Original Article

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A Prospective, Randomized Study to Compare Open Surgical Tracheostomy and Modified Griggs Percutaneous Tracheostomy in Patients of Traumatic Brain Injury

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Abstract

Background : Traumatic brain injury (TBI) patients with poor GCS usually require airway protection. Tracheostomy provides many benefits as compared to endotracheal tube. Percutaneous tracheostomy (PCT) performed by a trained professional dedicated to neurosurgical ICU may have advantages over open surgical tracheostomy. We conducted a prospective randomised study to compare both these procedures in patients of TBI. The aim is to compare open surgical tracheostomy (ST) and modified Griggs percutaneous tracheostomy (PCT) in patients of traumatic brain injury. **Subjects and Methods:** TBI patients in neurosurgical ICU were randomly allotted one of the two methods of tracheostomy that were being compared. Demographic profile of patients was recorded. Total duration of the procedure, length of incision, number of sutures used, days taken in wound healing after decannulation and complications were studied. Chi square and student's t-test were applied for statistical analysis. **Results:** Demographic profile of both groups was comparable. Total duration of the procedure, length of incision, number of sutures used and days taken to heal after decannulation were significantly lesser in PCT group as compared to ST group. Overall rate of complicated procedures was similar in PCT group as compared to ST group. There was no incident of raised intracranial pressure requiring treatment. Complications were mostly minor in nature and there was no mortality reported in any group. **Conclusion:** Both PCT and ST have lesser rate of major complications. PCT will be beneficial for TBI patients when it is performed by a trained intensivist.

Keywords: Tracheostomy, Brain Injuries, Traumatic, Bronchoscopy, Intracranial Pressure

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Introduction

Tracheostomy is a common and very important procedure in a neurosurgical ICU. Neurosurgical ICU patients usually need a prolonged airway device for airway protection as well as ventilation. Tracheostomy is advantageous over endotracheal tube as it has several additional benefits for these patients. Patient can swallow with minimal difficulty and oral care is proper and easy. Technical advantages such as decreased dead space and airway resistance result in reduced length of stay in ICU and rapid weaning from ventilator. [1,2] Changing of tracheostomy tube is less traumatic, easy and quicker than endotracheal tube. Trauma to the airway and oral cavity due to repeated laryngoscopies and intubations is avoided and most importantly the risk of hypoxia and hazards of drugs used for sedation during these procedures. In ICU there are two methods of tracheostomy; percutaneous and conventional open surgical tracheostomy. Open tracheostomy has been the gold standard method but lately percutaneous method has gained popularity among intensivists and surgeons especially in ICU. Several reported advantages are that it is less invasive, cost effective and easier to perform with proper training. [3–7] There are very few studies comparing these two methods exclusively in TBI patients. So we conducted a study to compare these two methods of tracheostomy in terms of length of incision, duration of procedure, healing time of wound and complications in our neurosurgical ICU.

Subjects and Methods

A prospective, randomized, and a single blinded study was conducted after ethical committee approval in 60 patients, aged 20-50 years with TBI of either gender on mechanical ventilation in neurosurgical ICU. Sample size was estimated based on complication rates of both the procedures in previous studies, to achieve α error of 0.05 and power of 95%.

Patients were randomly assigned by lottery method to one of the two techniques of tracheostomy.

PCT: Percutaneous tracheostomy was done.

ST: Surgical tracheostomy was done.

