

## Comparison of Standard and Percutaneous Tracheostomy Complications in Shariati Hospital in Iran

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### Abstract

**Background:** Tracheostomy is a procedure which aims at better managing patients' airway. It can be done using two methods: standard and percutaneous. The percutaneous method is a favorable choice for critically ill-patients because it is a less invasive procedure. This study compares the short-term complications of these two methods (during 7 days after the procedure).

**Methods:** This study was a cross-sectional research performed on 50 ICU patients in need of tracheostomy. The patients were divided into two groups of percutaneous procedure (15 patients) and standard procedure (35 patients). The complications were registered in questionnaires and the data were analyzed using SPSS software ( $\chi^2$  test and t-test).

**Results:** The two groups had no significant difference in age, sex, and vital signs. Average duration of the procedure was 24.4 minutes in the standard procedure (10-45 minutes) and 26.78 minutes (5-70 minutes) in the percutaneous procedure, and there was no significant difference between two groups ( $P = 0.814$ ). Average bleeding during 7 days after the procedure was 44 cc (10-150 cc) in standard procedure and 24.7 cc (10-50 cc) in the percutaneous procedure, and the difference was significant ( $P = 0.012$ ). The other variables were not significantly different in two groups.

**Conclusions:** There was no difference in short-term complications between percutaneous and standard tracheostomy method should be selected considering other important factors.

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### Introduction

Tracheostomy is one of the oldest surgeries, which has been performed by the ancient Egyptians 3500 years ago. During the last 25 years, it has been one of the most common procedures in critically ill-patients. Its indications include relief of upper airway obstruction, improve lung hygiene, access to trachea for positive pressure ventilation, and reduction of airway resistance to get the patient weaning from the ventilator. Its long-term benefits include better suction of airway, better tolerance of patients, less laryngeal complications, easy tube replacement, and compatibility for oral nutrition (1).

If the tracheostomy is performed by an experienced surgeon, it will be well tolerated by the patient, and the mortality rate will be  $< 2\%$ . The procedure's complications depend on the technique and require

careful care. The complications are divided into two groups: Early and late. Early complications include pneumothorax, pneumomediastinum, subcutaneous emphysema, wound bleeding, bloating, aspiration and tube displacement. Late complications include pneumonia, tracheal stenosis, tracheo-innominate artery fistula, tracheoesophageal fistula, tube obstruction, aspiration, dysphagia, and stoma infection (2).

The percutaneous procedure was introduced to provide a less invasive method for critical patients. Many surgeons prefer to perform tracheostomy in operation rooms, but the risk of transferring critical patients from an intensive care unit to an operation room, and lack of time or operation rooms to do the procedure may postpone tracheostomy in these patients (3). The percutaneous procedure is faster and cheaper than standard and causes less bleeding, but its late

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complications are more common (4).

Ciaglia was the first surgeon who performed a percutaneous tracheostomy using the dilatation method. In the percutaneous procedure, we should use the smallest tube size and smallest incision. A small incision helps keep the bleeding minimal. Also in this procedure, risk of infection is low because of less tissue exposure (5).

In two different studies by Kaylie et al. (6) and Wu et al. (7) there was no significant difference between the two procedures. In a meta-analysis in 1999, the complications of percutaneous are more than standard tracheostomy during the procedure, but the postsurgical morbidity was higher in the standard procedure (8). In centers that used the percutaneous procedure, mortality from rupture of major blood vessels, or rupture of thyroid ima artery has been reported (9). The aim of this study is to compare the short-term complications between percutaneous and standard tracheostomy.

## Materials and Methods

This study was a cross-sectional research between March 2012 and March 2014, on the general ICU and surgical ICU patients in need of tracheostomy in Shariati Hospital (an affiliated hospital of Tehran University of Medical Sciences, Tehran, Iran). Our study population were 50 patients, 15 patients were in percutaneous procedure group and 35 were in standard procedure group. Patients in both groups were intubated and on a ventilator. We planned to perform percutaneous tracheostomy procedures in ICU, but due to the lack of bronchoscopes and experienced personnel we had to do the procedure in operation rooms for both groups. Currently, both procedures are routinely performed in Shariati Hospital. In this study, we registered short-term complications of the two procedure during 7 days after tracheostomy.

