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Naushad's Modification of Griggs Percutaneous Tracheostomy: Retrospective Case Series Study on 200 Patients at Subharti Medical College, Meerut, India

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ABSTRACT

Introduction: *Percutaneous dilational tracheostomy (PDT) is a frequently performed procedure in critically ill patients in hospital emergency department, intensive care unit (ICU) and operating theater (OT). The purpose of this study is to describe a technical modification of Griggs percutaneous tracheostomy by using two 7G and 12G dilators after undergoing sterilization by ethylene oxide. Two hundred patients underwent the procedure. There were no major complications related to the procedure. There were two minor bleedings managed conservatively. The technical modification described in this study is safe and simple to execute and is most cost effective.*

Materials and methods: *Patients admitted to ICUs on prolonged mechanical ventilation who are difficult to wean and ventilate, those with facial trauma, oropharyngeal cancer patients, burn patients, a child with diphtheria, patients with chronic obstructive pulmonary disease requiring tracheostomy were included in our retrospective study. The study group underwent PDT using the Naushad's modified Griggs technique. The time taken to perform the procedure, its ease of insertion, number of attempts and its early and late procedural complications were recorded.*

Results: *The time taken by tracheostomy was 3-10 minutes. Our method is most cost effective, as it costs only around 1000 INR/15$, while the whole set of Griggs technique costs around 15000 INR/150 US $. There was only one post procedural infection, no long-term morbidity and a single case got converted to surgical tracheostomy.*

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Conclusion: *The technique seems reliable for carrying out percutaneous PDT at bedside in all patients admitted to different hospital departments, including ICUs, triage, emergency and routine OT, as a measure to secure the airway by mainly involving the oral and neck area.*

Keywords: percutaneous tracheostomy, Griggs technique.

List of abbreviations

PDT: percutaneous dilation technique
PCT: percutaneous tracheostomy
INR: Indian national rupee
USD $: United States dollar

INTRODUCTION

Tracheostomy is one of the most frequently performed surgical procedures on critically ill patients in emergency departments and intensive care units (ICUs). Currently, in ICUs, most tracheostomies are performed percutaneously (1).

A tracheostomy is a surgically created airway that is kept open with a breathing tube or tracheostomy tube. The tube is inserted directly into the trachea through an incision in the neck. A tracheostomy can be created with an open surgical or a percutaneous dilation technique (2) and can take place mainly in ICUs. The open technique involves dissection of the anterior pretracheal tissue and insertion of a tracheostomy tube under direct visualization.

The percutaneous technique can be performed quickly and safely at the bedside using a modified Seldinger technique with bronchoscopic guidance (3) (if available). This approach is associated with fewer bleeding complications than open tracheostomy and similar long-term morbidity (2).

There are many techniques described in the literature to carry out percutaneous dilational tracheostomy (PDT) (4-10). There have been many studies conducted by different investigators comparing the different techniques of percutaneous tracheostomy (11-14).

The aim of this study is to describe a technical modification of Griggs percutaneous tracheostomy technique by using two dilators acquired from the dialysis catheter insertion set after undergoing proper sterilization by ETO technique, making it most cost efficient.

The primary objective of the present study is to describe the efficacy of the modification to Griggs technique in different patient categories who are admitted in different hospital departments. The secondary objective is to acknowledge the cost, duration, and complications associated with this modified technique.

Indications and contraindications

Tracheostomy should be considered in patients with acute respiratory failure who require prolonged mechanical ventilation — defined as ventilation for seven days or more — and who are expected to have a meaningful recovery (15). Tracheostomy decreases the need for sedation and facilitates weaning from a ventilator (13, 15).

Additional indications include upper airway obstruction (including vocal cord paralysis), the need for airway protection in patients with conditions such as neurologic disease or traumatic brain injury, and the need for more effective pulmonary hygiene, including use of recruitment maneuvers and methods for clearing the airways from secretions. Neither previous tracheostomy nor other types of neck surgery are contraindications. In fact, percutaneous tracheostomy may be preferred in patients whose surgical planes have been distorted, i.e., traumatic facial injury patients (16).

