Research Article

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Journal of Intensive and Critical Care
ISSN 2471-8505

2020
Vol.6 No.5:19

DOI: 10.36648/2471-8505.6.5.19

Percutaneous Dilational Tracheostomy With or Without Bronchoscopic Guidance: A Retrospective Analysis of 201 Patients in an Intensive Care Unit of a Tertiary Care Centre

Agrawal VK*, Bansal A, Jain A, Singh RK, Kumawat BL, Sharma N

Department of Critical Care Medicine, Metro Heart Institute with Multispeciality, Sector 16A, Faridabad, Haryana, India

***Corresponding author:**
Agrawal VK

vkatbcd@hotmail.com

Department of Critical Care Medicine, Metro Heart Institute with Multispeciality, Sector 16A, Faridabad, Haryana, India.

Citation: Agrawal VK, Bansal A, Jain A, Singh RK, Kumawat BL, et al. (2020) Percutaneous Dilational Tracheostomy With or Without Bronchoscopic Guidance: A Retrospective Analysis of 201 Patients in an Intensive Care Unit of a Tertiary Care Centre. J Intensive & Crit Care Vol.6 No.5:19

Abstract

Introduction: Tracheostomy is one of many common procedures in intensive care unit which can be performed in two ways: open or surgical tracheostomy (ST) and Percutaneous Dilational Tracheostomy (PDT). PDT is preferred and performed with or without bronchoscopic guidance. We retrospectively analysed all cases of tracheostomy performed in our Intensive care unit.

Materials & Methods: We did a retrospective study and analysis of 209 patients admitted in our ICU during last two and half years on which tracheostomy were performed, out of which 201 cases were performed PDT. We used both Ciaglia blue rhino and Griggs technique to perform PDT.

Results: A total number of 53 complications were encountered in 14 (7%) patients and with remaining 187 (93%), the patients, procedure was uneventful. Common early complication encountered were minor bleeding (6.5%), transient hypotension (6%) guide wire kinking (5%). Major bleeding (2%), accidental extubation (1%) and false passage (0.5%) were few rare early complications. Infections (4%) and bleeding (1.5%) were delayed complications encountered.

Conclusion: Our study recoiled that tracheostomy with percutaneous dilational technique without bronchoscopic guidance can be performed rapidly, with ease while adhering to safety. It's without significant procedural complications, if conducted by an ICU physician or intensivist or a person who is well familiar and experienced with the procedure, eventually reducing the cost and duration, which is highly valued in present era.

Keywords: Percutaneous dilational Tracheostomy, Fiberoptic bronchoscopy, Intensivist, Ciaglia blue rhino, Griggs technique.

Received: October 13, 2020; **Accepted:** November 10, 2020; **Published:** November 20, 2020

Abbreviations: PDT- Percutaneous Dilational Tracheostomy; ST- Surgical tracheostomy; FOB- Fiberoptic bronchoscopy.

Introduction

Tracheostomy is one of the commonly and routinely performed procedures in intensive care units for airway protection, airway access or for prolonged mechanical ventilation. It also facilitates pulmonary toileting, reduces risk of sub-glottic stenosis, decreases the use of sedatives and vasopressors requirement and facilitates early weaning from the mechanical ventilation. It also reduces the length of stay in ICU there by reducing cost of treatment of critically ill patients. Tracheostomy is performed in two ways: open or surgical tracheostomy (ST) and Percutaneous Dilational Tracheostomy (PDT). There are numbers of techniques of performing PDT worldwide in critically ill patients, however the Griggs and Ciaglia blue rhino are the two adopted techniques

in existent use. PDT can also be done with the assistance of ultrasound, either rigid or under fiber-optic bronchoscopic guidance.