All the patients were on mechanical ventilation therefore consent was taken from relatives of the patient. Tracheostomy was done bedside. PCT was done by modified Griggs's technique using the kit manufactured by Portex Company without bronchoscopy. Exclusion criteria applied were age younger than 12 years, coagulation defects, emergency airway access, difficult anatomy like neck trauma, morbidly obese, previous tracheostomy and impending brainstem herniation. Basic monitoring like electrocardiogram, non-invasive blood pressure, pulse oximetry and end tidal CO_2 was attached. Patient was sedated with intravenous propofol, nalbuphine and paralyzed with vecuronium. Position for tracheostomy was made. Ventilation was done with 100% oxygen. All the tracheostomies were done by trained intensivist and surgeons who were assisted by post graduate students. Endotracheal tube was withdrawn so that its cuff was visualized just below vocal cords on direct laryngoscopy. Oral and endotracheal suctioning was done. A transverse incision of 1.5 cm was made between cricoid cartilage and suprasternal notch after injecting local anaesthesia. After adequate blunt dissection the centre of first and second tracheal rings was confirmed by palpation. Thyroid tissue was retracted cephalad if encountered during the dissection. A probing needle of 25G was used to confirm trachea and rule out obstruction by endotracheal tube. After aspirating air, 4% lignocaine filled syringe via 14G sheathed needle, local anaesthetic was injected in trachea. Needle was withdrawn and air was again aspirated from sheath left in trachea. Guidewire was inserted after confirmation of trachea and sheath was removed. Dilatation of trachea was done with dilator and Griggs's forceps over the guidewire. Tracheal tube was inserted over guidewire; cuff was inflated and immediately suctioning was done to remove any blood entered during procedure. ST was done according to conventional steps. Ventilator was connected to the tracheostomy tube and end tidal CO_2 graph was monitored for confirmation of proper placement. Suctioning was again done with closed suction catheter. Tube was secured and aseptic dressing was done. Suturing was done if required for haemostasis and closure of a too wide incision if it was required.

A check chest x ray was done to check tube position and any complication. Aspects that were evaluated were incision length, total time taken for tracheostomy, number of sutures used, days taken in healing of tracheostomy incision after decannulation and short and long term complications. Total time taken was taken from time of giving incision to completion of suturing if required. Short term complications such as stoma infection, false passage, loss of airway indicated by disturbed end tidal CO_2 graph, raised intracranial pressure requiring intervention such as hyperventilation and mannitol, pneumothorax, rupture of tube cuff during insertion resulting in leak and bleeding were noted. Minor bleeding was defined as one that required more than three changes of dressing per day or adrenaline soaked gauze dressings and major bleeding as one that required cauterization, surgical treatment or blood transfusion. Any difficulty in routine change of tubes was also noted. Long term complications such as tracheal stenosis presenting and trachea oesophageal fistula were looked for by neurosurgeons in outpatient follow up by history and examination.

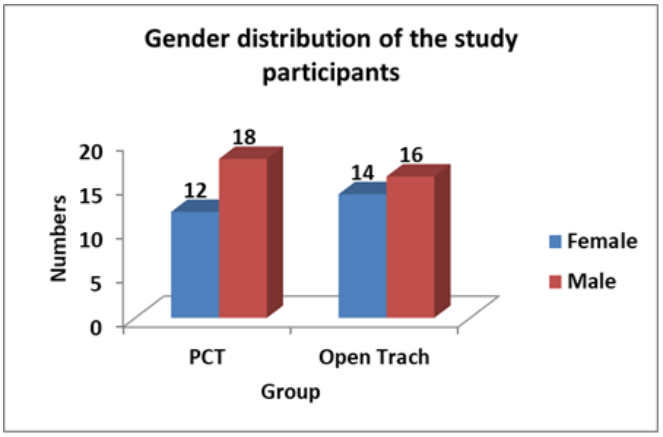
Statistical analysis

Data entered in Microsoft excel sheets was processed using SPSS version 21. Qualitative data was expressed as numbers and percentages. Quantitative data was expressed as mean±SD. Chi square test was used to find association between quantitative variables and student's t-test was used to test significance of difference between quantitative variables. A P-value of <0.05 was considered as significant and <0.01 as highly significant.

Results

Demographic aspects of the two groups were comparable. Mean length of incision in ST group was 3.19±0.26 cm which was significantly longer statistically than 2.04±0.38 cm in PCT group. Similarly statistically significant longer mean total duration of procedure was observed in ST group (20.60±4.18 minutes) as compared to PCT group (15.87±3.78 minutes). Sutures were used in 21 procedures in ST group as compared to 3 in PCT group. Total number of complicated procedures in PCT group were 6 and in ST group were 10. These complication rates were statistically comparable. Majority of complications in PCT group comprised of minor bleeding events (66.67%) that were easily managed with conservative treatment. Complications in ST group varied with minor bleeding (31.3%), false passage (18.8%) and stoma infection (18.8%). There were also incidences of loss of airway necessitating reinsertion of endotracheal tube (12.5%), tracheostomy tube cuff damage (12.5%) and major bleeding (6.3%) in ST group. Mean days to heal after decannulation were significantly lower in PCT group (7.46±1.2) as compared to ST group (9.70±1.99). There was

no mortality that could have been attributed to tracheostomy in our study. Any accidental decannulation or difficulty in routine change of tracheostomy tubes was not reported. There was no report of tracheal stenosis and tracheoesophageal fistula over three month follow up. 4 Patients were lost to follow up and 8 died due to primary diagnoses or complications unrelated to tracheostomy.



