PERCUTANEOUS DILATATIONAL TRACHEOSTOMY: A PROSPECTIVE ANALYSIS ABOUT THE SAFETY OF PROCEDURE AMONG ICU PATIENTS

Syed Mazhar Ali Naqvi[1], Muhammad Javed Bashir[2], Muhammad Hussain[3], Hamna Rao[4]

[1-4] Department of Pulmonary and Critical Care Medicine, Services Institute of Medical Sciences, Lahore - Pakistan.
Address for correspondence:
Syed Mazhar Ali Naqvi
Medical ICU, Department of Pulmonary and Critical Care Medicine, Services Institute of Medical Sciences, Lahore - Pakistan.
Email: naqvisyedmazharali@yahoo.co.uk
Date Received:
July 17, 2016
Date Revised:
December 12, 2016
Date Accepted:
December 22, 2016

ABSTRACT

Objective: To evaluate the percutaneous dilatational tracheostomy procedure safety among the critically ill Medical ICU patients.

Methodology: The study was descriptive and conducted in Medical ICU, Department of Pulmonary and Critical Care Medicine, Services Institute of Medical Sciences, Lahore, from February 2015 to May 2016. Fifty three Medical ICU patients underwent tracheostomy procedure through percutaneous dilatational technique using both Grigg's and Ciaglia's methods. Procedure was performed at bed side using local anesthesia, sedation and systemic analgesia, under bronchoscopic guidance. Patients were monitored for intraprocedural and postprocedural complications like: hemorrhage, stomal infection, injury to adjacent structures, arrhythmias, transient hypoxemia, transient hypotension, paratracheal insertion, pneumothorax, sub-cutaneous emphysema, loss of airway, accidental decannulation, tracheal ring fracture and new lung infiltrate or atelectasis.

Results: A total of 53 procedures were performed. Intraprocedural complications included: Transient hypoxemia 4/53 (7.5%) & hypotension 3/53 (5.6%), hemorrhage 3/53 (5.6%) & one case of paratracheal placement. No procedure related mortality was noted. 10 patients died during the ICU stay due to the primary underlying disease and one patient died after a successful decannulation. 36 patients had uneventful decannulation. Six patients were directly discharged from ICU.

Conclusion: Percutaneous dilatational tracheostomy is a safe procedure with low complications rate and suitable for critically ill ICU patients.

Key Words: Percutaneous dilatational tracheostomy, Tracheostomy

This article may be cited as: **Naqvi SMA, Bashir MJ, Hussain M, Rao H. Percutaneous dilatational tracheostomy: A prospective analysis about the safety of procedure among ICU patients. J Postgrad Med Inst 2017; 31(1): 56-60.**

INTRODUCTION

Tracheostomy is a well-known surgical procedure which was described earlier back in ancient Egypt[1]. In nineteenth century, it was considered to be a dangerous procedure and seldom performed, due to its high complications rate. Jackson[2] in 1909, defined the surgical principles to perform this operation and could able to avoid most of its (short and long term) complications. Toye and Weinstein in 1969 described the unique technique of percutaneous tracheostomy with the help of Seldinger guide wire and cutting dilators[3] but technique did not gain the popularity probably due to its bleeding complications and it has since then been refined with various modifications. Ciaglia in 1985[4], described the first percutaneous dilatational tracheostomy technique without any large skin cutting except for the small skin incision and multiple dilators usage, over the Seldinger wire, which was safe and quick. Sooner a commercial kit which used this technique became available, and the procedure started being carried out with low complications rates, both short and long term.

Percutaneous dilatational tracheostomy (PDT) is an invasive procedure in which a tracheostomy tube is placed after establishing a tracheal stoma through dilatation method, rather than the surgical creation of a tracheal stoma. Tracheostomy tube insertion is a common procedure which is mostly being performed in the intensive care units where prolonged mechanical ventilation is expected, as it is associated with higher rates of ICU mortality and compromised post-ICU discharge health associated quality of life[5].

The significantly increased implementation of this practice for the past decade may partly be explained by the improvement of percutaneous dilatational tech-

nique which allows easy and rapid insertion of tracheal cannula at bedside by an experienced intensivist[6].

