Research Article

Griggs percutaneous tracheostomy without bronchoscopic guidance is a safe method: A case series of 300 patients in a tertiary care Intensive Care Unit

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Abstract

Introduction: Percutaneous tracheostomy (PCT) is being increasingly done by intensivists for critical care unit patients requiring either prolonged ventilation and/or for airway protection.[1] Bronchoscopic guidance considered a gold standard,[2,3] is not always possible due to logistic reasons and ventilation issues. We share our experience of Griggs PCT technique without bronchoscopic guidance with simple modifications to ensure safe execution of the procedure. **Objective:** The purpose of this study was to evaluate the safety issues and complications of PCT without bronchoscopic guidance in a multi-disciplinary tertiary Intensive Care Unit (ICU). **Materials and Methods:** A retrospective review of consecutive PCTs performed in our ICU between August 2010 and December 2013 by Griggs guide wire dilating forceps technique without bronchoscopic guidance is being presented. It is done by withdrawing endotracheal tube with inflated cuff while monitoring expired tidal volume on ventilator and ensuring the free mobility of guide wire during each step of the procedure, thereby ensuring a safe placement of the tracheostomy tube (TT) in trachea. **Results:** Analysis of 300 PCTs showed 26 patients (8.6%) had complications including 2 (0.6%) patients deteriorated neurologically and 2 (0.6%) deaths observed within 24 h following procedure. The median operating time was 3.5 min (range, 2.5–8 min). There were no TT placement problems in any case. **Conclusion:** Percutaneous tracheostomy can be safely performed without bronchoscopic guidance by adhering to simple steps as described.

Keywords: Bronchoscopy, critical illness, griggs technique, percutaneous tracheostomy

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Introduction

Tracheostomy is performed in critically ill patients receiving long-term mechanical ventilation.[4] It facilitates pulmonary toileting, reduces risk of subglottic stenosis, decreases the sedative requirement, and facilitates early weaning from the ventilator. It also reduces the length of stay in ICU, thus bringing down the cost of treatment.[1,5]

Percutaneous tracheostomy (PCT) via the modified Seldinger technique was first described by Shelden *et al*.[6] in 1955 and is the preferred method of tracheostomy in most of the ICUs. There have been many modifications to this technique in the following years. A technique of performing PCT using serial dilators over a guide wire was first described by Ciaglia in 1985 and in 1990, Griggs *et al*. developed another one-stage dilatation technique using a modified Howard-Kelly forceps as tracheal dilator for PCT.[7,8]

Most of the PCTs in ICU are done either by Ciaglia or Griggs technique, there are proponents of either techniques[2,9] but further studies are needed to conclude

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superiority of one over the other. In view of familiarity and experience, Griggs technique of PCT without bronchoscopic guidance has been the standard technique for PCT in our department.

The technique is to puncture the trachea and insert a guide wire into it. This was done blindly till 1990 when Marelli *et al*.[10] used bronchoscopy as an adjunct to PCT to increase the safety of the procedure. Use of bronchoscope, however, can cause ventilation issues (hypoventilation, hypercarbia, and respiratory acidosis); increases cost of the procedure and requires presence of an additional specialist physician in addition to posing technical difficulties.[1,11,12] In our study, we describe the safety of Griggs technique of PCT without bronschoscopy with minor modifications.

Materials and Methods

We conducted a retrospective review of all PCTs done from August 2010 to December 2013 on adult patients admitted in the medical and surgical ICUs in our hospital. The guide wire dilational forceps technique as described by Griggs *et al*. without use of bronchoscope followed. A commercially available kit (Portex percutaneous tracheostomy kit, Portex; Hythe, Kent, UK) used. An informed consent from the next of kin was taken before the procedure. Patients with thyroid enlargement or unfavorable anatomy were excluded. Platelet count and coagulation profile were done before the procedure. The procedure is performed at the bedside under aseptic precautions, by any of the three authors with 3 years or more of experience in doing PCT in the ICU setting. One trainee registrar took care of the intubated airway and monitored ventilation, electrocardiogram, blood pressure, and SpO_2. Ventilation was continued on a pressure controlled or pressure support mode with 100% FiO_2. Lignocaine 2% for local anesthesia and sedation with bolus doses of Fentanyl and Midazolam, with or without muscle relaxants were used during the procedure.

