JIOM Nepal, Volume 41, Number 1, April 2019, page 1-7

Comparison of Percutaneous Dilatational Tracheostomy with Open Tracheostomy in Intensive Care Unit

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ABSTRACT

Introduction

Tracheostomy is one of the frequent surgical procedure carried out in intensive care unit. Percutaneous tracheostomy is becoming increasingly popular compared to conventional open surgical tracheostomy in ICU.

Methods

A prospective randomized trial with twenty patients in each group was conducted to compare the outcomes of percutaneous and surgical tracheostomy. Percutaneous tracheostomy was performed using Ciaglia Blue Rhino technique and surgical tracheostomy was performed using established technique. The outcomes were compared in relation to randomization to tracheostomy, completion of procedure, intra operative and post-operative complications, hospital length of stay and cost.

Results

There were no major complications in either group. Most variables studied were not statistically significant. The two groups did not differ in terms of basic demographics or APACHE II score. The only variables to reach statistical significance were time duration from tracheostomy randomization to start of procedure and time taken for completion of procedure. It was mean 31.85±15.35 hours in Percutaneous Tracheostomy group and in Surgical Tracheostomy group it was mean 49.10±23.61 hours respectively ($p<0.009$). Time taken to perform percutaneous tracheostomy was mean 15.50±3.22 minutes and for surgical tracheostomy it was mean 20.30±3.38 minutes. ($p<0.001$).

Conclusion

Percutaneous dilatational tracheostomy is simple, faster to perform and can be done at bedside to avoid considerable delay in the performance of open tracheostomy where there is high demand for elective and emergency procedures in operating room.

Keywords: *Complications, intensive care unit, percutaneous tracheostomy, surgical tracheostomy*

INTRODUCTION

Tracheostomy, as a means of airway access, is one of the oldest surgical procedures documented, dating back to approximately 4000 years. However, it wasn't until the early 20th century, when Chevalier Jackson introduced clear guidelines, was tracheotomy deemed a safe and viable procedure.[1] With advances in technology and increasing interest in minimally invasive procedures, variations of the standard open tracheotomy have evolved over the last half century.

Since Ciaglia et al introduced the percutaneous dilatational tracheotomy (PDT) in 1985, percutaneous tracheostomy (PCT) has become increasingly popular and has gained widespread acceptance in many ICU and trauma centers as a viable alternative approach.[2] In some institutions, PCT has become the procedure of choice.

A large number of studies have been published comparing several techniques of PCT with the open surgical tracheotomy over the last 2 decades. Most studies suggest either lower complications rates with PCT or

Table 1. Demographics of study population

Details		Group		p value
		PCT	ST	
Age (years)		40.00±15.07	39.05±17.45	0.37
Sex		11	11	0.50
Reason for intubation	Respiratory failure	9	8	0.50
	Airway protection	11	12	
APACHE II score		21.05±2.28	20.50±3.05	0.17
Days of ventilation before tracheostomy		12.85±2.92	13.70±1.65	0.21

no statistical significant differences between the two methods.[3] Proponents of PCT defend smaller skin incisions, less tissue trauma, lower incidence of wound infection and cost effectiveness.[4] Furthermore, a recent meta-analysis by Higgins and Punthakee demonstrated no significant difference when comparing overall complications, with a trend toward favoring percutaneous method.[5]

In 2072 there were 54 surgical tracheostomies performed in TUTH which included both elective and emergency tracheostomy.[6] Both percutaneous and surgical tracheostomy are frequently performed in our ICU.

METHODS

This study is a prospective, comparative, randomized, single blinded study conducted in Mixed Medical Surgical 11 bedded ICU of Tribhuvan University Teaching Hospital in a duration of 6 months. Ethical Approval was taken from Institution Review Board, Research Department, Institute of Medicine. Written informed consent was taken from next to kin.