The only absolute contraindications to our percutaneous tracheostomy technique included coagulopathy and thyroid mass.

Relative difficulties include cervical trauma patients, burn patients having a surgical site involved, difficult anatomy (short neck, morbid obesity, minimal neck extension, and tracheal deviation), and infection at the planned insertion site, or severe respiratory disease resulting in either the inability to withstand periods of apnea or loss of positive-pressure ventilation. ❑

MATERIAL AND METHODS

This was a retrospective study. It was performed at the Subharti Medical College and

Hospital, Department of Anesthesiology and Critical Care, India, which mainly deals with patients in SICU, RICU, MICU, PICU and Neuro-ICU, triage, emergency and elective OT. Two hundred critically ill patients who required tracheostomy were included after obtaining approval from the ethics committee of the institute and written informed consent from patients or their next of kin.

The sample size was calculated according to the number of percutaneous tracheostomies done in our institute and by statistically analyzing the power of the study.

Inclusion criteria were as follows: oxygen requirement greater than 0.8 fraction of inspired oxygen (FiO_2) or greater than 5 cm of water positive end expiratory pressure (PEEP), oxygen requirement of 0.4 fraction but difficult to wean, i.e., requiring prolonged ventilation, potential or diagnosed lesion in the cervical spine, anatomical distortion of the trachea, previous neck surgery, gross cervical obesity, infection involving the operative site, burn patient, non-intubated patients requiring definitive airway before surgery, and emergency surgical airway requirement in adult and pediatric patients.

Exclusion criteria included uncorrected coagulopathies and goiter or large thyroid mass.

After fulfillment of inclusion criteria, patients were prepared to undergo percutaneous tracheostomy by Naushad's modified Griggs technique. Routine monitors were attached.

All tracheostomies were conducted by two specialists, one of which having a large experience in critical care, and two post-graduate trainee residents in anesthesia for training purpose and experience.

Equipment

Performance of a bedside tracheostomy requires medications for sedation, analgesia and possible paralysis. A sterilized tracheostomy kit consisting of a central line guide wire, introducer needle, two dilators of 7 G and 12 G, 11 number surgical blade, two forceps- artery and mosquito, and Griggs dilator, underwent proper sterilization by ETO in the CSSD department of Subharti Medical College and Hospital (Figure 1).

The size of the selected tracheostomy tube should be appropriate for each patient. We used Ramsons percutaneous tracheostomy tubes of size 7, 7.5 and 8 in adult female and male patients, and size 5, 5.5 and 6 in children (Figure 1).

Patient and provider positioning

The patient should be in the supine position. A shoulder roll should be placed beneath the patient's scapulae, which can help to extend the neck and improve exposure of the anterior neck. Patient's head should be supported by a towel or small pillow, if needed. The intensivist should be able to access the patient's neck while standing, so the height of the bed should be adjusted as required. Team members should stand around the bed in a manner allowing them to carry out the necessary procedures safely, effectively, and efficiently.

First personnel should stand at the head of the bed, a position that allows direct control of the airway and provides access to the ventilator (Figure 2). The second one should be positioned at the patient's left side, next to the tracheostomy set. Although the intensivist is generally positioned on the patient's right side, with a direct view, a left-handed intensivist may prefer to be on the patient's left side, with the second assistant on the right side.

Identification of anatomical landmarks

Palpate the neck to identify key anatomical landmarks. These include the thyroid cartilage, cricoid cartilage, and the sternal notch. The ideal location for placement of the tracheostomy tube is between the second and third tracheal rings, 2-3/cm^2

FIGURE 1. Griggs forceps, two dilators, 16 G needles, two artery forceps, blade, guide wire, 5 mL syringe and Ramsons *per* cutaneous tracheostomy tube

FIGURE 2. PCT in severe burn patient, with one intensivist standing on the right side of the patient and another on the head end side

finger from the suprasternal notch at the center of neck.