Currently two percutaneous dilatational tracheostomy tube placement commercial kits are available: Griggs technique (Portex Ltd; Hythe Kent, United Kingdom) that used an "over the guide-wire" dilating forceps having a central opening, and the other kit which used Ciaglias method (Blue Rhino; Cook Critical Care; Bloomington. IN) that used a single curved conical dilator over the seldinger wire[7]. Both of these methods are safe, quick and simple.

Percutaneous tracheostomy has several advantages over the conventional surgical technique of tracheostomy tube placement. It is simpler, faster, cheaper, and can be executed at bedside without displacing the patient[8]. We prospectively performed the percutaneous dilatational tracheostomies in a tertiary care hospital, among ICU patients to once again evaluate the safety along with the effectiveness of the technique using both of the dilatational methods randomly.

METHODOLOGY

This prospective, non-randomized, observational study was conducted in the Medical ICU, Department of Pulmonary and Critical Care Medicine, Services Institute of Medical Sciences, Lahore, from February, 2015 to May, 2016. The study comprised of 53 ICU patients who were intubated and ventilated for various indications including sepsis, tetanus, stroke, ARDS, COPD exacerbation, MOF, ACS and Post CPR vegetative states etc. All of these patients were either ventilator dependent or expected to require long term ventilatory support. Procedure was performed between 04 to 16 days of endo-tracheal intubation/ventilation. Patient with tracheal, neck and spinal abnormalities, previous tracheostomy or neck surgery, thyromegaly, soft tissue infection in the neck, severe hypoxemia, uncorrectable coagulopathy, thrombocyte count <50,000, severe hemodynamic instability or autonomic dysfunction, severe sepsis and status epilepticus were excluded.

All 53 patients underwent tracheostomy procedure through percutaneous dilatational technique using both commercially available kits (Portex Ltd; Hythe Kent, United Kingdom, that used an "over the guidewire" dilating forceps with central opening - Griggs technique, and Blue Rhino; Bloomington, that uses a single curved, conical dilator with seldinger technique - Ciaglias technique). The procedure was done at bedside in the setting of Medical ICU after obtaining an informed consent from next to kin of patient about the benefits and potential complications. The procedure team was comprised of four persons; an ICU interventionist, who directly performed the procedure, a bronchoscopist who guided the interventionist endotrachealy during each step of the procedure using Fiberoptic Olympus Bronchoscope(FOB), a bedside nurse who assisted the interventionist and a bronchoscopy technologist.

Procedure was performed without transportation and the help of anesthetist, in Medical ICU. Sedation and analgesia was achieved using a bolus of both IV Nalbuphine 5-10mg or Tramadol 50-100mg and Propofol, until the adequate sedation was achieved. Atracurium 0.4 to 0.5mg/kg bolus was used as muscle paralyzing agent after adequate sedation and analgesia. Patient was kept on mechanical ventilation during the procedure using controlled mode and 100% FiO_2. Endo-tracheal tube (ETT) was upsized to 8mm to facilitate the smooth passage of bronchoscope across the ETT and to ensure adequate minute ventilation during the procedure. All patients had continuous ECG, BP, SpO2, Temperature and end tidal carbon dioxide level ($EtCO_2$) monitoring. Following sedation and muscle relaxation, the head was brought to extension by placing a roll pillow under the shoulders.

Gastric emptying was achieved before the procedure by aspirating NG tube. Povidone-iodine was used to cleanse the region and the area was covered with perforated sheet and 2% lidocaine was used as local anesthesia. Patients were followed prospectively for complications like: hemorrhage, stomal infection, injury to adjacent structures, arrhythmias, transient hypoxemia, transient hypotension, paratracheal insertion, pneumothorax, sub-cutaneous emphysema, loss of airway and new lung infiltrate or atelectasis.