After consent was obtained from next to kin, randomization was done using sealed

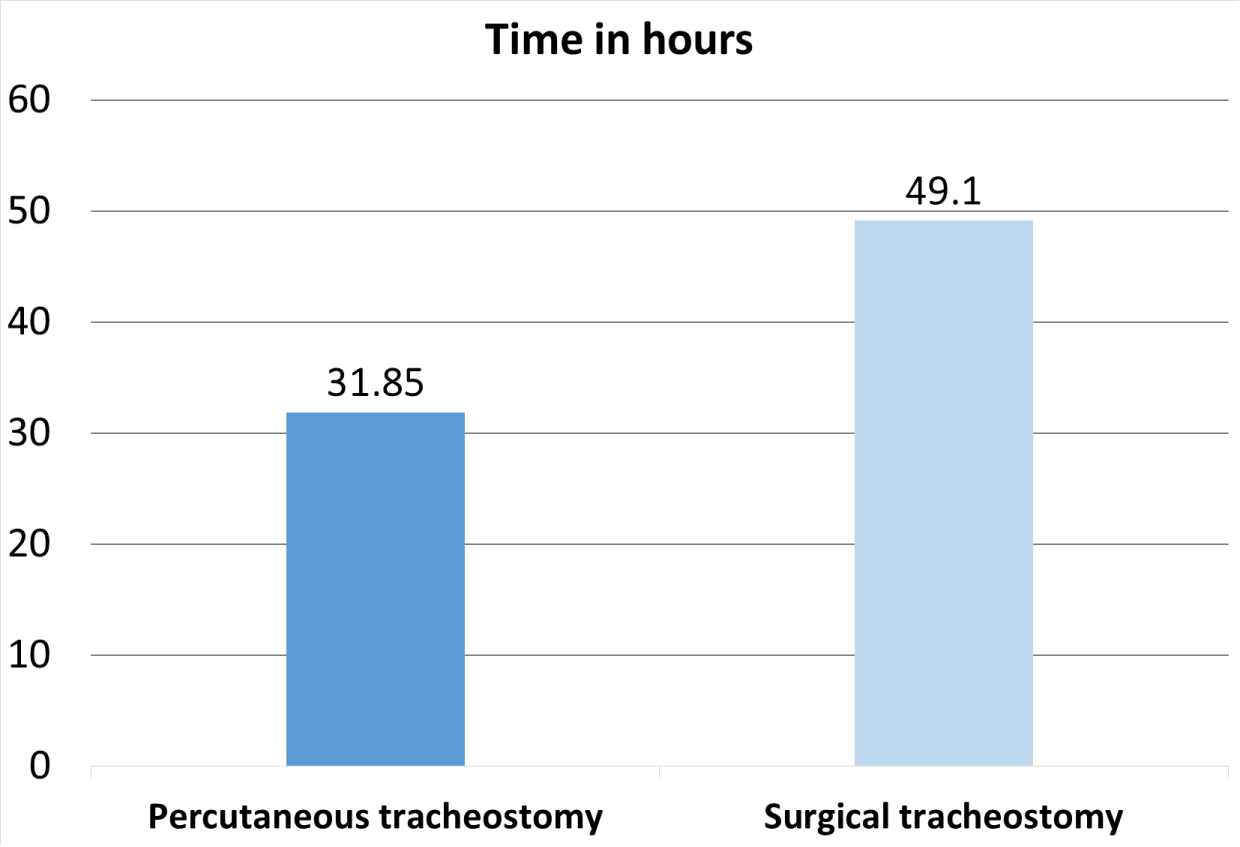

Figure 1. Time from randomization to tracheostomy

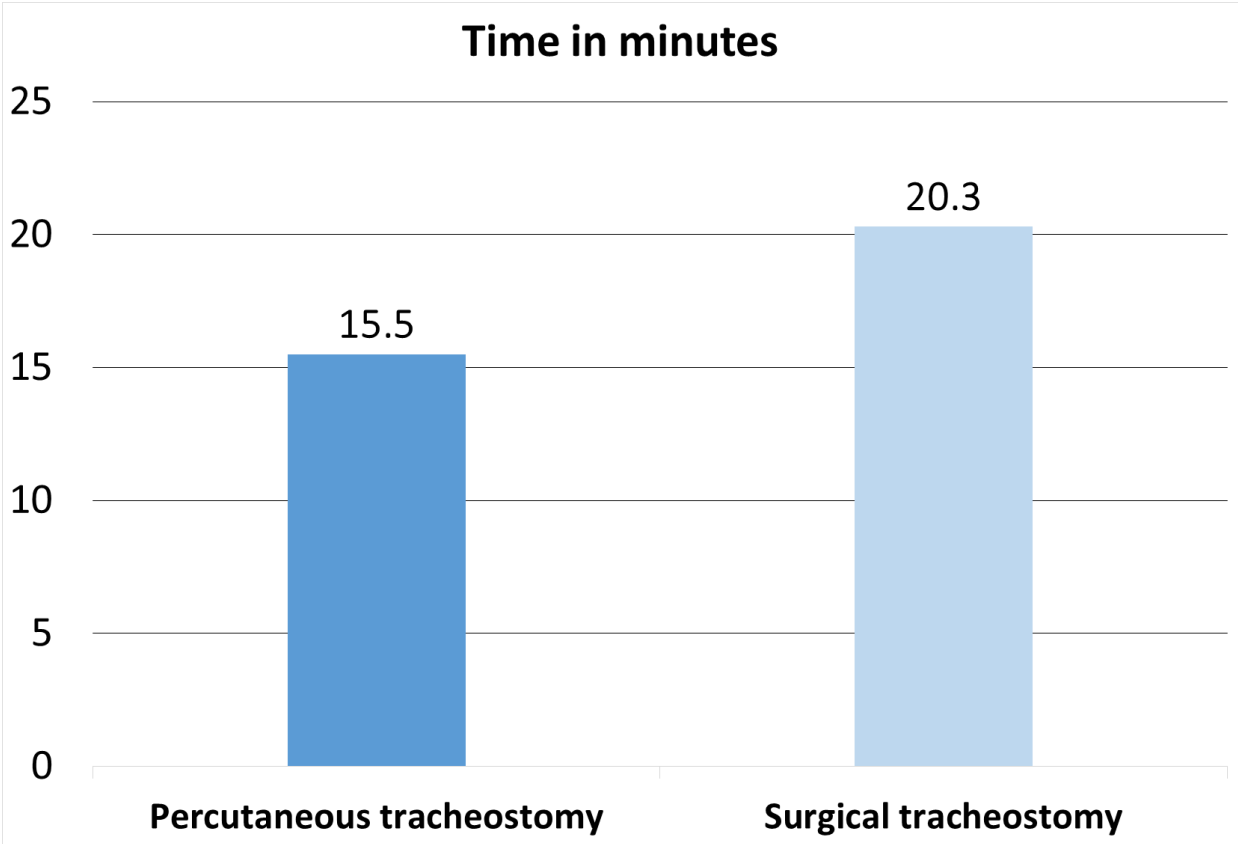

Figure 2. Duration of procedure

envelope technique. When the group was known, proceduralistwas immediately informed about the tracheostomy. All patients in intensive care unit needing mechanical ventilation requiring tracheostomy with Age ≥ 16 yrs were included. People who were excluded from involvement in the study were patients with skin infection at tracheostomy site, distorted anatomy with unidentifiable anatomic land marks, platelet count<50,000/ mm^3 INR>1.5, unstable cervical spine, FiO2>60% and PEEP>10 cm of H_20 and hemodynamically unstable patients with requirement of Nor Epinephrine > 0.2µg/ kg/min or more than one vasopressor. The general objective of this study was to compare the outcome of percutaneous dilatational tracheostomy and surgical tracheostomy in a mixed medical surgical ICU with specific objective to compare time from randomization to start of the tracheostomy procedure between the groups, duration, incidence of intraoperative blood loss, lowest SpO_2 , post-operative bleeding, post-operative infection at Day 3 and Day 7, length of hospital stay post tracheostomy, total cost of tracheostomy and mortality in ICU.