Naushad's modified Griggs percutaneous tracheostomy technique

We performed 200 PCTs at ICU bedside, OT and triage. Below we report the procedural steps of PCT performed with a modified Griggs guide wire dilator technique. Readers are encouraged to watch the supplementary video for a more comprehensive understanding of the procedure on https://youtu.be/6uJgjKrqFJk.

The tracheostomy team was formed by two specialists, one of which having good experience in critical care, and two post graduate residents in anesthesia and critical care. Before starting the procedure, the team should take a time-out to verify the patient's identity and the procedure to be performed.

After the time-out, all mechanically ventilated patients were administered injectable midazolam 1-2 mg and fentanyl 50-100 micrograms, and then they were placed on 100% oxygen starting five minutes before and until five minutes after the completion of the procedure.

We did not encourage deep muscle relaxation as we wanted to maintain patients' breathing efforts and reflexes during the technique.

The operative site is prepared with 10% povidone iodine solution and infiltrated with 2% lidocaine 10 mg/kg maximum dose of injectable xylocaine + adrenaline 2% 3-4 mL. The anterior neck was sterilized and draped, making sure that the draping would allow easy access to the oral endotracheal tube.

In already intubated patients, the oral endotracheal tube is carefully withdrawn till 18 cm mark, watching the ventilator for proper ventilation of the patient. The introducer needle must be inserted through the anterior wall of the trachea at the level of the second tracheal ring, perpendicular to the trachea, with the bevel facing towards the foot. Placement of the needle bevel in this position caudally will help to direct the guide wire into the distal trachea. It is critical to avoid damaging the balloon on the oral endotracheal tube. If there is difficulty performing the tracheostomy, as long as the balloon is intact, the oral endotracheal tube is simply advanced to its original location and normal ventilation is resumed. If the balloon is compromised, the ability to provide positive pressure ventilation is also compromised (4).

A new airway may be expeditiously established by means of new oral endotracheal intubation, with an intact balloon depending upon the patient's stability. The guide wire should be fed through the needle, advancing it distally till minimum 20 cm mark. The needle is then removed over the wire, keeping the wire in place within the trachea at all times.

A 7-8 mm horizontal incision of 4 mm is made on each side of the guide wire in the neck that directly overlies the trachea. The subcutaneous fascia, fatty layer, superficial and middle cervical fascia is dissected with two artery forceps of different sizes. Once we reach the pretracheal fascia, two different dilators of 7 G and 12 G are introduced. The small 7G dilator is advanced over the wire to dilate the tract. The small 7G dilator is removed and the 12G dilator is advanced over the wire. The progressive dilator is removed, keeping the wire in place, then the guide wire is held between the Griggs forceps, which are inserted into the trachea till a pop sound is heard; Griggs forceps are opened while in trachea, and coming out is done while keeping forceps open. Next, the guide wire is passed through a special hole in Ramsons PCT tube, which confirms the correct placement of the PCT tube. An appropriately sized tracheostomy tube is placed directly into the trachea. Once the tube is in place, the wire is removed, the tracheostomy cuff is inflated, the circuit is connected to the tracheostomy tube, and ventilation is resumed.

The presence of end-tidal carbon dioxide confirms placement in the airway. It must be remembered that the guide wire should come out with ease, without pulling it or applying force. If the guide wire does not come out smoothly, the possibility of going into a false tract should be excluded. Correct placement of the tracheostomy tube is confirmed by chest auscultation for air entry, capnography and rise of chest wall, once satisfactory placement is confirmed, secure the tracheostomy tube. Once the patient is appropriately ventilated through a secured tracheostomy tube, the oral endotracheal tube may be removed, followed by proper oral and tracheal suction.

Chest X-ray was taken to look for tracheostomy tube position, pneumothorax, pneumomediastinum, atelectasis and other changes.