Traditional standard surgical tracheostomy is usually performed, under general anaesthesia by surgeons in controlled environment of operation theatre. The existent technique of surgical tracheostomy was first introduce in 1909 by Chevalier Jackson [1] and had not altered markedly since then. Surgical tracheostomy (ST) requires operation theatre, surgeon and assistance of an anaesthetist subsequently increasing the cost of treatment furthermore. It may present with undue risk during transportation of a critically ill patients from an intensive care unit to the operation theatre as well as decision to procedure time-lapse. Hence, PDT is preferable method nowadays and is being performed in intensive care units all around the world. Since last two decades, PDT has been performed frequently in ICUs worldwide. It is a cost effective procedure which can be performed bedside, quickly and safely by a trained ICU team usually including anaesthetist, intensive care physician etc., who are well familiarized with the procedure. Therefore, it's safe to affirm that PDT is safer, faster and cost effective technique in comparison to traditional standard surgical tracheostomy with better cosmetic effect after decannulation, since the incision made during PDT is comparatively smaller than surgical tracheostomy. We retrospectively analysed all cases of tracheostomy performed in our Intensive care unit in last 30 months. However, we did anticipate that there would be significant economic advantages without considerable inflation in complication rate with PDT done with or without bronchoscopy.

Materials and Methods

In our Intensive care unit of a 200 bedded tertiary care centre, we commonly perform tracheostomy through percutaneous dilational method. We have statistically a large number of neurologically deficit (including both neurology and neurosurgery), COPD (chronic obstructive pulmonary disease) and post-operative patients in addition to the patients with other serious medical illnesses, requiring airway management and prolonged ventilation. Most of the neurologically deficit (CVA) patients required tracheostomy for securing clear airway, its protection and removal of excessive secretions while COPD or post-operative patients require it for prolonged or difficult ventilation in view of lower respiratory illnesses. We did a retrospective analysis of 209 patients admitted in our ICU who underwent tracheostomy during last two and half years, where open or surgical tracheostomy was performed in only 8 patients with indication encompassing thyroid enlargement and unfavourable anatomy. PDT was done successfully in rest of 201 patients. All PDT were performed on intubated patients under adequate sedation and muscle relaxant along with 100% oxygen supplement. Equipments for emergency re-intubation and difficult intubation were always prepared proactively.

Techniques used for PDT

We used both Ciaglia blue rhino and Griggs [2] technique to perform PDT in our ICU. Initially, we used fiberoptic bronchoscopic and ultrasound assistance for performing PDT. However, as the ICU team gained proficiency to perform PDT, both fibrotic bronchoscope and ultrasound assistance was subsequently executed. It aided in reducing cost and duration of the procedure. The procedures were performed bedside by qualified intensivist with minimum 5 years of experience in intensive care unit. The progressive dilation method described by Ciaglia, et al [3] was mostly used while performing PDT in our ICU (176 patients). In this technique a Seldinger guidewire with a teflon cannula was inserted into the trachea between the first and second tracheal ring or between second and third tracheal rings and was used as guide to series of dilators used to create a tracheostomy stoma for the tracheostomy tube [4]. The free movement of the guide wire was ensured throughout the procedure to prevent misplacement and kinking. The tracheostomy tube with obturator was railroaded through the guide wire into the trachea.

The more recent approach with one stage dilation technique proposed by Griggs [2] was also used in performing PDT. In this technique, modified Howard- Kelly [5-10] forcep (or also called guide wire dilator forcep) is used to facilitate the formation of the tracheal stoma by achieving the tracheal membrane split which thereby increased the speed of tracheostomy insertion. A chest X-ray was routinely done after PDT for early detection of complications.

Results

In our ICU during the period of last two and half years, we performed PDT on 201 patients at the bedside. The demographic data, indication for tracheostomy, length of resources utilisation, complication rate, success rate of weaning from ventilator and economics rationality were collected and analysed retrospectively from patient's records (**Tables 1 and 2**). There were 62 (31%) patients with medical conditions like sepsis, poisoning and other acute medical condition requiring ICU admission, other 78 (39%)

Table 1 Demographic data: (n=209).