The patient was positioned supine with a pillow underneath the shoulders to hyperextend the neck. After cleaning the neck and upper chest with 2% chlorhexidine in alcohol, surgical site was draped with sterile sheets.

At midpoint between supra sternal notch and tip of thyroid cartilage, i.e., space between second and third tracheal ring was chosen for tracheostomy incision. After infiltrating the selected site with 2% lignocaine (2–3 ml), a 1.5–2 cm horizontal skin incision was made with scalpel, The subcutaneous tissue was separated out down to pretracheal fascia by using a fine and later bigger curved hemostats. The endotracheal tube (ET) with an inflated cuff was withdrawn slowly and blindly without use of the laryngoscope till the cuff was hitting the vocal cords (one gets a resistance), while monitoring the expired tidal volume on ventilator.

A 14 Gauze cannula with its needle (provided in the kit) was attached to a syringe containing saline was gradually inserted between the second and third tracheal ring at the midline while holding the trachea with the left thumb and index finger.

First loss of resistance while advancing the needle and then aspiration of air into the syringe with gentle aspiration confirmed needle's entry into the trachea. The needle and syringe were then removed leaving the outer cannula in the trachea, A gush of air ejecting out of the cannula further confirmed the placement of the cannula tip in trachea.

The guide wire was then inserted through the cannula for approximately 10 cm and checked for its free in and out movement. The cannula was then removed leaving the guide wire in the trachea.

The 14-French plastic dilator provided in the kit gently forced down over the guide wire in a clock and anticlockwise movement until the shoulder of the dilator was at the skin level, while ensuring a free movement of the guide wire in the dilator during the maneuver, following which the dilator was removed over the guide wire *in situ*.

A fully closed metal tracheal dilator forceps (provided in the kit) was passed over the guide wire into the trachea up to the proximal part of the angulation of the forceps at the skin level. The free movement of the guide wire in the tracheal dilator forceps ensured correct placement of the latter without any kink of the former. The tracheal dilator forceps was opened gently using both hands to dilate trachea just enough to accept the tracheostomy tube (TT) and then the tracheal dilator forceps was withdrawn in the semi open position.

The TT with the obturator was then railroaded over the guide wire into the trachea. Free movement of the guide wire was again tested throughout the negotiation of the TT into the trachea. The guide wire and then the obturator of the TT were removed leaving the TT in the trachea, and its position was confirmed by bilateral air entry into the lungs by chest auscultation. The ET was then removed after establishing ventilation through the TT.

The operating time from skin incision to placement of the TT inside the airway was noted. Early (within 24 h of PCT) and late procedure related complications up to a follow-up period of 60 days or hospitalization period, whichever is later are recorded.

Results

During the study period out of 5425 patients admitted in our ICU, 300 patients underwent PCT. All PCTs were performed successfully in first attempt on intubated patients at the bedside.

Demographic data [Table 1] showed sex and age distribution of these patients.

There were 103 (34.3%) patients with road traffic accidents resulting in head injury, 15 (5%) patients were other postsurgical patients, while 182 (60.6%) patients had medical conditions requiring ICU admission. Among the medical group of patients 41 (13.6%) were admitted with sepsis, 67 (22.3%) with hemorrhagic or ischemic cerebrovascular accident, 17 (5.6%) after cardio-pulmonary resuscitation and three cases (1%) with acute poisoning.

A total of 81 complications were encountered in 26 (8.6%) patients and in the remaining 274 (91.3%) patients the procedure was completed uneventfully. Early [Table 2] and Late [Table 3] complications were recorded.