The sample size is calculated as 20 in each group to detect a difference of at least 50 % between Percutaneous Tracheostomy and Open Surgical Tracheostomy at 80% power and at 5% level of significance. Data were entered in Microsoft Excel and analyzed using SPSS, version 17.0. Mean was calculated using t-test. Median was calculated with Mann-Whitney test. Age, APACHE II, randomization to start of the tracheostomy procedure, duration of tracheostomy procedure, lowest SpO2 during tracheostomy, length of hospital stay post tracheostomy were analyzed using independent sample t-test.

Intra-operative blood loss, post-operative bleeding was analyzed using Pearson Chi-square test. Infection at day 3 and day 7, death in hospital, death in ICU were analyzed using Fischer exact test.

RESULTS

Total 40 patients were enrolled in the study with 20 in each group. Average age, sex ratio was similar in both the groups (table 1). Base

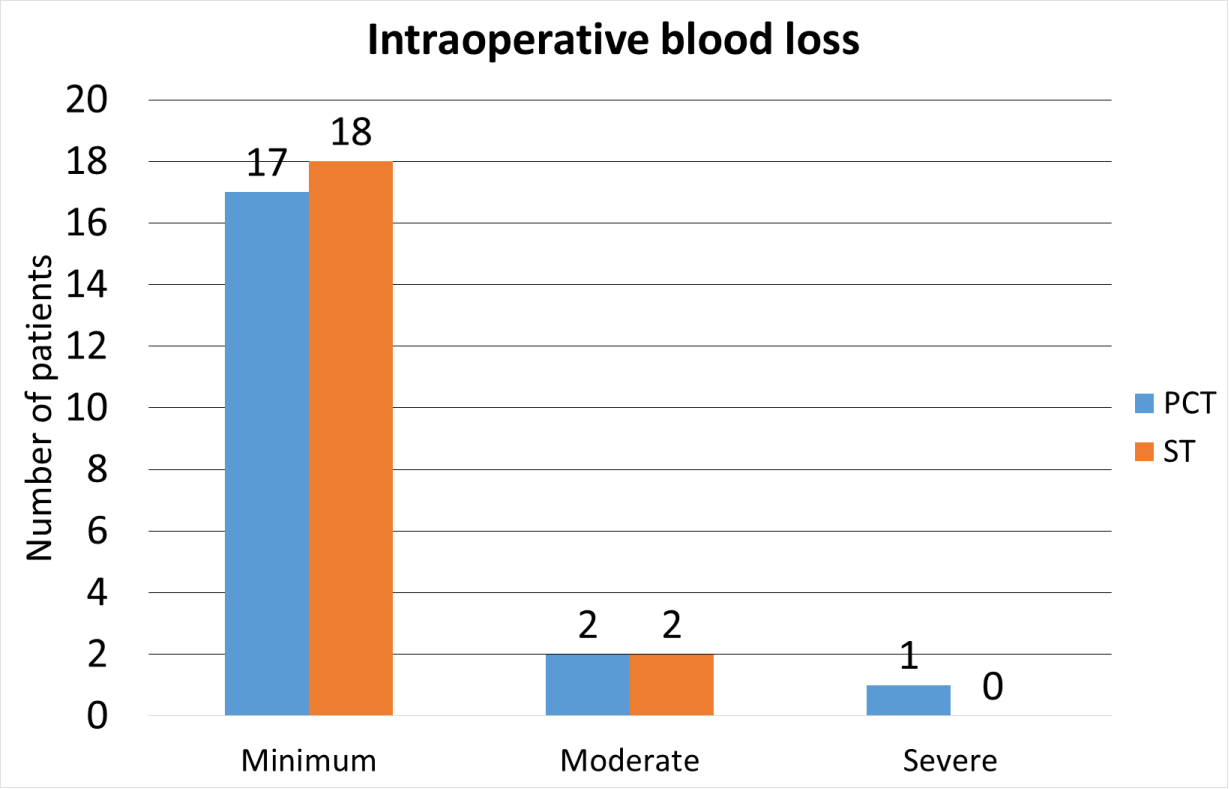

Figure 3. Intraoperative blood loss

line APACHE II score were similar in both the groups. Mean days of mechanical ventilation were 12.85±2.92 days in percutaneous tracheostomy and 13.70±1.65 days in surgical tracheostomy group. None of the baseline parameters were statistically significant.