Observations	n (range)
Total no. of patients	209 (152 males, 57 females)
Age in years, mean ± SD	62 ± 16 (range 14-92 years
Total number of open/surgical tracheostomy	08 (6 males, 2 females)
Total number of PDT	201 (146 males, 55 females)
PDT with FOB assistance	46
PDT without FOB assistance	155
PDT decision to procedure time, Median (range)	76 min. (40 min. to 6 hrs.)
Operating time without FOB in minutes, Median (range)	3.4 (2.5-8)
Operating time with FOB in minutes, Median (range)	4.6 (3.5- 10.4)
No. of PDT with Griggs technique	25
No. of PDT with Ciaglia technique	176
Indication for PDT (%)	
Airway protection	157 (78%)
Prolonged ventilation	42 (21%)
Upper airway obstruction	2 (1%)

PDT: Percutaneous dilational tracheostomy SD: Standard deviation; FOB: Fiberoptic bronchoscopy

Table 2 Result and patient outcome: (n=209).

Observations	n (range)
Endotracheal tube days, median (range)	6 (1-14)
Ventilator days post PDT, median (range)	4.64 (0-22)
Successful decannulation	48 (24%)
Decannulation of TT, median (range)	14 days (4-62 days)
Average cost reduction in PDT without FOB	36%
Patient Outcome (%)	
Discharge with TT	136 (68%)
Discharge after decannulation	48 (24%)
Died in hospital	16 (8%)

TT: Tracheostomy tube; PDT: Percutaneous dilational tracheostomy
FOB: Fiberoptic bronchoscopy

patients had suffered hemorrhagic or ischemic cerebrovascular accident or anoxic brain injury; whereas 36 (18%) patients had acute exacerbation of respiratory problems including COPD, Bronchial asthma, ARDS etc; 14 (7%) patients were admitted with injuries of assault or road traffic accident (RTA) and 10 (5%) were post-operative patients.

Complications

A total number of 53 complications were encountered in 14 (7%) patients and in remaining 187 (93%) patients procedure was performed uneventfully. Since, many patients had suffered more than one complication, therefore number of complications (53) are higher than the total number of patients (14) who had encountered complications. Early and late complications are given in **Tables 3 and 4** subsequently.

Table 3 Early complications: (n=209).

Events	n (%)
No complications	187 (93%)
Accidental extubation during procedure	2 (1%)
Puncturing of ET cuff (3%)	6
Minor bleeding (10-50 ml blood loss)	13 (6.5%)
Major bleeding (>50 ml blood loss) (2%)	4
Transient hypotension (6%)	12
False passage (0.5%)	1
Guide wire dislodged during dilation	Nil
Guide wire kinking	10 (5%)
GCS deterioration	Nil
Death within 24 hrs of the procedure	Nil
Hypoxia during the procedure (SpO_2 <90%) (1%)	2
Conversion to surgical tracheostomy (1%)	2
Sub cutaneous emphysema	1 (0.5%)
Pneumothorax	Nil
Posterior tracheal wall puncture	Nil
Total no. of complications	53 in 14 (7%)

Note: Total no. of complications are more than 14 because many patients had more than 1 complication.
ET: Endotrachial tube; GCS: Glasgow coma score

Discussion

PDT is a widely accepted procedure and is growingly being used in the last few years. One of the refinement to this technique

Table 4 Late complications: (n=209).

Events	n (%)
Infection/ Cellulitis at local site	8 (4%)
Persistent stoma requiring operative closure	Nil
Subglottic stenosis	2 (1%)
Bleeding (after 24 hrs of the procedure)	3 (1.5%)

is fiberoptic bronchoscope assisted procedure for direct endotracheal visualization. Bronchoscopy provides certain benefits such as confirmation of needle placement, dilation and tube placement, resulting in a safe completion of the procedure [11,12]. But these studies are not designated to assess the impact of bronchoscopy on PDT since there are no large randomized controlled studies depicting direct comparison on PDT with or without bronchoscopic assistance [13]. PDT with the help of bronchoscopic guidance requires the availability of the equipment, skilled personnel and may increase the overall cost of the procedure [14].

