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Retrospective Evaluation of Percutaneous Tracheostomy Methods Applied In A Tertiary Intensive Care Unit

Cevdet Yardımcı[1*], Gamze Talih[2], Ahmet Yüksek[1]

[1]Department of Anesthesiology and Reanimation, Yozgat Bozok University, Yozgat, Turkey
[2]Hatice Muammer Kocatürk Develi State Hospital, Develi, Kayseri, Turkey

ABSTRACT

Tracheostomy is a usual procedure for patients who will be dependent on ventilator therapy for a long time to reduce complications associated with long-term endotracheal intubation. Different percutaneous methods focused on safety and convenience have also been described to perform tracheostomy.

There are still some debates which technique is the most easy to applicate and safe. In this study, it was aimed to evaluate the Griggs' guide wire dilatational and Ciaglia's blue rhino techniques in terms of safety and convenience.

After obtaining ethical approval from local ethical committee, file records of patients stayed in our ICU between March 2019 and March 2020 were assessed. Fifty four patients to whom percutaneous tracheostomy applied were included in the study

Among the patients included in the study, the groups were similar according to the age, gender and duration of intubation. The procedure time was less in the Group GWFD (mean±SD; 18.62±6.92 mins) than in Group BR (mean±SD; 23.40±5.37 mins) (p: 0.006). There was no difference between the groups in terms of minor bleeding, major bleeding, pneumothorax, emphysema and hypoxia. But the total complication rate was higher in Group GWFD [10 (41.7%)] than in Group BR [5 (16.7%)] (p: 0.042).

This study's results reveal that the GWFD technique is faster but the BR technique is safer. Differences in the definition of procedure time may have affected the results. For this reason, more studies are needed in this area.

Key Words: Percutaneous tracheostomy, Grigg's wire dilatation, Ciaglia's blue rhino, tracheostomy complication

Introduction

Patients who underwent endotracheal intubation in intensive care units may stay connected to mechanical ventilation for a long time. Prolonged intubation has some complications such as laryngeal injury, vocal cord paralysis, glottic and subglottic stenosis, infections, tracheal injury (tracheomalasia, tracheal fistula, and tracheal stenosis eg.). The first concern in the tracheostomy procedure is to avoid tracheal injury. Additionally, it facilitates tracheal aspiration, reduces anatomical dead space and shortens the length of stay in intensive care unit (ICU). These aforementioned advantages of tracheostomy makes it useful in case of long-term intubation (1).

Tracheostomy is one of the oldest surgical procedures and have been existed more than 3000 years (2). Ciaglia et al. described the percutaneous sequential dilatational tracheostomy by using a needle, guide wire and different sized dilatators in 1985 (3). Ciaglia improved his own method by placing multiple dilatators to a single conical dilatator "Blue Rhino" in 1999. Griggs et al. developed a smooth round tipped guide wire and dilatation forceps for percutaneous tracheostomy (PT) in 1990 (4). In our clinic, both Griggs' forceps dilatation (GWDF) and Ciaglia's Blue Rhino (BR) methods are the most often used techniques.

In this study, it was aimed to compare the complications and procedural times of these two techniques performed in our clinic in the 2019.

Material and Method

The local ethical approval was obtained for the study (The decision no: 2017-KAEK-189_2020.01.08_13). Medical records of the patients between March 2019 - March 2020 in the intensive care unit with 16 beds of our clinic were assessed retrospectively and PT performed patients were identified. The tracheostomy techniques performed were evaluated in terms of complications encountered and the duration of the