Time from randomization (figure 1) to start of procedure in percutaneous tracheostomy group was mean 31.85±15.35 hours and in Surgical Tracheostomy group it was mean 49.10±23.61 hours and statistically significant ($p<0.009$) (figure 1).

Time taken to perform percutaneous tracheostomy was mean 15.50±3.22 minutes and for surgical tracheostomy it was mean 20.30±3.38 minutes and was statistically significant ($p<0.001$)(figure 2).

There was mostly minimum blood loss in percutaneous tracheostomy group with no difference between intraoperative blood loss between two groups and it was not statistically significant ($p>0.05$)(figure 3).

Lowest SpO_2 during percutaneous tracheostomy was mean 92.90±3.64% while during surgical tracheostomy it was mean 92.35±2.99% respectively. There was one minimal Infection in each Percutaneous Tracheostomy and Surgical Tracheostomy Group. At Day 7 there were 2 moderate infections in surgical tracheostomy Group, Acinetobacter baumannii and Pseudomonas aeruginosa were isolated. There was 1 moderate infection in tracheostomy Group from which Klebshiella pneumoniae was isolated. The rate of post-operative infection was not statistically significant between percutaneous and surgical tracheostomy groups ($p>0.05$). Length of hospital stay post tracheostomy in percutaneous tracheostomy group was mean 34.85±22.24 days and surgical tracheostomy group length of hospital stay was mean 36.20±22.39 days and statistically not significant ($p>0.05$). Average cost for percutaneous tracheostomy was Rs. 8241 and for surgical tracheostomy it was Rs. 10547. Total cost of percutaneous tracheostomy was lower in percutaneous tracheostomy group.

DISCUSSION

Tracheostomy is one of the most frequently performed procedures in the critically ill patients in the intensive care unit. Both Percutaneous

tracheostomy and surgical tracheostomy are associated with intraoperative and postoperative complications. In this randomized, prospective comparative study percutaneous tracheostomy resulted in early randomization to tracheostomy with shorter operative time with similar complication rates.

Demographics of the study population, APACHE II score were similar in both the groups. The time from randomization to start of procedure in percutaneous tracheostomy group was mean 31.85±15.35 hours and in Surgical Tracheostomy group it was mean 49.10±23.61 hours respectively. In 1996, Friedman et al reported the time from randomization into the study until tracheostomy performed was 28.5±27.9 h in the PDT group and 100.4±95.0 h in the ST group.[7] In agreement with other authors we found that randomization to start of procedure to be shorter in percutaneous tracheostomy group. Moreover, there is a considerable delay in the performance of open tracheostomy in the operating room due to a lack of available operating theaters and the relative high demand for elective and emergency procedures. These delays may range in duration from 2 to 7 days. As such, this may result in a significant waiting time for tracheostomies performed, which may subsequently prolong the hospital length of stay, delay the weaning process, and increase patient morbidity.[8] But we performed percutaneous tracheostomy at bedside, this could have been different if surgical tracheostomy was also performed at bedside.

Time taken to perform percutaneous tracheostomy was mean 15.50±3.22 minutes and for surgical tracheostomy it was mean 20.30±3.38 minutes in our study. Lukas and colleagues reported the average operation time for PDT was 5.5 minutes (SD 3.2; median 5.0; range 2-22 minutes), which was shorter than the average time for ST, which was 15.1 minutes (SD 6.4; median 15.0; range 4.5-60 minutes).[9] The present study found that the PDT procedure required less time than the ST procedure, consistent with findings of Lukas et al.

