: Percutaneous tracheostomy has largely replaced surgical tracheostomy in the intensive care unit setting. Although it seems logical that surgeons continue to do tracheostomies, anesthesiologists and intensive care specialists are familiar with airway control and guide wire techniques and could replace surgeons in the performance of PDT.

Objectives: To assess the safety and effectiveness of bedside PDT in the ICU.

Methods: We conducted a retrospective chart review of 207 patients in the ICU who underwent PDT by an intensive care physician.

Results: Subcutaneous emphysema without pneumothorax occurred in one patient. Four patients underwent surgical revision following PDT. Early bleeding (during the first 48 hours following the procedure) was the indication in two patients and late bleeding, on the 10th post-PDT day, in one. In one case PDT was converted to surgical tracheostomy due to inadvertent early decannulation. There was one death directly related to the procedure, due to an unrecognized paratracheal insertion of the tracheostomy tube followed by mechanical ventilation, which led to bilateral pneumothorax, pneumomediastinum and cardio-circulatory collapse. No infectious complications were seen at the stoma site or surrounding tissues.

Conclusions: PDT by intensive care physicians appears to be safe and should be included in the curriculum of intensive care residency.

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Tracheostomy is a common procedure performed in critically ill patients [1]. It is indicated when prolonged airway protection or mechanical ventilation is required [2]. Tracheostomy is usually performed using a surgical technique that has not changed substantially since it was first described by Jackson in 1909 [3].

Surgical tracheostomy is usually conducted in the operating room, which necessitates the transportation of critically ill patients, exposing them to a potentially high rate of transport-related complications and difficulties [4]. Shelden et al. [5] in 1955 were the first to describe percutaneous tracheostomy as a simple alternative to the surgical technique. In 1969 Toy and Weinstein [6] introduced the use of a guide wire for the dilator and cannula.

In our institution, an ear, nose and throat surgeon usually performs surgical tracheostomy in the operating room on a semi-elective basis. However, the ENT department and the operating room are usually overloaded and the procedure is often postponed, even for days. In order to avoid transportation of critically ill patients and to overcome the unavailability of an operating room and/or an ENT surgeon, most tracheostomies in the general intensive care unit of the Soroka Medical Center have been performed since 1997 by an intensive care physician at the bedside, using the percutaneous dilational technique.

Patients and Methods

The general ICU at the Soroka Medical Center has a data collection system in a locally developed database (TOREN) that allows search by demographic variables, diseases, syndromes, interventions, medications, complications, types of surgery, length of stay, and mortality [7]. We extracted from this system the records of patients who underwent PDT, and from these records collected demographic data, indications for admission to the general ICU, the timing of PDT, the incidence of stomal infection, and success rates for weaning from mechanical ventilation. The need for surgical revision of the PDT was also investigated.

In all but one patient the procedure was performed with an orotracheal tube in place, under sedation and muscle relaxation, and with administration of 100% oxygen throughout. Patients were monitored by electrocardiogram, invasive blood pressure, pulse oxymetry and capnography. A plain chest X-ray was routinely performed after PDT. The Portex Griggs methodTM for PDT [8] was used in all the patients in this series without bronchoscopic assistance. The availability of ENT backup was always confirmed before PDT.

Linear regression analysis was used to assess a possible correlation between the timing of tracheostomy and the success of weaning from mechanical ventilation. Statistical analyses were performed using the Epi Info 3.3TM Statistic Package (Centers for Disease Control, Atlanta, USA).

Results

From February 1997 to January 2005, 5948 patients were admitted to the general ICU. Tracheostomies were done on 567 of those

PDT = percutaneous dilational tracheostomy
ICU = intensive care unit

ENT = ear, nose and throat

patients (9.5%): 360 (6%) by ENT surgeons (operating room open technique) and 207 (3.5%) by general ICU physicians ("bedside PDT"). Even though the PDT was available from February 1997, most of the tracheostomies in the first years were done by ENT surgeons. The selection was done mostly according to anatomic limitations (short neck, inability to palpate the cricoid cartilage, pulsatile artery over the surgical area) and availability of qualified personnel to perform PDT (two ICU physicians and an anesthesiologist).

In the PDT group there were 140 males and 67 females. The mean age was 55.6 ± 22 years (range 15–91). Sixty-three patients were admitted to our department due to respiratory failure, 60 due to multiple trauma, 31 due to sepsis or septic shock (according to the American College of Chest Physicians/Society of Critical Care Medicine criteria) [9] and the others due to less common causes [Table 1].

The mean time interval from the decision to perform PDT to actually performing it was 11.9 ± 6.84 days (range 1–35 days). The shortest interval was for an apneic patient following a bulbar ischemic stroke, and the longest was for a post-coronary artery bypass graft patient who did not consent to tracheostomy initially. Table 2 summarizes the indications for tracheostomy.

Thirty-five patients (16.9%) died during hospitalization in the general ICU (of causes unrelated to PDT). One death was related to the procedure, caused by an unidentified false route and cannula misplacement, followed by erroneous controlled mechanical ventilation and attempts at manual ventilation. In the patients who underwent open tracheostomy by ENT surgeons the mortality was 16.5% (60 patients died). The overall mortality in the general ICU in that time period was 15%.