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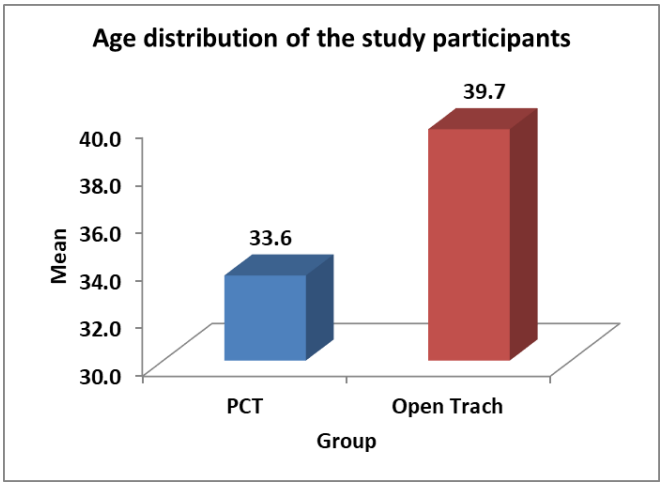

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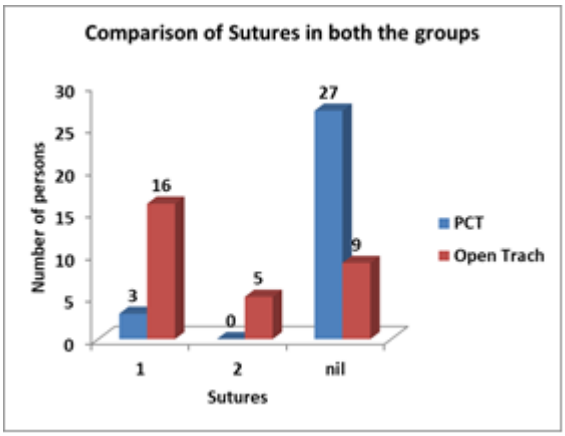

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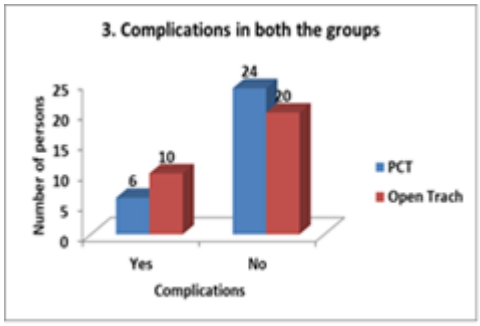

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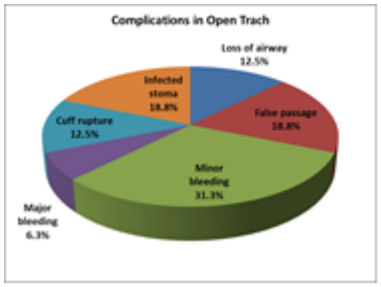


Figure 5:

Discussion

In neurosurgical ICU tracheostomy plays a vital role in management of patients. It is superior over endotracheal tube in managing airway secretions by suction as well as patient's own cough. [8] It optimizes ventilation by decreasing dead space and sedation requirements which leads to early recovery. General patient care also improves and becomes easier. [9,10] Technique of surgical tracheostomy was described by Chevalier Jackson more than a hundred years ago. [11] The age of percutaneous tracheostomy started in 1955 when Sheldon et al first described the technique. [12] Continuous yearning for safety and efficiency in various aspects led to the development of several other techniques for performing tracheostomy. We performed modified Griggs percutaneous tracheostomy procedure in this study as it is the routine method of percutaneous tracheostomy in our neurosurgical ICU. It