Table 1: Demographic data (*n*=300)

Observations	*n* (range)
Total number of patients	300 (224 male, 76 female)
Age in years, mean±SD	64±17.4 (range: 19-80)
ET days, median (range)	7 (1-15)
Operating time in minutes, median (range)	3.5 (2.5-8)
Ventilator days post-PCT, median (range)	6 (0–38)
Successful decannulation	84 (28%)
Decannulation of TT, median (range)	10 days (4-56 days)
Indications for PCT (%)	
Airway protection	210 (70)
Prolonged ventilation	78 (26)
Upper airway obstruction	12 (4)
Patients outcome (%)	
Discharge on request with TT	110 (36.6)
Discharged with TT	2 (10.6)
Discharged after decannulation	52 (17.3)
Died in hospital	106 (35.5)

TT: Tracheostomy tube; PCT: Percutaneous tracheostomy; SD: Standard deviation; ET: Endotracheal tube

Table 2: Early complications (*n*=300)

Events	*n* (%)
No complications	274 (91.3)
Accidental extubation during procedure	6 (2)
Puncturing of ET cuff	12 (4)
Minor bleeding (<10 ml blood loss)	25 (8.3)
Major bleeding requiring blood transfusion	2 (0.66)
Transient hypotension	9 (3)
False passage	2 (0.66)
Guide wire dislodged during dilation	3 (1)
Guide wire kinking	18 (6)
GCS deterioration	2 (0.6)
Death within 24 h of the procedure	2 (0.6)
Hypoxia during the procedure (SpO_2<90%)	Nil
Conversion to surgical tracheostomy	Nil
Sub-cutaneous emphysema	Nil
Pneumothorax	Nil
Posterior tracheal wall puncture	Nil
Total number of complications	81 in 26 (8.6) patients

Total are more than 26 because many patients had more than 1 complication.
ET: Endotracheal tube; GCS: Glasgow coma scale

Table 3: Late complications (*n*=300)

Events	*n* (%)
Infection/cellulitis	Nil
Persistent stoma requiring operative closure	Nil
Subglottic stenosis	4 (1.3%)
Bleeding	Nil

Discussion

Bronchoscopy provides certain benefits, such as confirmation of needle placement, dilatation, and tube placement resulting in a safe completion of the procedure.[10,13] But all these studies were not designed to assess the impact of bronchoscopy on PCT, as there are no large randomized controlled studies depicting direct comparison with or without bronchoscopy and proving that a bronchoscopic guided technique is superior to the blind one or has led to decrease in procedural complications.[11,12] On the other hand, there are several reports on the use of bronchoscopy raising concern about few unwanted side effects like hypoxia, hypercarbia, raised intracranial pressure, and damage to bronchoscope during tracheal cannulation.[3,11,13]

Dennis *et al*.[1] in a retrospective analysis of 3162 PCTs majority without bronchoscopic guidance from the year 2001 to 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 accounting for death in 5 (0.16%) patients.

Cabrini *et al*.[9] in a meta-analysis of randomized studies on different techniques in PCTs from 1998 to 2010 involving 13 trials with a total of 1030 patients, found that Griggs technique was equivalent with other techniques as far as safety and success rate was concerned. Of the 13 trials, bronchoscopy was not used in five, and the rate of minor complications was 31% in all of them.

Jackson *et al*.[12] and Abdulla *et al*.[14] in their retrospective review of PCTs with and without bronchoscopic guidance found complications, mostly minor and of insignificant difference between them. Operation time was shorter in patients without bronchoscopy. Both the studies suggest bronchoscopic guidance should not be routinely used but may be an important adjunct in selected patients with difficult anatomy.

Kearney *et al*.[15] examined the complications of 827 PCT procedures, mostly done without bronchoscopic guidance found a premature extubation (1%) during ET withdrawal as the most common perioperative complication, followed by bleeding (0.9%). Procedure-related mortality rate was 0.6%.