Patient was kept in supine position with neck mildly hyperextended, the local area was cleaned with alcohol followed by povidone-iodine solution. The skin and subcutaneous planes were infiltrated with 2% lidocaine. Simultaneously Olympus Fiberoptic Bronchoscope was inserted through ETT (#8) using "adapter for uninterrupted bronchoscopy" to avoid air leak from the circuit. After a brief endo-bronchial examination, ETT was pulled up in a fashion to keep the cuff immediately under the vocal cords. A 14-G cannula (using the commercially available, either Griggs or Ciaglias kits) was moved between the second and third tracheal rings until air was inspired and/or bronchoscopist confirmed the safe and central position of the tip of cannula inside the trachea.

Tracheal space was determined either through palpation of tracheal rings or endo-bronchially by transillumination of the FOB light inside the trachea. Cannula was slided over the needle further into the trachea and needle was withdrawn. After placing the guide wire in the tracheal lumen, cannula was removed. A 10mm transverse skin incision was made (5mm on each side of the tracheal puncture) and the track was dilated with 8-F dilator. Further dilatation was achieved using dilat-

ing forceps or blue Rhino dilator, depending upon the availability of kit and a No. 7 tracheostomy tube was placed for females and No.8 tracheostomy tube for male patients. Tracheostomy cuff was inflated after confirming the position of the tube with bronchoscopist. ETT was removed and ventilator switched to tracheostomy tube.

Bronchoscopist, afterwards performed the endo-bronchial examination via tracheostomy tube to reassure the desired position of the tracheostomy tube in the trachea, to estimate the distance of the tracheostomy tube tip from the carina, and to reassure the patency of distal airways. A chest x-ray was ordered for every patient after the procedure, to rule out pneumothorax, surgical emphysema and atelectasis.

Data including the age, sex, cause for intubation and tracheostomy, days of intubation/ventilation, APACHE II Score, duration of procedure, lowest intraprocedural SpO_2, lowest intraprocedural BP, intraprocedural complications such as bleeding, loss of airway for more than 20 seconds, subcutaneous emphysema, tracheal ring fracture and paratracheal placement of the tube; postprocedural complications such as accidental decannulation, pneumothorax, hemorrhage, stomal granulation, infection of stoma or a new lung infiltrate within 48hours of tracheostomy; duration of tracheostomy; planned decannulation and mortality were recorded.

Complications were defined as below: Hypotension as systolic BP less than 90mmHg. Hypoxia as SaO2 under 90%. Bleeding was classified to be mild (25 to 100mls), moderate (from 100 to 250mls) and severe (>250mls). A stomal infection was considered when there was a frank purulent discharge from the source with surrounding erythema of ≥1cm.

RESULTS

In our series, total 53 percutaneous dilatational tracheostomies were performed. Out of 53, 29 were females and 24 male patients with age ranges between 15 to 71 years. Mean age was 44±27years. Patients were tracheostomized on average at 10±6 days.

No patient underwent a repeat tracheostomy after an elective decannulation and no patient died during the PDT due to any intraprocedural complications. A total of 10 patients (19%), out of 53 died during the ICU stay due to the original underlying disease with tracheostomy tube, and only one patient (≈2%) died after a successful decannulation, related to primary disease as well. Of the 36 patients (68%) out of 53, who survived successful decannulation, the time duration from the insertion of tracheostomy to decannulation ranged 10 to 96 days. Out of 53, six patients (11%) were directly discharged from ICU with tracheostomy in situ, for home nursing care, with or without domiciliary ventilatory support.

The intraprocedural complications are shown in table 2. One case (≈2%) of paratracheal placement of tracheostomy was observed due to technical difficulty, which was corrected during the same procedure.

Post-procedural complications as shown in table 3 were not observed in our case series. Only one case (≈2%) of mild post procedural hemorrhage was noted

Table 1: Patient's characteristics

1.	Male/Female=53	24/29=53
2.	Age, yr, Mean ±SD	44±27
3.	Indications for Tracheostomy	
a.	Prolonged Ventilation:Tetanus,GBS,COPD,ARDS,Myasthenia etc	31(58.5%)
b.	Airway protection	3(5.6%)
c.	Post CPR status/Persistent vegetative state	5(9.4%)
d.	Difficult Weaning due to various reasons.	8(15%)
e.	VA/Low GCS state.	4(7.5%)
f.	Sepsis/MOF/Polytrauma	2(3.7%)
4.	Days of Intubation prior to tracheostomy	10 ±6
5.	Repeat Tracheostomy after an elective decannulation	0
6.	Mortality during the PDT procedure.	0
7.	Patients died with tracheostomy due to original disease	10 (19%)
8.	Patients died after successful decannulation due to primary disease	1 (≈2%)
9.	Procedure Duration, mins (time from local anesthesia till tracheostomy insertion)	9.5±4.5
10.	APACHE II score	19±6