Table 1. Indication for admission to the ICU

Indication	No. of patients
Acute respiratory failure	63
Multiple trauma	61
Sepsis/septic shock	31
Postoperative care	18
Coma	14
Cardiac problems	7
Major burns	6
Exacerbation of chronic obstructive pulmonary disease	4
Spinal cord injury	3

Table 2. Indication for PDT

Indication	No. of patients
Prolonged mechanical ventilation	175
Coma	14
Inability to cough	10
Upper airway obstruction	8

Altogether, 121 patients were successfully weaned from mechanical ventilation following PDT. Twenty-three patients underwent decannulation in the ICU without any detectable clinical problem. Of the 141 patients discharged from the general ICU, 20 were still being treated by mechanical ventilation when they were transferred from the department.

Four patients underwent surgical exploration after PDT, three due to bleeding (two in the first 48 hours and one 10 days later) and one due to accidental decannulation. Subcutaneous emphysema without pneumothorax was seen in one patient. There was no evidence of infection of the stoma site in any patient. There was no correlation between the timing of tracheostomy and success of weaning from mechanical ventilation.

Discussion

PDT is gaining increasing popularity in clinical practice [0] and is becoming the technique of choice for tracheostomy in the ICU setting [11]. There are several reasons for the procedure's appeal: acquiring adequate skills is easy [12]; it can be performed at the bedside obviating the need for transfer to the operating room; and it is quicker, cheaper and considered to have fewer complications than the standard surgical method [13].

An important issue in the development of PDT is who should perform this procedure. In some studies only surgeons performed percutaneous tracheostomy [14,15], while in other studies it was performed by anesthesiologists and intensive care physicians [16,17]. In any event, the availability of surgical backup is critical when non-surgeons perform the procedure [18]. A key advantage to having tracheostomy performed by ICU physicians is that once the decision has been reached and the patient (or the legal guardian) has provided consent, the procedure can be undertaken without delay [19].

In the present series serious complications were recorded in five patients, including one death. Three patients underwent surgical exploration due to early bleeding from the stoma site and one patient due to late bleeding and a suspected tracheo-innominate fistula. One patient with early bleeding had a tear of the thyroid isthmus and another had a lesion in the thyroid lobe. No source of bleeding was found in the third.

Unintentional early decannulation (day 2) occurred in one patient, necessitating surgical exploration and open cannulation. Because the tracheostomy tract is not stable and may collapse after removal of the tracheostomy tube within the first 2 weeks, any accidental decannulation requires surgical exploration and open reinsertion of the cannula. Blind attempts at reinsertion can cause tube misplacement that can threaten the patient's life [20].

Paratracheal misplacement of the tracheal tube occurred in one patient. Because this problem was not immediately recognized, the patient was connected to controlled mechanical ventilation. Pulse oxygen saturation sharply decreased, and vigorous manual ventilation with a self-inflating bag was performed, leading to severe barotrauma with bilateral tension pneumothorax, pneumoperitoneum, pneumomediastinum, subcutaneous emphysema and death. This complication occurred

in the early phase of PDT in the ICU. Since then 170 PDTs have been performed without recurrence of this grave complication.

We do not use bronchoscopic guidance during PDT. Bronchoscopy increases costs, requires the presence of an additional physician and can cause technical difficulties. Furthermore, there is no adequate controlled study proving that an endoscopic guided technique is superior to the blind one. Therefore, routine use of bronchoscopy appears to be unnecessary [21].

We found no correlation between the timing of the tracheostomy and success of weaning. Others authors have demonstrated that early tracheostomy does not reduce the overall duration of mechanical ventilation [22].

The incidence of serious complications in our series was 2.41%, including one death (0.48%). This was not a case-control study (we did not compare between groups of surgical and percutaneous tracheostomies), but we did compare the major complications rate in our study with those from surgical tracheostomy reported in the literature. These rates are similar to those reported with surgical tracheostomy. In a review of 1130 patients who underwent surgical tracheostomy, major complications occurred in 49 (4.33%), including 8 deaths [23].

There was no evidence of infection of the stoma site in this series. It is generally accepted that PDT causes less infection of the surrounding structures and has a 0.6% incidence rate of stoma infection [24].

It is true that a sample of 207 is too small for a definitive recommendation. With such a small sample, the 95% confidence interval for the six complications is 0.96–6.8%, and for the one death 1–6%, as determined by the Poisson distribution. However, our positive results can be used as a basis for further studies.

Conclusions

The Griggs' technique for PDT seems to be a safe and effective modality in the hands of intensive care physicians. Because it can be performed easily at the bedside, the transport of critically ill patients to the operating room, with its inherent exposure to serious physiological derangement, can be averted [25]. In addition, when intensive care physicians perform PDT, delays relating to the surgeon or operating room are no longer a problem. Although we did not compare the effect of bronchoscopic guidance on the incidence of complications, its use appears to be unnecessary when adequate skills and experience have been acquired. For these reasons, we strongly recommended the addition of PDT to the curriculum of intensive care training programs.

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