Table 1: Age Distribution of Study Participants

Age in Years	N	Mean	Standard. Deviation	P Value
PCT	30	33.6	11.7	0.076
Open Trach	30	39.7	14.4	

Table 2: Gender Distribution Of Study Participants

Gender	PCT		Open Trach		Total		P-Value
	No.	%	No.	%	No.	%	0.6
Female	12	40.0%	14	46.7%	26	43.3%	
Male	18	60.0%	16	53.3%	34	56.7%	
Total	30	100.0%	30	100.0%	60	100.0%	

Table 3: Comparison of different variables among the groups

Variables	Group	N	Mean	Std. Deviation	P Value
Incision	PCT	30	2.04	0.38	<0.001*
	Open Trach	30	3.19	0.26	
Total duration	PCT	30	15.87	3.78	<0.001*
	Open Trach	30	20.60	4.18	
Days to heal	PCT	24	7.46	1.72	<0.001*
	Open Trach	23	9.70	1.99	

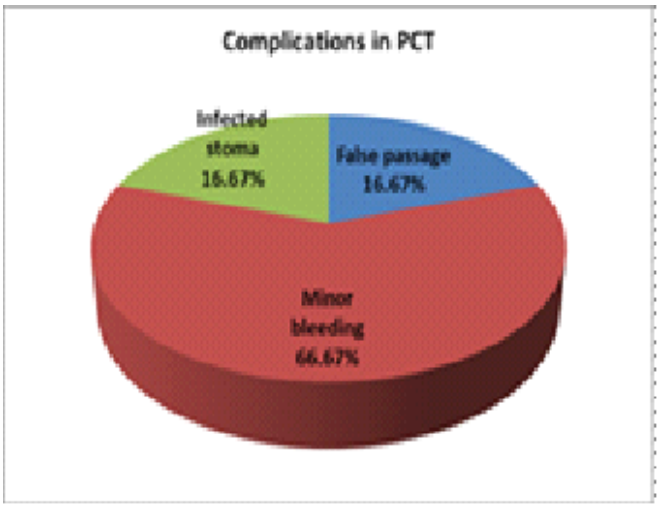
Table 4: Comparison of Sutures in both the groups

Sutures	PCT		Open Trach		Total		P Value
	No.	%	No.	%	No.	%	
1	3	10.0%	16	53.3%	19	31.7%	<0.001*
2	0	0.0%	5	16.7%	5	8.3%	
Nil	27	90.0%	9	30.0%	36	60.0%	
Total	30	100.0%	30	100.0%	60	100.0%	

Table 5:

Compl	PCT		Open Trach		Total		P Value
	No.	%	No.	%	No.	%	
Yes	6	20.0%	10	33.3%	16	26.7%	0.243
No	24	80.0%	20	66.7%	44	73.3%	
Total	30	100.0%	30	100.0%	60	100.0%	

is reported to be a more advantageous method in aspect of duration of the procedure.[13] It is less invasive as it involves dilatation of structures. The time taken in both procedures was lesser in our study as reported previously.[14] That may be due to the fact that we didn't use bronchoscopy and took start from time of incision instead of from sterilization of procedure site. On comparison total duration of procedure was significantly less with PCT than ST. Similar finding was concluded by Kwon J et al who observed significant lengthier procedure time with ST than with PCT (39.0 [30.0–60.0] min vs 15.0 [11.0–23.0] min, p<0.001).[6] The mean length of incision was significantly shorter in PCT group when compared to ST group in our study as also observed by Gysin C et al.[15] It led to lesser or no need of suturing and quick healing of stoma after decannulation. In our study mean duration of healing was significantly lower with PCT technique as also



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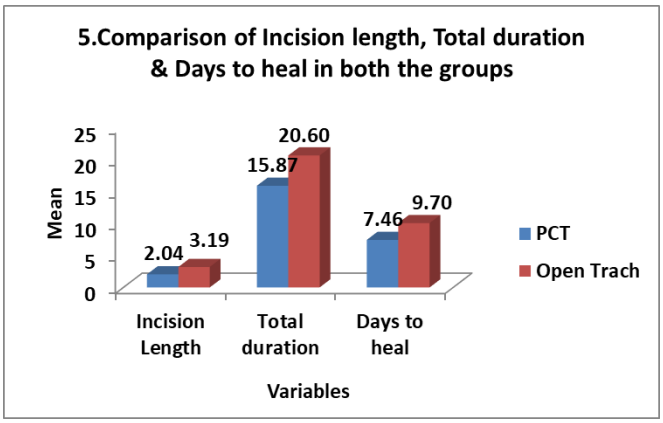