Table 2: Intra-procedural complications

No.	Complications		n / %
1.	Transient Hypoxemia/SpO_2 drop ≤ 90% for more than 2mins		4/53 (7.5%)
2.	Transient Hypotension/ BP < 90 systolic		3/53 (5.6%)
3.	Bleeding	Mild (25 to 100mls)	3/53 (5.6%)
		Moderate (100 to 250mls)	0/53
		Severe (>250mls).	0/53
4.	Loss of Airway for more than 20 seconds		0/53
5.	Subcutaneous Emphysema		0/53
6.	Tracheal Ring Fracture		0/53
7.	Paratracheal Placement of the tube		1/53 (≈2%)

Table 3: Post-procedural complications

No.	Complications	n / %
1.	Accidental Decannulation	0/53
2.	Pneumothorax	0/53
3.	Hemorrhage (Mild - 25 to 100mls)	1/53 (≈2%)
4.	Stomal Granulation	0/53
5.	Stomal Infection	0/53
6.	A new Lung Infiltrate within 48hours of tracheostomy	0/53

which was due to stomal skin bleeder. This required exploration of stoma and bleeding vessel was ligated.

DISCUSSION

PDT has several benefits over the routine surgical approach. It is simpler, quicker, less expensive and easy to perform at bedside without moving the patient outside the ICU premises[7]. This is mostly important in cases where the patient's condition is critical, and displacing the patient from the unit is difficult and sometimes dangerous[8].

The complications rate of ordinary surgical tracheostomy seems inordinately high in the context of being relatively simple surgical procedure[9]. Surgical tracheostomy complications rate ranges from 6 to 66% and mortality from 0 to 5% and the complications rate of procedure done in ICU are comparable to those performed in operating theater[10]. In contrast to "routine" tracheostomy, the PDT technique uses the tube of smallest possible size (and stoma) required for adequate air flow and suctioning, and moreover, this smaller size aids in minimizing the chance of hemorrhage[11]. When properly performed, the large blood vessels are avoided, and the slight ooze of blood from the small incision is tamponaded by the snug fit of the tracheostomy tube. In addition, the rate of infection is reduced, since less soft tissue is exposed for a possible contamination. One study[12] compared PDT and surgical tracheostomy and reported that PDT was more advantageous in terms of hemorrhage and complication and so was preferred over surgical tracheostomy.

In our case series of 53 patients, in whom percutaneous dilatational tracheostomy tube was inserted, using both Grigg's and Ciaglia's methods, no procedure technique related mortality was observed. Intraprocedural complications rate was significantly low, which is comparable with internationally published data about the safety of PDT[12-14]. A single case of paratracheal placement, which was corrected during the same procedure uneventfully, was related to obesity and kinking of guide wire & guiding catheter. Transient hypotension and hypoxemia, occurring in 3 & 4 patients respectively, was related to either sedatives/muscle relaxants use or due to the preexisting compromised respiratory status of a patient. Drug induced hypotension was controlled in successive procedures by injecting the sedatives/muscle relaxants in small & frequent boluses, and by improving the hydration status of patient before the procedure. Early tracheostomies were performed in our study especially for patients like tetanus, GBS and with low GCS state.

We have found the PDT bedside procedure very useful and safe, especially for patients in whom transportation carried more risk due to different reasons like: morbid obesity, polytrauma/axial skeleton fractures, unstable general status, difficult intubation and moder-

ate to severe dysautonomias. Patients with minor coagulopathies, anemia or mild thrombocytopenia who had relative contraindication to blood products transfusion, e.g a patient with a recent history of transfusion related acute lung injury, were declared unfit for the procedure by surgeons and anesthetists for conventional surgical tracheostomy procedure. These patients underwent PDT without any increased incidence of intra or post-procedural complication rate emphasizing the ease and safety of the procedure. Same findings were noted by Karvandian et al[13] and Saritas et al[14] that the complication rates of hemorrhage, pneumothorax, surgical emphysema, esophageal perforation and tracheomalacia were significantly less with percutaneous dilatational tracheostomy and was preferred for critically ill patients.