The following variables were observed and recorded: age, sex, baseline FiO_2, number of days on mechanical ventilation prior to tracheostomy, time taken for tracheostomy (defined as local infiltration to connection of the breathing circuit to tracheostomy tube and confirmation of the tube placement by auscultation and rise of the chest), ease of the technique as well as procedural and early and late complications. The tracheal stoma of most survivors was closed before discharge. Survivors were interviewed in person or by telephone at 6–10 weeks after de-cannulation and were enquired about any late complications.

Statistical analysis was done using the Statistical Package for the Social Sciences (SPSS) software version 10.0 for windows and Epi info version 6.04d. For this study, a P-value of less than 0.05 was considered statistically significant.

Loss of the airway

The most serious procedural risk associated with endotracheal intubation is loss of the airway. This typically occurs in one of two ways: the patient coughs during manipulation of the endotracheal tube or the balloon on the tube is damaged. If the patient's condition becomes unstable or if there is difficulty placing the tracheostomy, the oral endotracheal tube should be advanced to its original location and ventilation resumed. If the balloon is compromised, the provision of positive pressure ventilation is compromised. Either a new airway must be established expeditiously by creating a tracheostomy or by replacing the compromised endotracheal tube with an intact tube through oral endotracheal intubation (16). However, in our technique there occurred no incidence of loss of airway.

Aftercare

In the immediate postoperative period, the tracheal stoma requires regular assessment and wound management, including frequent cleaning of the skin around the stoma and changes in dressing as needed. Pulmonary hygiene, ventilator weaning, and eventual decannulation should be performed in accordance with institutional guidelines and the patient's clinical status. Maturation of the tracheal stoma occurs after approximately seven days, when the tracheostomy tube may be replaced or downsized, depending on the patient's clinical needs (16).

Complications

Early complications after placement of a tracheostomy tube include bleeding and obstruction or dislodgement of the tracheostomy tube (14). Bleeding is the most common complication, but it is usually self-limited or can be controlled through measures such as application of pressure or use of hemostatic agents. Inadvertent decannulation and obstruction of the tracheostomy tube are rare, but when they occur both can be managed by securing the airway through oral endotracheal intubation. If obstruction of the tube cannot be cleared with standard suctioning techniques or if the tube becomes dislodged, the airway should be secured by means of orotracheal intubation; insertion of a new tracheostomy tube through a tract that has not fully matured should not be attempted (16).

Late complications after tracheostomy include (5): tracheoinnominate fistula, tracheoesophageal fistula, and tracheal stenosis (17). The development of fistulas is a rare complication that requires surgical consultation. Tracheo-innominate fistulas are rare and life-threatening. If a fistula is suspected, immediate operative repair must be performed, as it affords the only chance of survival (18). Trache-oesophageal fistula typically occurs in patients with an esophageal foreign body such as a feeding tube (17). Operative repair is indicated after the patient's critical illness has resolved. Tracheal stenosis can occur anywhere along the trachea, from the tracheal stoma to the cuff of the tracheostomy tube. Stomal stenosis results from the trauma of tube insertion or excessive movement at the entry site. Cuff stenosis is related to mucosal ischemic injury from high cuff pressures.

Tracheal dilation is palliative; definitive treatment requires resection and reconstruction (19). ❑

RESULTS

During the study period, 200 patients underwent percutaneous tracheostomy by the Naushad's modified Griggs technique described in this study. Percutaneous tracheostomies were performed in 64 (32%) SICU patients; among them, there were 10 burns patients (Figure 2), two head and neck surgery patients (Figures 3 and 4), while the remaining 52 were trauma and post-surgery patients who were difficult to wean or ventilate; there were 48 (24%) Neurosurgery ICU (NICU) patients (Figure 7), 41 (20.5%) Medicine ICU (MICU) patients, 31 Respiratory ICU (RICU) patients (15.5%), and four (2%) Pediatric ICU (PICU) patients of which three with trauma (Figure 8) and one with diphtheria. It was done in five (2.5%) patients in triage with severe facial and neck trauma, in three (1.5%) patients in preoperative room, in patients with cervical spine immobility, in two (1%) patients in operative room, in patients with intrasurgical complications who were predicted difficult to wean postoperatively, and in two (1%) patients in emergency OT with severe distorted anatomy post head and neck cancer (Figures 5 and 6).

