Original Article

Percutaneous dilatational tracheostomy: A prospective analysis among ICU patients

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Abstract

Introduction: Percutaneous dilatational tracheostomy (PDT) is a simple bedside procedure, particularly useful in the intensive care units. Over the last few decades, the technique of PDT has gained popularity due to its comparable safety to the more surgical tracheostomy (ST).

Objective: To describe the outcome of PDT using modified Ciaglia's technique in patients of Surgical ICU.

Methodology: This was a prospective cohort study that analysed the outcomes of PDTs carried out on critically ill patients admitted in the surgical ICU, Pakistan Institute of Medical Sciences, Islamabad from August 2015 to January 2017. All PDTs were performed by the presiding consultant and his team using modified Ciaglia's (Blue Rhino) technique. The main outcome was the frequency of perioperative and early complications within the first six days. Demographic variables and complications were recorded. Data was analysed using SPSS version 18.

Results: Seventy-four patients underwent PDTs in the surgical ICU with mean age of the patients was 49.17 ± 12.82 years. The commonest indication of tracheostomy was prolonged mechanical ventilation followed by failure to wean. Complications rate was 12.16% of which perioperative bleeding occurred in 6.7% of patients. Early complications within the first six days were wound infection, tube displacement and blocked tube.

Conclusion: PDT is a valuable, efficacious and safe method that can be performed at the bedside with minimal complication rate and needs to be considered more frequently in the intensive care units in developing countries.

Keywords: Percutaneous Dilatational Tracheostomy, Complications, Intensive Care Unit.

Introduction

Over the last few decades, the technique of percutaneous dilatational tracheostomy (PDT) has gained popularity in the intensive care units due to its comparable safety to the more conventional surgical tracheostomy. PDT is a simple bedside procedure in experienced hands and is considered as an integral part of the critical care physician's professional skills.[1,2] In patients who need prolonged mechanical ventilation, the advanced airway of choice has long been the tracheostomy tube.[3]

Tracheostomies have many advantages over the endotracheal tube; they decrease the risk of tube displacement, laryngeal oedema and injury, oropharyngeal damage and infections (ventilator associated trachea-bronchitis and pneumonia and sinusitis) and improved tracheal toilet.[4,5] However, the conventional surgical technique has been known for complications like haemorrhage, loss of airway, displacement of tracheal tube, damage to surrounding anatomical structures such as trachea-oesophageal fistula, pneumothorax, tracheal stenosis.[6,7]

Ciaglia et al first described the currently, widely accepted technique of PDT. His method used seven dilators of progressively larger size to create the tracheal stoma.[8] Griggs et al then proposed a second technique in 1989 which involved the use of over-the-guide wire dilating forceps.[9] Both methods drastically reduce these complications and have, thus, gained popularity in the intensive care units because of their recognized advantages. The benefits are numerous. Primarily, the PDT provided a solution for timely tracheostomies in patients that could not be transported to surgical theatres, enabling early tracheostomy and decreasing delays in tracheostomy performance. Hence, faster weaning from the mechanical ventilator. They also reduced the incidence of serious complications and perioperative mortality.[10,11] It is estimated that in Europe, 75% of PDTs are performed by intensivists.[12] When performed by an experienced operator on carefully selected patients, the technique of PDT is associated with fewer perioperative complications.[13]

The results of an international survey which was endorsed by the European Society of Intensive Care Medicine has shown wide variations among physicians in terms of the choice of the procedure; surgical versus percutaneous.[12] According to this survey, PDT was most commonly performed by intensivists followed by Anaesthesiologists. This could be because most of the respondents were from mixed ICUs where an assigned, qualified intensive care physician was responsible for day to day decision making. In addition, the results of this international survey showed that surgical tracheostomy is more commonly performed outside Europe as compared to PDT. Whereas in Europe, seventy percent of patients in the ICUs who require tracheostomy undergo PDT.[12]

Data from Pakistan is scant, with very few studies done by ICU teams to determine the effectiveness of PDT as safe, cost effective and efficacious method. This study aims to describe the outcome of PDT using modified Ciaglia's (Blue Rhino) technique in patients of Surgical ICU.

Methodology

This prospective, cohort study was undertaken at the Surgical Intensive Care Unit of the Pakistan Institute of Medical Sciences, Islamabad, which is a tertiary care centre. Formal approval from the ethical committee was sought before the start of the data collection. All patients who underwent percutaneous between August 2015 and January 2017 were included in the analysis.

Patients were excluded from the study based on an understanding of both relative and absolute contraindications. (Table 1)

Table 1: Exclusion Criteria applied to patients before enrolment in this study.

Exclusion criteria
• Patient or family refusal
• Paediatric patient
• Midline neck mass
• Uncorrected coagulopathy or platelet dysfunction
• Infection at site
• Suspected or known difficult intubation
• Poor respiratory function: fio2 > 0.6, peep > 10
• Difficult anatomy – obese/short neck/neck distortion
• Tracheomalacia
• Unstable c-spine or c-spine immobilization (cervical fusion/instability, rheumatoid arthritis)

The procedure was performed by the on-duty consultant and his team of physicians after careful confirmation that the selected patients did not have any contraindications to the procedure.