There was mostly minimum blood loss in percutaneous tracheostomy group. Two cases had moderate blood loss and one had severe blood loss. In surgical tracheostomy group also there was minimal blood loss, only two had moderate blood loss. In 2006, Silvester et al also reported no difference in incidence of intraoperative bleeding between PCT and ST groups.[10] These findings are also consistent with of Delany et al showing low incidence of significant bleeding.[11]

Lowest SpO_2 during percutaneous tracheostomy was mean 92.90±3.64 % while during surgical tracheostomy it was mean 92.35±2.99% respectively. Youssef et al reported the lowest SpO_2 during procedure, $PaCO_2$ after operation and intra-operative bleeding for both groups were nearly similar with no statistical difference.[12] These findings are also consistent with Silvester et al who reported oxygenation in both groups was excellent throughout the procedure.[10]

Most of the post-operative cases did not have surgical bleeding. Three cases had minimal and one case had moderate bleeding in each of percutaneous and surgical tracheostomy groups both were controlled with topical hemostatic agents. There was no difference in post-operative bleeding between two groups. These findings are consistent with that reported by Claudine et al.[13] There was One minimal Infection in each Percutaneous Tracheostomy and Surgical Tracheostomy Group. At Day 7 there were 2 moderate infections in Surgical tracheostomy Group, AcinetobacterBaumannii and Pseudomonas aeruginosa were isolated. There was 1 moderate infection in Percutaneous tracheostomy Group from which KlebshiellaPneumoniae was isolated. Claudine et al also reported similar rate of complications in post-operative period13. There was no incidence of Pneumothorax or accidental decannulation during study period.

Length of hospital stay post tracheostomy in percutaneous tracheostomy group was mean 34.85±22.24 days. In Surgical tracheostomy group length of hospital stay was mean 36.20±22.39 days. There was no difference in length of hospital stay between percutaneous tracheostomy and surgical tracheostomy group. Kornblith et al in 2011 reported a

hospital length of stay was 35±0.8 days in percutaneous tracheostomy group.[14] These findings are consistent with that of our study.

Average cost for percutaneous tracheostomy was Rs. 8241 and for surgical tracheostomy it was Rs. 10547. Cobean and colleagues reported mean patient charges for the procedure performed in the intensive care unit by a surgeon, nurse, and respiratory therapist were $997 (95% confidence interval, $975 to $1018) compared with $2642 (95% confidence interval, $2513 to $2772) for standard tracheostomy (P<.001). This represented a savings of $1645 (95% confidence interval, $1492 to $1798) per tracheostomy.[15] But Susanto I et al found out that the shorter operating time needed for the percutaneous method is not a cost advantage when both the procedures are done at the bedside. Most percutaneous tracheostomies are now done using disposable kits under bronchoscopic guidance. These increase the cost, rendering percutaneous tracheostomy more expensive than open surgical tracheostomy when both are done at the bedside.[16] We reused the percutaneous tracheostomy set by resterilising the Cialglia Blue Rhino Dilator kit which minimized the cost of percutaneous tracheostomy. The cost of percutaneous tracheostomy would have been higher if new percutaneous tracheostomy set was used in each procedure.

There were 40% deaths in both Percutaneous and Surgical Tracheostomy groups during their ICU stay. There were 50% deaths in Percutaneous Tracheostomy group and 55% deaths in Surgical Tracheostomy groups during their stay in hospital. These findings are consistent with Engoren M et al who reported hospital mortality of 57% on long term tracheostomised patients.[17] High mortality in long term patients on tracheostomy may be due to limitation of resources for long term care of the sick patients.

Both percutaneous and surgical tracheostomies can be safely performed with minimal complications but percutaneous dilatational tracheostomy is faster to perform and can be done at bedside to avoid considerable delay in the performance of open tracheostomy where there is relative high demand for elective and emergency procedures in operating room.

CONCLUSION

Both percutaneous tracheostomy and surgical tracheostomy is frequently performed in ICU. Both procedures are associated with low risk of complications like intra operative and post-operative bleeding, post-operative infection and pneumothorax. Percutaneous tracheostomy is faster to perform and can be done at beside. Percutaneous tracheostomy also avoids the delay in the performance of open tracheostomy in the operating room where there is lack of available operating theaters and the relative high demand for elective and emergency procedures.

Thus percutaneous tracheostomy may be better in critically ill patients in a setup where surgical tracheostomy has to be performed in operating theatre but further large multicenter studies would be beneficial to strengthen this recommendation.

CONFLICTS OF INTEREST

None declared.

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