In another study which was conducted on 300 patients who were managed in an ICU of a tertiary care hospital, Pattnaik et al[15] reported an overall 8.6% complication rate which included the cases of minor and major bleeding which is comparable with our case series where the overall intraprocedural complication rate was 20.7%.

CONCLUSION

Percutaneous dilatational tracheostomy is a safe procedure with low complications rate. PDT is particularly suitable for critically ill patients and can safely be performed without transporting the patients outside the ICU premises.

REFERENCES

1. Bormon J, Davidson JT. A history of tracheostomy: Spiritum Ducit vivit (Cicero). Br J Anaesth 1963; 35:388-90.
2. Jackson C. Tracheostomy. Laryngoscope 1909; 19:285-90.
3. Toye FJ, Weinstein JD. A percutaneous tracheostomy device. Surgery 1969; 65:384-9.
4. Ciaglia P, Firsching R, Syniec C. Elective percutaneous dilatational tracheostomy: A new & simple bedside procedure:preliminary report. Chest 1985; 87:715-9.
5. Combes A, Costa MA, Trouillet JL, Baudot J, Mokhtari M, Gibert C et al. Morbidity, mortality and quality of life outcomes of patients requiring ≥ 14 days of mechanical ventilation. Crit Care Med 2003; 31:1373-81.
6. Antonelli M, Michetti V, Di Palma A, Conti G, Pennisi MA, Arcangeli A et al. Percutaneous translaryngeal versus surgical tracheostomy: A randomized trial with 1 year double blind follow up. Crit Care Med 2005; 3:1015-20.
7. Paran H, Butnaru G, Hass I, Afanaswa A, Gutman M. Evaluation of a Modified Percutaneous Tracheostomy Technique WithoutBronchoscopic Guidance. Chest 2004; 126:868-71.
8. Friedman Y, Fildes J, Mizock B, Samuel J, Patel S, Appavu S et al. Comparison of percutaneous tracheostomy. Chest 1996; 110:480-5.
9. Heffner JE, Miller KS, Sahn SA. Tracheostomy in the intensive care unit: Part 2. Complications. Chest 1986; 90:430-6.
10. Stock MC, Woodward CG, Shapiro BA, Cane RD, Lewis V, Pecaro B. Perioperative complications of elective tracheostomy in critically ill patients. Crit Care Med 1986; 14:861-3.
11. Ciaglia P, Graniero KD. Percutaneous dilatational tracheostomy: Result and long term follow up. Chest 1992; 101:464-7.
12. Duger C, Kaygusuz K, Gursoy S. The evaluation of the complications of surgical and percutaneous tracheostomies in intensive care unit. Turk J Anaesth Reanim 2013; 41:84-7.
13. Karvandian K, Mahmoodpoor A, Baigmohammadi M, Sanaie S. Complications and the safety of percutaneous dilatational tracheostomy with Grigg's method versus surgical tracheostomy: A prospective trial with six months follow up. Pak J Med Sci 2009; 25:41-5.
14. Saritas A, Saritas PU, Kurnaz MM, Beyaz SG, Ergonenc T. The role of Fiberoptic bronchoscopy monitoring during percutaneous dilatational tracheostomy and its routine use into tracheotomy practice. J Pak Med Assoc 2016; 66:83-9.
15. Pattnaik SK, Ray B, Sinha S. Griggs percutaneous tracheostomy without bronchoscopic guidance is a safe method: A case series of 300 patients in a tertiary care intensive care unit. Indian J Crit Care Med 2014; 18:778-82.

CONTRIBUTORS

SMAN conceived the idea, planned the study, and drafted the manuscript. MJB, MH and HR helped acquisition of data and did statistical analysis. All authors contributed significantly to the submitted manuscript.