Standard tracheostomy is performed in operation rooms under general anesthesia, using a cutaneous incision to open trachea from the second to fourth tracheal rings. The percutaneous procedure is performed by Ciaglia Method (gradual dilatation), and direct observation by a bronchoscope to assure the correct position of the tube. First, the tracheal rings are palpated, then a 14 gauge needle is passed through the tracheal rings, and the position of needle in the trachea is confirmed by air aspiration and bronchoscopy. Then a guidewire is passed through the needle, and the needle is withdrawn. Afterward we use dilators on the guidewire from smallest dilator to the larger ones, to find the right size (which depends on the patient's sex and body mass index). Finally, the tracheostomy tube gets fixed to the skin using nylon sutures. During all stages we assure the right position of devices by bronchoscopy.

## Results

This study was performed on 50 patients in need of tracheostomy in Shariati Hospital between 2012 and 2014. Data from both methods were collected in a questionnaire, analyzed using SPSS for windows (version 20; IBM Corp., Armonk, NY, USA) by  $\chi^2$  and t-test.

Among these, 15 patients had percutaneous, and 35 had a standard tracheostomy. 60% of patients were male (19 from the standard group, and 11 from the percutaneous group) and 40% were female (16 from the standard procedure group, and 4 from the percutaneous procedure group). The mean age for the standard group was 60.2 years (22-88), and for the percutaneous group 60.5 years (42-82). 37 patients had comorbid diseases, in whom 22 patients were in the standard procedure group (63% of the patients in this group) and 15 patients were in the percutaneous procedure group (all the patients in this group).

Five people (14%) of the standard group and seven people (47%) of the percutaneous group had diabetes mellitus. 13 patients (37%) in the standard group and five patients (33%) in the percutaneous group had hypertension. Three patients (9%) from the standard group and two patients (13%) from the percutaneous group had the history of cerebrovascular accidents. Six patients from the standard group (17%) and five patients from the percutaneous group had the history of ischemic heart disease. Only one patient (2% of all patients) had end-stage renal disease, and he was in the standard group. Only two patients in the surgical group (4% of all patients) had congestive heart failure. Other accompanying diseases (Guillain-Barre syndrome, myasthenia gravis, pneumonia and Creutzfeldt-Jakob disease) were seen in 10 patients (20% of all patients, 7 in standard procedure group and 3 in percutaneous procedure group) (Table1).

Mean duration of procedure was 24.4 minutes (10-45 minutes) for the standard procedure, and 26.78 minutes (5-70 minutes) for the percutaneous procedure, and there was no significant difference between these 2 groups ( $P = 0.814$ ). Average bleeding during the procedure was 17.3 cc (10-100 cc) for the standard procedure and 18.7 cc (5-100 cc) for the percutaneous procedure ( $P = 0.550$ ). Average bleeding during 7 days after the procedure was 44 cc for the standard procedure (10-150 cc) and 24.7 cc (10-50 cc) for the percutaneous procedure, and there was significant difference between two groups ( $P = 0.012$ ). The rate of infection was 3% (one patient) in the standard procedure group and 7% (one patient) in the percutaneous procedure group ( $P = 0.514$ ) (Table1).

In this study, there was only one patient in whom we needed to convert percutaneous tracheostomy to open tracheostomy (7% of the percutaneous tracheostomy patients) (Table1).

