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ORIGINAL ARTICLE

Percutaneous dilatational tracheostomies in a newly established trauma center: a report from Qatar

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Abstract
Background Percutaneous dilatational tracheostomy (PDT) is a routine surgical procedure for critically ill patients who require prolonged ventilatory support.
Methods We conducted a retrospective cohort study of all PDTs performed at the adult Trauma Intensive Care Unit (TICU) of Hamad Medical Corporation in Doha, Qatar, from January 2009 through September 2012. For all adult patients, we analyzed the demographic characteristics, mean ventilator time before the procedure, injury severity score (ISS), complications, and outcomes.
Results Of the 1,442 trauma patients admitted to the adult TICU during our study period, 124 (8.5 %) underwent PDT using the Ciaglia Blue Rhino technique. The vast majority were male (94.3 %). The mean age was 35 ± 15.6 years; mean ventilator time before the procedure, 12 ± 3 days; and mean ISS, 24.2 ± 9.3. More than half of patients had head injury (56 %), followed by chest and abdomen (26 %) and cervical spine injuries (18 %). Early complications included difficult tube placement (0.8 %), hypoxemia (0.8 %), minor bleeding (1.6 %), and hypotension (0.8 %), but the vast majority (93 %) of patients had no complications. The procedure-related mortality rate was 0 %.
Conclusion PDT is safe and can be performed with minimal complications even in a newly established trauma center.

Keywords Tracheostomy · Complications · Intensive care unit

Introduction

The first percutaneous tracheostomy by Shelden and Pudenz [1] was reported in 1957; however, percutaneous *dilatational* tracheostomy (PDT) was popularized by Ciaglia et al. [2] in 1985. PDT is the preferred method of tracheostomy for patients requiring prolonged ventilator support. Associated with less tissue damage, PDT can be easily and safely performed at the bedside—thereby avoiding the unnecessary risks inherent in transporting critically ill patients from the intensive care unit (ICU) to the operating room [3, 4], as well as eliminating operating room costs.

Of the various PDT techniques, only a few are popular. In current practice, the most widely accepted is the modified Ciaglia technique [5]. A single-dilatation technique introduced by Griggs et al. [6] uses a guidewire and grooved Howard Kelly forceps [7].

Several studies have compared the safety and performance of the Ciaglia and Griggs techniques. Both are safer [8–10], with less risk of complications, than surgical tracheostomy [11–13]. However, some investigators have reported significantly lower procedure-related complications with the Ciaglia technique than with the Griggs technique [14, 15].

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In ICUs, the usual indications for tracheostomy include the need for prolonged ventilatory support and long-term airway maintenance. Tracheostomy helps prevent the development of complications associated with long-term translaryngeal intubation [16]. The exact timing for tracheostomy varies according to the individual patient's condition, which primarily depends on the prognostic evaluation [17]. Kane et al. [18] demonstrated improved patient care and lower administrative costs in patients undergoing early tracheostomy. However, Maziak et al. [19] observed no correlation between tracheostomy timing and clinical outcome.

The procedure-related complications associated with PDT are typically minor: they include bleeding, infection, and hypoxia, almost always without any serious deleterious outcome [5]. Nonetheless, complications can be significant, especially if precautions are not taken to avoid them. Deaths have occurred after PDT, but only rarely [5]. In our study, our aim was to review complications of PDT in our adult ICU patients with traumatic injuries.

Methods

We conducted a retrospective cohort study of all PDTs performed at the adult Trauma Intensive Care Unit (TICU) of the Department of Trauma Surgery, Hamad Medical Corporation, Doha, Qatar, from January 2009 through September 2012. Excluded from our study were patients with local anatomic abnormalities of the thyroid gland. We obtained informed consent from the patients' representatives, according to institutional regulations to perform the procedure, and the study was approved by HMC medical research centre (IRB# 13073).

For all of our PDT patients, we used the Ciaglia Blue Rhino (CBR) technique, with the help of a Portex tracheotomy kit. The attending trauma surgeon or attending intensivist (anaesthesiologist) and a clinical fellow in trauma and critical care performed the procedure at the bedside, using aseptic techniques. Ventilatory and hemodynamic parameters (including electrocardiography, blood pressure, and oxygen saturation) were monitored continuously. After insertion of the tracheostomy tube, its position was examined by chest X-ray. Complications were defined according to the classification of acute tracheotomy complications by Durbin et al. [20].

Description of technique

The CBR technique uses a single Blue Rhino dilator (Cook Critical Care, USA). In our study, we postponed PDT in patients with poor oxygenation until they could tolerate a fraction of inspired oxygen (FiO_2) value of 0.6 % or less and positive end-expiratory pressure (PEEP) of less than 12 cmH_2O. Before PDT, we placed patients on the ventilator on pressure control mode, maintaining a FiO_2 value of 1.0, and a PEEP of less than 12. During PDT, we positioned all patients—except those with cervical injuries—supinely, with a shoulder roll to achieve optimal neck extension. For analgesia, sedation, and muscle paralysis, we used fentanyl, propofol, and cisatracurium.