Demographic data showed that our study was done in the age group of 4-72 years, which included 103 (51.5%) male patients and 97 (48.5%) female patients out of the total number of 200 patients. Percutaneous tracheostomy was also done in four pediatric patients. Out of 64 patients ad-

FIGURE 4. Post PCT Naushad's technique

FIGURE 5. Patient with carcinoma tongue with distorted anatomy

FIGURE 4. Operated for carcinoma buccal mucosa

FIGURE 6. Patient after PCT by Naushad's technique

FIGURE 7. Patient with intracranial bleed requiring long term ventilation. PCT done by Naushad's technique

FIGURE 8. Child with severe head injury

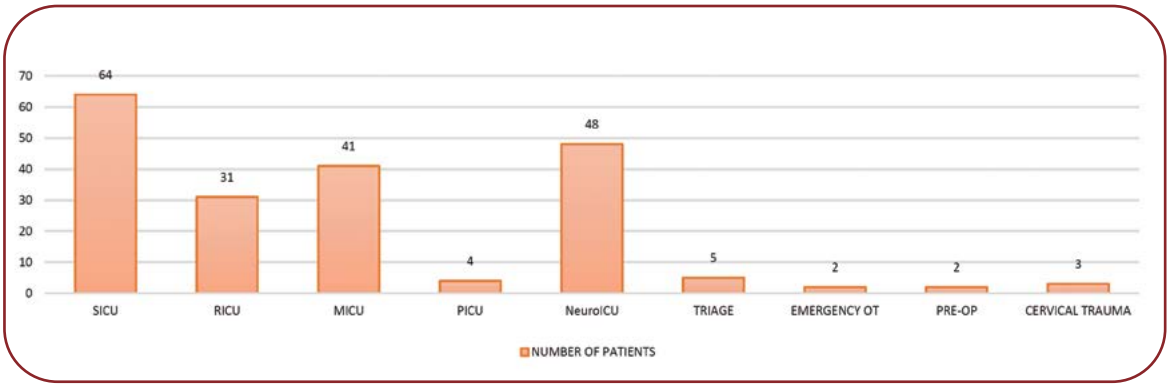

FIGURE 9. Number of patients admitted in different sections of hospital

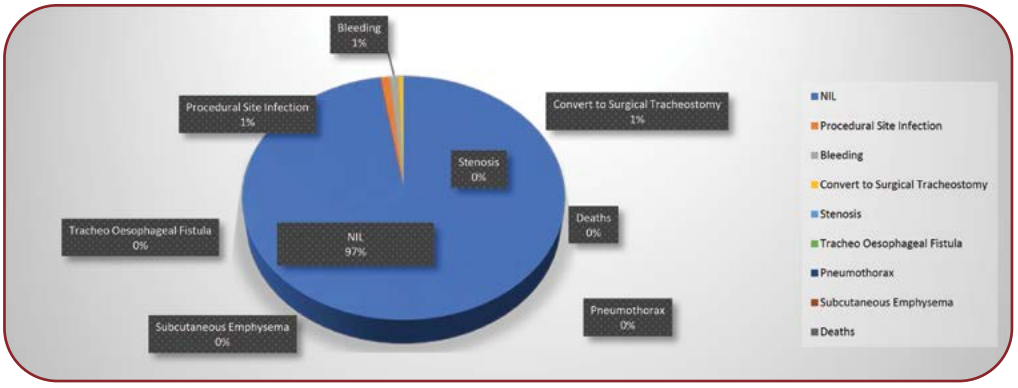

FIGURE 10. Complications related to pct by Naushad's technique

mitted in SICU, 52 (26%) were patients with post-operative and trauma related (mainly chest) complications who were difficult to wean from mechanical ventilator, 10 (5%) severe burn patients requiring definitive airway, and two (1%) post facial and neck surgery patients. Among others, 48 (24%) were patients in NICU, 41 (20.5%) in MICU, 31 (15.5%) in RICU, four (2%) in PICU, and five (2.5%) patients with severe facial trauma needing definitive airway whose PCT were done at triage mostly. Three (1.5%) patients had cervical spine injury, two (1%) patients required PCT pre-operatively before surgery because of malignancies involving face and neck areas. In two (1%)