***Corresponding Author:** Cevdet Yardımcı, Bozok University Faculty of Medicine, Department of Anesthesiology and Reanimation, Yozgat, Turkey
E-mail: cevdetyardimci@hotmail.com, Phone: +90 (505) 224 33 67
ORCID ID: Cevdet Yardımcı: 0000-0001-9176-891X, **Gamze Talih:** 0000-0003-4743-9734, **Ahmet Yüksek:** 0000-0002-7529-2971
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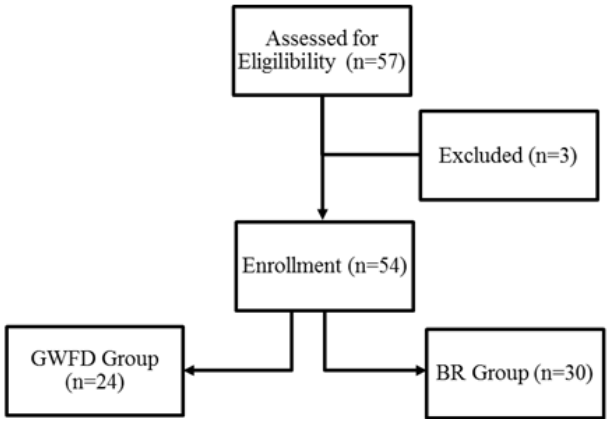

Fig. 1. Consort Diagram
Fiftyseven percutaneous tracheostomy applied patients were assessed for eligilibility of evaluation. Three patients were excluded from the study (insufficient data, n=3)

procedure. The patients whose data couldn't be reached and patients had surgical tracheostomy (ST) were excluded from the study. Routine monitorisation such as invasive tension arterial pressure, electrocardiography (ECG), peripheral oxygen saturation (SpO_2) and end tidal carbon dioxide ($EtCO_2$) monitorisations were performed to all of the patients, during the procedure. No bronchoscopy was applied to patients during the procedure. A standard anesthesia protocol was applied to all patients wtih propofol (1.5-2 mg/kg), fentanyl (2 mcg/kg) and midazolam (2 mg). Rocuronium (0.5 mg/kg) were applied to the patients with spontaneous breathing and motor response for neuromuscular blockade. All the patients were ventilated with controlled mechanical ventilation with 100% fractioned oxygen (FiO_2) concentration. A pillow was placed under the shoulders by stating neck in the middle position to ease the tracheostomy procedure. The endotracheal tube was drawn under the vocal cords in a controlled manner. Anterior neck region was cleaned with povidon iodine 2% and covered with sterile drapes. Jugular notch, thyroid, cricoid cartilages and the first three tracheal cartilage rings were identified by using anatomical landmarkers. Lidocain 1% with adrenaline (1:200.000) 3-5 ml was injected subcutaneously. All of these preparations were applied to all of the patients routinely.

The correct placement of the tracheostomy canula was confirmed with end-tidal CO_2 monitorization. Respiratory sounds were checked, then antero-posterior chest radiography was obtained to evaluate whether pneumothorax was developed or not. Early complications (minor hemorrhage, major hemorrhage, subcutaneous emphysema, pneumothorax, hypoxia and mortality) evolved in patients were recorded. Minor bleeding was defined as the need to apply gauze around the stoma to stop bleeding after the bleeding or aspirating blood from the endotracheal tube lumen with a gentle aspiration. Bleeding in spite of compression around the stoma and bleeding from the lumen of the endotracheal tube were considered as major bleeding. The time between surgical area cleaning and completion of the cannula sutures was accepted as the duration of the procedure.

Statistical Analysis: Data were analyzed using the Statistical Package for the Social Sciences Software (version 20.0) for Windows (SPSS Inc, Chicago, IL, USA). Quantitative variables are described as mean±standard deviation. Categorical variables are expressed as percentages. Comparisons between means were done with the Student's t-test. Comparison between percentages were performed with the Chi–square and Fisher's exact test. $P<0.05$ values were accepted significant statistically.

Results

It was determined that PT was performed to 57 patients staying in the ICU between March 2019 and March 2020. Three of them were excluded from the study because their records couldn't be reached. Fifty-four patients were included in the study. PT was applied to 24 (44.4%) of these patients by the GWFD method (Group GWFD) and to 30 (55.6%) of them Ciaglia Blue Rhino method (Group Br) (Figure 1).