All of our PDT patients undergo simultaneous flexible bronchoscopy. Using local anesthesia with 2 % lidocaine and epinephrine infiltration, we make an incision (of 8–10 mm) horizontally on the skin over the midline trachea, at the level about 1–2 finger breadths above the sternal notch. We dissect the subcutaneous tissue with a curved artery forceps. Then, we puncture the trachea, using a 14-gauge Teflon catheter introducer needle with saline. After performing aspiration, we insert a J-tip guidewire. To initially dilate the trachea, we use an introducer dilator; to dilate the opening to a sufficient size; we use a Blue Rhino dilator (Cook) and insert a preloaded tracheostomy tube. After tube insertion, we check for air entry in both the lungs. We routinely obtain a chest X-ray after any PDT.

Results

Of the 1,442 trauma patients admitted to the adult TICU during our study period, 124 (8.5 %) underwent PDT. The vast majority of patients were male (94.3 %). The mean age was 35 ± 15.6 years; mean ventilator time before the procedure was 12 ± 3 days; and mean Injury Severity Score (ISS) was 24.2 ± 9.3. More than half of our patients had head injury (56 %) followed by polytrauma (chest and abdomen 26 %), and cervical spine (18 %). Early complications included difficult tube placement (0.8 %), hypoxemia (0.8 %), minor bleeding (1.6 %), and hypotension (0.8 %), but the vast majority (93 %) of patients had no complications (Table 1). There was one conversion to open, performed in the operating room, due to difficulties reaching the tracheal lumen with the tracheostomy. This patient was left intubated and was taken to the operating room. The procedure-related mortality rate was 0 %.

Discussion

The Hamad Trauma Center was established in 2008; however, the Trauma Intensive Care Unit (TICU) has been created in 2009. The TICU is staffed by trauma surgeons and anesthesiologists. The most common mechanism of injury seen in our Trauma Center is blunt trauma in over 95 % of cases and this include road traffic injuries,

Table 1 Outcomes of the percutaneous dilatational tracheostomy (PDT)

Complications	Frequency	Percentage
No complications	115	92.75
Complications	9	7.25
Hypoxemia	1	0.8
Unwanted extubation	0	0
Cardiac dysrhythmia	1	0.8
Difficult tube placement	1	0.8
Posterior wall injury	0	0
Immediate cuff leak of tracheostomy tube	1	0.8
Esophageal injury	0	0
Kinking of guidewire or dilator	1	0.8
Hypotension	1	0.8
Pneumothorax	0	0
False passage	0	0
Tracheal ring fracture	0	0
Minor bleedings	2	1.6
Procedure abandoned and converted to open in the operating room	1	0.8
Mortality	0	0

construction-related injuries, pedestrians, as well as fall of objects and fall from heights.

Critically ill patients often require tracheostomy for continued airway support. The procedure can be performed either via open surgery in the operating room or via the percutaneous method at the bedside (i.e., PDT). Associated with a lower infection risk than surgical tracheostomy, PDT is favored in patients who have already undergone surgery for neck injuries [22].

Over time, the Ciaglia technique [2] for PDT has become the method of choice, thanks to its quick performance time and low rate of complications [3]. However, the single-dilator technique (Blue Rhino) appears to be even faster, with even a lower risk of complications, than the multiple-dilator technique of Ciaglia [4, 21]. However, many complications do happen, as reported by Durbin [20]. Airway loss is one the most feared complications of any tracheostomy placement. Pneumothorax is infrequent with PDT, but the rate can be as high as 3 % [26, 27]. Routine chest radiography is no longer recommended after tracheostomy placement, unless there are signs of unexpected compromise of air exchange [23], but we continue to obtain a chest X-ray in all of our PDT patients after the procedure. One of the more serious concerns is posterior tracheal wall injury [24]. Serious bleeding can occur with either surgical tracheostomy or PDT, but it is infrequent with PDT. The mortality rate with PDT is lower than with open surgery, according to earlier studies by Hill et al. [25] and Cobean et al. [3].

Given the lack of consensus regarding the definition of acute complications with PDT, the reported rates vary widely in the literature. In our study, the overall complication rate was 7.25 % and the mortality rate was 0 %—both lower than the overall complication rate of 19 % and the mortality rate of 0.5 % in the study by Hill et al. [25]. There were no tracheal stenosis seen as a complication in our cohort, but we do not have long-term follow up data on our patients. Throughout the literature, the rate of major or serious insertion complications, such as major bleeding, posterior tracheal wall injury, and pneumothorax, was also higher than in our study [13, 26, 27]. The tracheal cartilage fracture rate was 6.1 % per Glossop et al. [27] and 9 % per Dempsey et al. [26]. In stark contrast, in our study, we had no injury to the tracheal cartilage, no posterior tracheal wall injury, and no pneumothorax.

Conclusion

Percutaneous dilatational tracheostomy is safe and can be performed at the bedside, with minimal procedure-related complications, even in the ICU of a newly established trauma center. Proper preparation and supervision is mandatory. Patient selection and teamwork is crucial. If there is any question of perceived difficulties, patient should be taken to the operation room for a tracheostomy, either PDT or an open technique.

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Conflict of interest None.

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