**Table 1.** Comparison between two methods of tracheostomy

Variables	Standard procedure group	Percutaneous procedure group
Age	60 ± 18.6	60.5 ± 12
Duration of procedure	24.4 ± 7.8	26.78 ± 18
Bleeding during procedure	17.3 ± 15.8	18.7 ± 25
Bleeding during 7 days after procedure	44 ± 27	24.7 ± 12.5
Arterial O <sub>2</sub> saturation, 7 days after procedure (%)	96 ± 3	96.5 ± 2
Systolic blood pressure, 7 days after procedure	114.5 ± 15	119.5 ± 14
Diastolic blood pressure, 7 days after procedure	69 ± 8	74 ± 6.5
Heart rate, 7 days after procedure	91.9 ± 11	86.5 ± 11

There were no cases of pneumothorax, subcutaneous emphysema, and improper placement of tube or tube displacement. There was no case of death during tracheostomy in any groups. Four patients in the standard procedure group (11%) and one patient in the percutaneous procedure group (7%) died after tracheostomy. There was no correlation between death and comorbid diseases ( $P = 0.595$ ). Three patients from the standard procedure group weaned from ventilator in days 4-7 after procedure, and two patients from the percutaneous procedure group weaned from ventilator in days 6-7 after procedure, and there was no significant difference between two groups ( $P = 0.859$ ) (Table 1).

## Discussion

This study was conducted to evaluate the short-term (7 days after the procedure) complications of standard versus percutaneous tracheostomy in Shariati Hospital, to see which the preferred method is.

In studies performed by Kaylie et al. (6) and Wu et al. (7) there was no significant difference between the two procedures. In a meta-analysis which was published in 1999, the complications during the procedure were more in the percutaneous procedure while the morbidity was higher in standard tracheostomy (8).

In the current study, the duration of standard tracheostomy was  $24.4 \pm 7.8$  minutes (10-45 minutes), and in percutaneous procedure  $26.78 \pm 18$  (5-70 minutes) and there was no significant difference between two groups. Another study by Khalil et al. compared the duration of percutaneous and standard procedure on 60 ICU patients, and the duration was significantly shorter in the percutaneous tracheostomy procedure (8 minutes vs. 13 minutes in standard tracheostomy) (3). Another research Silvester et al. compared the bleeding during 3 days after procedure between percutaneous and standard procedures. There were three cases of bleeding in percutaneous and 4 cases in standard group (6). In a meta-analysis by Delaney et al. less bleeding and mortality was reported in percutaneous method (10).

In the current study, there was one case of infection in each group and there was no significant difference in rate of infection, but in Higgins et al. study the rate of infection and unusual scarring were significantly less in

percutaneous procedure (10).

In this study, there was no case of pneumothorax in the patients, but in Khalil et al. study the incidence of pneumothorax was 6.7% in the standard procedure and zero in the percutaneous procedure (3).

Also, there was no case of subcutaneous emphysema in none of the groups, but in Khalil et al. study it was 16.7% in standard procedure and zero in the percutaneous procedure (3).

In the current study, we had to convert from percutaneous to standard tracheostomy method in one patient, but in research by Beltrame et al. no patient needed conversion from percutaneous to the surgical procedure (11).

In our study, mortality during 7 days after tracheostomy occurred in 10% of patients, and there was no significant difference between the two groups (4 deaths in surgical procedure and 1 in the percutaneous procedure). In Delaney et al. study the overall mortality rate was 37% (10). Also, in Higgins et al. study there was no significant difference between mortality between two groups (12).

In our study, the average time of weaning from the ventilator was not significantly different in two groups. This variable was not evaluated in other studies.

## Conclusion

In this study, we were not able to perform percutaneous procedures in ICU (due to the lack of experienced personnel and bronchoscopes). If the percutaneous procedure is performed in ICU on patient's bedside by an experienced surgeon, the results would be favorable. In contrast to other studies that mentioned percutaneous tracheostomy is cheaper and can reduce the costs, in our study because of the high tracheostomy sets prices, the final cost of percutaneous method was more than the surgical procedure, and the percutaneous procedure could not be considered as the inexpensive method.

There were no significant differences in complications between the two groups, except for the bleeding during 7 days after procedure. So, none of the procedures can be introduced as the preferable procedure, but we recommend more studies on larger populations and with longer follow-up to be able to reach more precise conclusions.

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