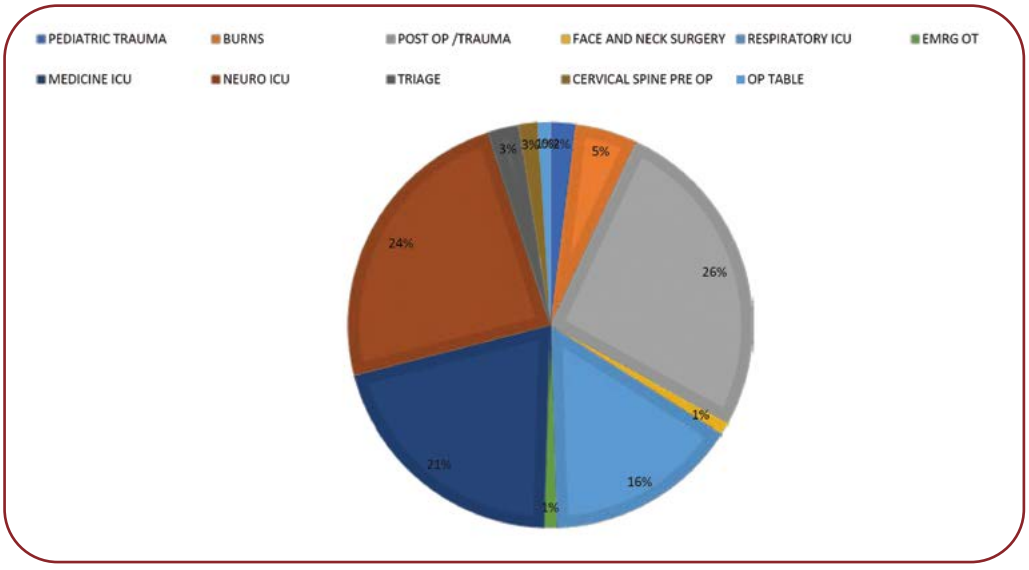

FIGURE 11. Category of patients subjected to PCT

TABLE 1. Different characteristics and parameters used while performing PCT by Naushad's technique

Characteristics	Patients (n = 200)
Age (years)	4-72
Sex	
Male	103
Female	97
Pediatrics	4
BMI	18-35
Thyromental distance	4-6 cm
Comorbidities	
Hypertension	12
Diabetes mellitus	37
Chronic liver disease	18
Stroke	11
Obesity	09
Positive end expiratory pressure (peep in cm H_2O)	6 +/- 2.5
FiO_2	0.4-0.85
Days on ventilator before tracheostomy	1-12
Procedure time (minutes)	3-8

patients, PCT was done in the emergency OT because of severe distorted anatomy of neck and face areas as a result of malignancy (Figures 9 and 11).

The most common indication for percutaneous tracheostomy was the need for prolonged ventilator support, with a mean intubation period of 1-12 days. Percutaneous tracheostomy procedure time was 3-10 minutes, which was assessed from infiltration of local anesthesia to the time of connecting to the ventilator. Ramsons (easily available) tracheostomy tube size from 5 mm to 8 mm were used in the study, out of which 7.5 mm size tubes were used in 120 (60%) of patients.