Figure 7:

concluded by Karvandian K et al.[16] Major bleeding was not encountered in any patient in PCT group. These results were similar to Freeman et al and Delaney et al.[4,17] There was less frequency of false passages with PCT than open tracheostomy as guidewire and dilating forceps in PCT ensures a smooth passage for tracheostomy tube. Incidence of tube cuff damage during insertion was more with ST in our study similar to the finding of Crofts et al.[18] That maybe due to sharp edges of tracheal incision at insertion site. Leonard et al reported zero incidence of tracheal stenosis and tracheoesophageal fistula similar to our study.[19]No incidence of tracheal stenosis in our study maybe due to the method used for percutaneous tracheostomy which does not involve multiple passage of dilators.[20] Turkmen et al reported two cases of tracheal stenosis post percutaneous tracheostomy.[21] They evaluated the airway by MRI.

There was no incidence of subcutaneous emphysema or pneumothorax in our study in any group. Powell et al reported 1-4 % incidence of these complications.[22] Immediate suctioning after insertion of tracheostomy tube before connecting ventilator helped us in avoiding subcutaneous emphysema that can lead to further difficulty in proper placement of tube in future attempts. If inside trachea, catheter will be inserted to a desirable length and there will be mucous in secretions. There was no conversion of PCT to ST. Stoma infection rate in PCT group was 16.67% as compared to 0.6% in Klein et al.[23] All the patients in our study were of TBI and aspiration is very common in these patients which explains higher incidence of stoma infection. In their study majority of patients were with medical diseases. Overall complication rates of both groups were similar to already published reports.[4,17,24–26] with a tendency of fewer complications with PCT as compared to ST. Majority of complications were minor and bleeding was the commonest one. There was no life threatening complication. Kost et al also found a complication rate of 9.2% in PCT group and half of them were minor ones.[27] Lagoo et al reported a complication rate of 14.6 % and minor bleeding was the most frequent complication. They also didn't report any life threatening complication.[28] Our study was prospective and randomised but dropout due to patients lost to follow up or succumbing to the disease was the limitation in studying long term complications. Long term complications such as tracheal stenosis can be better studied by MRI. Findings of our study corroborate with international literature.

Fibre optic bronchoscopy guided PCT has its own advantages and disadvantages. In our study we preferred not to use bronchoscope as PCT was being performed in patients with TBI. In these patients intracranial pressure is of utmost importance. Prolonged bronchoscopy can cause hypoxia, hypercarbia and raised intracranial pressure.[29] Also there have been studies showing no impact of routine use of bronchoscopy on safety of PCT.[30] Study by Kwon et al observed no incidence of raised ICP during PCT requiring treatment because it was done by a neurointensivist in short duration.[6] Another study by Milanchi et al also concluded that PCT itself does not lead to raised intracranial pressure in neurosurgical patients.[31] One episode of raised ICP undergoing PCT was reported by Seder et al that required treatment.[7] They used bronchoscope in their study. Some studies reported significant hypercarbia and acidosis in bronchoscopy guided PCT as compared to Doppler guided PCT and open surgical tracheostomy.[32,33] Our study also supported the same observation as no patient in any group had raised intracranial pressure that required treatment. There have been studies demonstrating safety of tracheostomy by intensivists in ICU that corroborates our findings. Experienced and dedicated intensivist avoids several trivial but important mistakes that increase complication rates. A common example is excessive dilatation of trachea with Griggs forceps that can

result in major bleeding. [34]

Conclusion

Our study concludes that PCT by Griggs technique is a viable alternative to ST in TBI patients if a professional invests time in attaining the skill and applies discretion in selecting patients. It may be a safe procedure even if done by postgraduate students after adequate training under proper supervision. However further studies to determine this aspect of the procedure are needed. Including percutaneous tracheostomy in teaching curriculum of postgraduate students will help in this regard.

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