Some authors have documented the fiberoptic bronchoscopy impact on gas exchange and retention of carbon dioxide. Reilly, et al [15] showed incidence of increased intracranial pressure with the use of fiberoptic bronchoscope secondary to a rise in the carbon dioxide pressure. Nawaz, et al [16] reported that bronchoscope has no co-relation to post procedure morbidity rate however, it does increase duration of the procedure. A retrospective study published by Jackson et al. [17] in 2011 revealed that the incidence of early or late complications of the procedure were independent to the use of the fiberoptic bronchoscope. Dennis, et al [18] in yet another retrospective analysis of 3162 patients with PDT where majority were performed without bronchoscopic guidance between 2001 and 2011 showed successful completion of the procedure in 99.62% patients including morbidly obese patients with difficult anatomy. They had encountered major airway complications in 12 (0.38%) patients and accounting for mortality in 5 (0.16%) patients. Jackson et al. [17] and Abdulla, et al [19] in their retrospective review of PDTs also found only minor complications without significant difference between PDT performed with or without bronchoscopic guidance however operating time was shorter in patients without bronchoscopy. Both the studies suggested that bronchoscopic guidance should not be routinely used, perhaps it can be an important adjunct in selected patients with difficult anatomy. Kearney et al [20] examined the complications of 827 patients who underwent PDT procedures mostly done without bronchoscopic guidance and found premature extubation (1%) as the most common perioperative complication during ET withdrawal, followed by bleeding (0.9%) where procedure related mortality rate was 0.6%.

Complications pertaining to PDT without bronchoscopic guidance in our analysis are accidental extubation during the procedure, rupture of ET cuff, false passage, guide wire problems were minimal and not a causes of major concern. The most common complication was incidence of minor bleeding (10-50 ml blood loss) found in 13 (6.5%) patients, where bleeding was controlled using manual pressure during the procedure, followed by pressure dressing but in 4 (2%) patients incident of major bleeding (>50 ml blood loss) occurred. In 2 of these patients, bleeding occurred

during the procedure and surgeon was called in, to help suturing and cauterization of bleeding vessels. In other 2 patients post procedural bleeding occurred, where re-exploration was done at bedside and haemostasis was achieved with the help of suturing and other haemostatic agents like surgicel® etc. In rest of other patients, bleeding rarely interrupted the procedure since dilators and eventually tracheostomy tube placement controlled the haemorrhage effectively.

Among other complications which were encountered was transient hypotension during procedure secondary to deeper anaesthesia or sedation and guide wire related problems but they were managed promptly by experienced ICU team and did not lead to any major incidents or further complication. The notable disadvantages of bronchoscope assisted PDT like hypoventilation, hypercarbia, respiratory acidosis, increased intracranial pressure, damage to bronchoscope during tracheal cannulation etc. [21-23] were not much encountered in our experiences. Early detection for need of tracheostomy also helped us in early weaning from mechanical ventilator and subsequently reduced the length of stay in ICU.

Conclusion

Percutaneous Dilational Tracheostomy (PDT) is a procedure of choice in a critically ill patient in an ICU. Both PDT techniques, Griggs and Ciaglia can be used effectively and safely depending on competency and familiarity of intensivist or the person who is performing tracheostomy. After decannulation it has a cosmetic advantage since it leaves relatively smaller scar than standard surgical tracheostomy. We minimally used bronchoscopic assistance as it had significantly increased duration and cost of the procedure. Our study indicates that tracheostomy with percutaneous dilational technique without bronchoscopic guidance can be performed rapidly, easily, safely and without any additional pre or post procedural complications, provided it is done by a trained and competent ICU physician or intensivist or a person who is well familiar and experienced with the procedure, further reducing cost and duration of procedure which is of much importance and highly valued in healthcare industry.

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