Patients were followed for an average of 8 ± 2 days for complications. There were no false passages or fistula formations, no stenosis, or oxygen desaturation below 85%, inadvertent extubations, tracheostomy tube misplacements and deaths related to the procedure in our subjects. Post-procedure chest radiograph showed no pneumothorax and no subcutaneous emphysema in the neck. There were two (1%) bleeding complications that resolved on their own, two (1%) complications of post procedural site infection, and only one (0.5%) patient required conversion to surgical tracheostomy (Figure 10). ❑

DISCUSSION

Percutaneous tracheostomy via the modified Seldingers technique was first described in 1969 and has gained several variants since then (4, 6, 8, 9, 20-29). One of the main advantages of PCT is the bedside performance, thus eliminating the expenses and logistics involved in operating room set-up usually required for open surgical tracheostomies. Furthermore, several investigators have reported shorter procedure times and lower complication rates with percutaneous tracheostomy compared to open surgical tracheostomy (2, 24, 27, 28, 30-34). The PCT

method described in this study uses the principle of Griggs procedure. Acute complications with the PCT method described by us were restricted to hemorrhage. The post-procedure bleeding rate of 1% in our study is comparable to other reports (1.6–4%) (8, 23, 24, 28, 30-32, 35-37). Only one of the percutaneous tracheostomy patients who had a bleeding complication required a surgical intervention in the present study.

Experiences with dilatational technique have generally been favorable, with claims that, in comparison with the conventional method, they are safer, easier and quicker to perform at the bedside and are associated with fewer complications. However, in a meta-analysis of tracheostomy trials, Dulguerov *et al* (38) noticed that perioperative complications were more frequent with the percutaneous technique (10% *vs*. 3%), whereas postoperative complications occured more often with surgical tracheostomy (10% *vs*. 7%).

The purpose of this study was to describe a technical modification of Griggs PCT by using two 7G and 12G dialysis catheter dilators after undergoing sterilization by ETO, which was performed in patients admitted to ICU, Triage, and OT departments to look for ease of insertion and acknowledge any procedural or late complication after modification to the Griggs PCT technique.

The reason for this modification was to make the percutaneous technique more cost effective and affordable to patients. While the whole set of Griggs technique costs around 15000 INR/150 USD, our technique costs only about 1000 INR/15 USD.

The study was done on 200 patients, of which 51.5% were males and 48.5% females, amongst which 56.5% had no co-morbidities and 19% had type 2 diabetes mellitus. The maximum number of patients was from the SICU (32%) department of the hospital (Table 1).

In our study, the maximum number of days on ventilator before the procedure were two (11.5%) and five (11.5%) days, minimum FiO_2 before tracheostomy was 46 (0.5%), 52 (0.5%) and 79 (0.5%) and maximum 61 (5%), 77 (5%) and 80 (5%), maximum patients 125 (62.5%) had FiO_2 >90% after the procedure. In most patients, the time taken for the procedure was six minutes (27%), followed by five minutes (25%). In 99% of all patients, the tube was inserted in a single attempt and 96.5% had ease of insertion. The most common indication for percutaneous tracheostomy in our study was the difficult to ventilate category (42%), followed by the difficult to wean category (41%).

Percutaneous tracheostomy can lead to intra-procedural, peri-procedural and post procedural complications. The only complications that occurred in our study comprised bleeding (1%) and procedural site infection (0.5%) and only one (0.5%) patient got converted into surgical tracheostomy due to increased bleeding.

Limitations of our study included the learning curve for the technique and inability to perform pathological studies, computed tomography, magnetic resonance imaging and laryngo-tracheoscopy, and bronchoscopy during the follow-up. ❑

CONCLUSIONS

In our experience, Naushad's modification of Griggs percutaneous tracheostomy using two dialysis catheter dilators, described in this study, is safe, fast, simple, and very economical to execute. ❑

Conflicts of interest: none declared.

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Authors' contributions: Dr. Omar Naushad, consultant, performed the described technique; Dr. Krishina Murthy was the consultant surgeon; Dr. Muzamil Bashir, consultant, in charge with medical records for providing data; Dr. Sonal Rathee wrote the manuscript; and Ms. Bushra Ansari was responsible for statistics.

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