Pre-operatively, all patients were deeply sedated with a combination of midazolam, pethidine, propofol and were curarized to prevent hemodynamic instability and excessive movement during the procedure. All cases of PDT were carried out using the modified Ciaglia's (Blue Rhino) technique. Chest radiographs were performed post procedure in all patients to exclude post-procedural anatomical complications. As part of routine investigation, the coagulation profile and procedural complications that included early (<48 hours) and late (>48 hours).

All data was initially collected on patient proformas, and then entered by the data collector into an electronic data base. The data recorded included basic demographics, comorbidities, indication for admission to the ICU, indication for tracheostomy, mean procedure time, length of ventilation and perioperative and early complications within the first six days.

Data analysis was carried out using the SPSS software, version 18.0 (SPSS for windows, SPSS Inc., Chicago, USA), with descriptive statistics. Our primary outcome of measure was the frequency and type of early complications. All quantitative variables are presented in frequencies, and percentages.

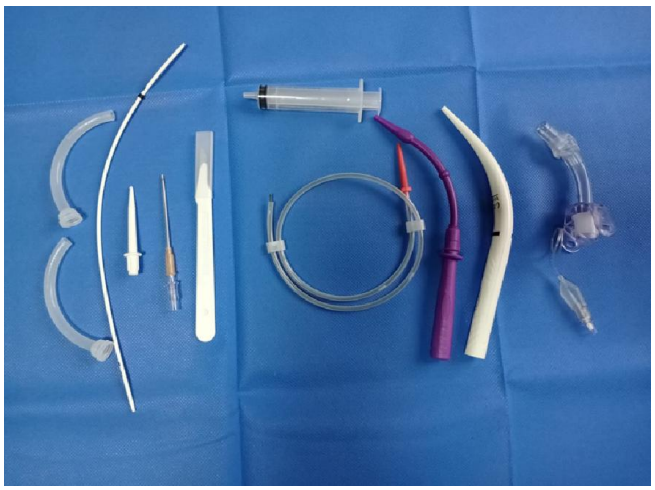

Figure 1: Tracheostomy kit (Portex)

Results

PDTs were performed successfully in 74 patients (100%) in the surgical ICU. Demographic data and reasons for admission in ICU are shown in Table 2. The mean age of the patients was 49.17±12.82 years (Range 18 – 81). These included 36 males and 38 females. The commonest indication of tracheostomy was prolonged mechanical ventilation followed by failure to wean. Mean time taken to perform tracheostomy is 8.7±4.5. This was the time taken from skin incision to insertion of the tracheostomy tube.

Table 2: Demographics and Reasons for ICU admission

Variables	*Numbers (Percent)/mean ± SD*
Age	49.17 ± 12.82 years
Gender	
Males	36 (49.64%)
Females	38 (51.35%)
Intubation days	11 ± 6
Time of the procedure (min)	9.6 ± 4.5
Reasons for ICU Admission	
Trauma	23
Post-operative	12
Sepsis	11
Firearm Injury	05
Tetanus	03
GB syndrome	03
Post-cardiac arrest	03
Liver failure	03
Poisoning	03
Eclampsia	02
Status epilepticus	02
Cerebral venous sinus thrombosis	01
Devic's disease	01
COPD	01
Miscellaneous	01

An overall complications rate of 12.16% was recorded. (Table 3) The common perioperative complication was bleeding that occurred in 5 (6.7%) patients. Minor bleeding that did not require surgical intervention or blood transfusion were observed in four (5.4%) patients and managed by local measures. Moderate bleeding occurred in one (1.3%) patient and required re-exploration but no blood transfusion. There was no patient of major bleeding that required blood transfusion and emergency surgery.

Other early complications within the first six days were wound infection (4.0%), tube displacement (1.3%), surgical emphysema (1.3%) and blocked tube (1.3%).

Table 3: Early Complications of PDT

Complications	*Number (percent)*
Bleeding	05 (6.7%)
Minor	04 (5.4%)
Moderate	01 (1.3%)
Major	00 (0%)
Wound infection	03 (4.0%)
Tube Displacement	01 (1.3%)
Surgical emphysema	01 (1.3%)
Tube blockage Occlusion of cannula	01 (1.3%)

There were no cases of pneumothorax, bronchospasm, hypotension, cardiac arrhythmias, accidental decannulation and death directly related to the procedure.

Discussion

PDT is rapidly becoming a preferred method of airway management in patients who need prolong ventilation in ICUs. Tracheostomy facilitates the weaning of the patients from the ventilator, as it reduces pulmonary dead space, provides access for clearing pulmonary secretions under various pathologic conditions, and improves the patient's comfort. In the recent past, efforts have been made to reduce the risks associated with the use of different techniques of PDT.[14] In this study modified Ciaglia'a technique is used that found safe, quick and effective method of PDT.