In our case series, we had successfully performed PCTs uneventfully in 91.3% patients. Our total number of complications was 81 in 26 (8.6%) patients. The most common complication was minor bleeding (<10 ml loss) found in 25 (8.3%) cases, where bleeding was controlled with manual pressure during the procedure and pressure dressing afterwards but in 2 (0.66%) cases where major bleeding occurred one after 14 hrs, postprocedure, where re-exploration was done at bedside to control the bleeding and in the other case bleeding found 2 hrs, postprocedure which was controlled with sutures. In our experience, bleeding rarely interrupted the procedure because the dilators and subsequent TT placement controlled the hemorrhage effectively.

Complications pertaining to PCT without bronchoscopic guidance are accidental extubation during the procedure, rupture of ET cuff, false passage, guide wire problems which were minimal in our case series and were not causes of major concern. TT getting into a false passage was noted in 2 (0.66%) cases which was recognized immediately and rectified without any complications.

Accidental extubation of the ET during the procedure happened in 6 (2%) patients. Where re-intubation was required in two cases by interrupting the procedure but remaining four cases procedure was completed successfully without re-intubation. Our incidence is higher than Kearney *et al*.[15] and Dennis *et al*.[1] perhaps due to relatively new registrars(<6 months experience) at the head end pulling the tube in the earlier stages of our study. A laryngoscopy guided withdrawal of ET could have prevented such a complication, but it would have required deeper anesthesia level which we wanted to avoid in all our cases to prevent hemodynamic instability.

Without bronchoscopic assistance occurrence of superficial posterior tracheal wall injuries cannot be ruled out but significant injury could not have occurred given the lack of clinically obvious complications relating to it in our patients.

Real-time ultrasound can be used as an alternative to bronchoscopy for assessing depth of a puncture by the cannula and tracheal dilatation by the dilating forceps.[2,16] Furthermore, capnography used by some for confirmation of tracheal puncture,[17] could be another alternative to bronchoscopy but more studies are warranted to establish its role in clinical practice.

Our median operating time of 3.5 min (range, 2.5–8 min) is comparable with other studies with a duration of 2.7–15 min.[4,14,11]

Three of four patients who had subglottic stenosis following decannulation of TT were intubated for 12 or more days prior to PCT, and one had a difficult airway with 4 times re-intubation trauma. Computed tomography (CT) neck and bronchoscopy confirmed stenosis of the subglottic region. This could not be related to tracheostomy.

In our early part of PCT procedures, Glasgow coma scale score went down in two cases (0.6%) probably due to bucking during the procedure due to inadequate sedation and no muscle paralysis. Both the patients were admitted with intracranial bleed and repeat CT scan revealed increased bleed size following tracheostomy.

Two deaths (0.6%) were reported within 24 h of post-PCT but not due to airway loss or ventilation issues during the procedure. One case was post cardio-pulmonary arrest following myocardial infarction (MI); he probably had another episode of MI. The other case was postoperative cervical decompression with weaning difficulty where the patient was in spinal shock with autonomic dysfunction. In both cases, a direct cause-effect relationship for the complication could not be established.

With respect to cost savings, it is still unclear whether PCT is less expensive than open tracheostomy done at bedside,[3,13,15] probably, PCT is a bit expensive because of the cost of the kit. In our hospital cost of one PCT procedure is Rs. 11500/- whereas surgical tracheostomy at bedside costs Rs. 9000/-. This extra cost could be preferred for advantages of PCT over surgical tracheostomy.[18]

Conclusion

Griggs technique of PCT without bronchoscopic guidance and with a few modifications such as pulling ET with partially inflated cuff while looking at the expired tidal volume on ventilator and ensuring free movement of guide wire back and forth at each step, is a safe technique. The disadvantages of bronchoscopic guidance were not encountered in our study. As the experience with PCT grows, current complications rate is expected to reduce further.

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