The mean procedure time in this study was similar to previous studies.[9] Our finding was in consistent with the results of the study by Karimpour HA et al;[15] while Siranovic, et al. reported in his study that PDT with Griggs technique was associated with a shorter procedure time.[16] The time to perform percutaneous dilatational tracheostomy was still, however, immensely lower than the time to perform surgical tracheostomy.

Early tracheostomy should be considered in any patient who is unlikely to wean early. The mean number of intubation days in our study was 11 before tracheostomy, which is similar to the study by Karimpour HA.[15] Griffith concluded that tracheostomy should be performed earlier in critically ill patients.[17] The study by Rumbak, et al. yielded important evidence suggesting that early tracheostomy should be considered in any patient who is unlikely to wean early.[18] The evidence reported findings in support of early tracheostomy, safety of PDT and lack of complications when the procedure is performed by qualified clinicians. Because complications may be potentially life threatening, the procedure should be carried out or supervised only by appropriately trained personnel. In this study all PDTs were performed by consultant with his team of ICU after careful selection of patients.

Complications are usually minor, but severe bleeding, hypoxia, and airway obstruction have been reported. Tracheostomy-related complication is not defined and the reported complication rate in the literature varies from 2.1% to more than 20%.[19,20] In this descriptive study, the frequency of complications was minimal (12.6%), which is in consistent with other studies.[21-23] Most of the complications were minor, treated by conservative methods and improved quickly. Patients were less likely to suffer from iatrogenic complications such as pneumothorax, surgical emphysema, massive haemorrhage, tracheal ring fracture, tracheal rupture, or surgical conversion if they underwent PDT.[24] Naqvi et al described the findings of a non-comparative study where they followed 53 patients after they had undergone PDT. Their findings were of lower complication rates with improved outcomes.[25] A total of four percutaneously performed tracheostomies resulted in minor haemorrhaging which was controlled by the tamponade effect of the tracheostomy dressing, and one patient had moderate bleeding that needed re-exploration but no blood transfusion. In another study, out of 136 patients, six cases with need of surgical hemostasis and three cases of bleeding with need of transfusion of blood products were reported,[26] while the study by Staffer showed 9 cases with bleeding in 1130 cases of ST.[27] One's patient tracheostomy tube became displaced within the perioperative period where fibreoptic bronchoscopy was not used as an aid to placement. Three patients in our study developed wound infections that were treated with repeated dressing and antibiotic cover.

Surgical tracheostomies have been performed as early as ancient Egypt.[28] The need for tracheostomy in critically ill patients has been immensely deliberated upon. The question of when and how still haunts the medical community. Some studies have shown that the performance of tracheostomy early than later aids in easier nursing care, weaning and decreases the incidence of ventilator associated pneumonia.[29] However, the TracMan trial did not show any advantage of early (≤ 4 days) tracheostomy in terms of improvement in 30-day mortality and other important secondary outcomes.[30] Other studies indicated that the only advantage of an early tracheostomy to a later tracheostomy was the earlier weaning times.[29] In our hospital's setup, patient turnover and demand for ICU

is very high. It is because of this reason that earlier weaning from mechanical ventilation is an important goal.

The authors of this study believe that the long-term benefits are still unclear; however there is a clear advantage with the use of the PDT in comparison to the ST such as infection, tracheal stenosis, and tracheomalacia.[9]

Standardized international guidelines are unavailable on the use of fibreoptic bronchoscopy (FOB) in PDT. We understand that it can be performed without the use of FOB, however, the only case of misplacement of the tracheostomy tube was seen in a patient where FOB was not used. Similar benefits of FOB are also noticed elsewhere.[31]

An important highlight of our study was that PDT as a bedside procedure was very useful and safe, especially for patients in whom transportation carried greater risk due to different reasons like: morbid obesity, poly-trauma/axial skeleton fractures, unstable general status, difficult intubation and ARDS with high positive end expiratory pressures (PEEP) ventilation requirement. In other words, those patients that would have been declared unfit for surgery by surgeons and anesthetists for conventional surgical tracheostomy procedure.

Our study had some limitations, like this was a cohort study which looked at a subset of the patient population. Long-term complications were, thus, impossible to assess because turnover in the surgical ICU is rapid.

Further, our study has yielded results in line with the findings of globally published literature; the PDT is more efficacious, safe, and has a lower complication rate in comparison to the surgical technique.[32,33] By carrying out the procedure at bedside, we avoided wastage of human resources, operation theatre time, anaesthetic gases, and thus, the procedure was comparatively cost effective.

Conclusion

PDT is a safe and cost-effective procedure can be performed at the bedside invalidating the need for moving critically ill individuals, with acceptable complication rate.

In the future, randomized controlled trials are needed to assess the long-term risks of percutaneous dilatational tracheostomies such as the development of tracheal oesophageal fistulas, tracheal stenosis, tracheomalacia, stomal infection and scarring.

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