There were no statistical differences between the groups according to the gender and age ($p>0.05$). The tracheostomy time were 16.66±5.52 th day of intubation in the Group GWFD and 16.66±5.52 th day of intubation in the Group BR. This difference wasn't statistically significant ($p=0.687$) (Table 1).

The procedural time were 18.62±6.92 min in the Group GWFD and 23.40±5.37 min in the Group BR (Table 1). The procedural time was significantly lower in the Group GWFD than the Group BR ($p=0.006$).

Due to the procedure, major bleeding, pneumothorax, and hypoxia were observed in three patients of Group GWFD, no major complication was observed in the Group BR. When the total number of major and minor complications were considered, at least one complication was observed in 41.7% of Group GWFD and 16.7% of Group BR. This difference was statistically significant ($p=0.042$). In both of the groups, the most frequent complication was minor bleeding. No mortality was observed related to procedure (Table 2).

Table 1. Age, Gender, İntubation Period and Procedural Time Features of The Groups

	Group GWDF (n=24)	Group BR (n=30)	P
Age (years)	65.62±10.62	64.56±16.18	0.786
Gender (F/M)	10/14 %41.7/58.3	11/19 %36.7/63.3	0.708
Intubation period (day)	16.66±5.52	17.23±4.83	0.687
Procedure time (min)	18.62±6.92	23.40±5.37	0.006*

Statistical analysis Independent sample's t Test *: Chi square p< 0.05 significant
(F: female, M: male, min: minute)

Table 2. Comparison of Complications

	Group GWDF (n=24) n (%)	Group BR (n=30) n (%)	P
Minor Bleeding	4 (16.7%)	3 (10%)	0.687
Major Bleeding	3 (12.5%)	0 (0%)	0.082
Pneumothorax	1 (4.2%)	0 (0%)	0.444
Emphysema	1 (4.2%)	2 (6.7%)	0.585
Hypoxia	1 (4.2%)	0 (0%)	0.444
Total Complication	10 (41.7%)	5 (16.7%)	0.042*

Statistical analysis Chi square and Fisher's exact test p< 0.05 significant

Discussion

PT is an easy applicable method in ICU without needing an operating theatre. In this way, it is not necessary to move the patient from their location to another place, even with an intensive care bed. The monitoring of patients is not interrupted even for such a temporary period. In addition, it doesn't give extra workload to the ICU staff to transfer the patient to an operating area, and there is no disruption in the execution of ICU tasks. PT is stated that is a quite reliable method when performed by experienced hands (5),(6),(7).

While the tracheostomy complication rate is 3-16%, procedure related mortality is about 0,03-0,6% (8). In a study with 164 patients, Massick et al. compared bedside surgical tracheostomy (n=50), surgical tracheostomy in the operating room (n=64), and bedside percutaneous tracheostomy (n=50). In this study, they found that complication rates in surgical tracheostomy performed in the operation room were lower than the rate of tracheostomy complications applied on the bedside. Besides, they did not find any difference between surgical and percutaneous methods in bedside practice. However, in this study, these rates varied depending on the percutaneous tracheostomy method applied at the bedside (9).

In this retrospective study, it was found less complications in tracheostomies performed with BR technique than with GWFD technique (p=0.042). Nevertheless the complications in this study are still higher than the complications stated as 16% for GWFD in the literature.

The most common complication in this study was minor bleeding. However, it is not clear this amount of bleeding how effects the patient's status. It was observed in this study that the complications were lower in BR technique than GWFD technique but it took longer (p=0.006). We believe that this time-complication relationship is an issue that should be supported by other studies and its reflection on the patient's clinic should be evaluated. Since PT procedures are performed under elective conditions, it may be more important to reduce complications than to save time.

In a retrospective study evaluated of tracheostomies performed with GWFD in their ICUs, Özgür M. et al. (10) stated that they observed minor bleeding 9.5% most often. In our retrospective study, in GWFD method minor bleeding was the most frequent complication with a rate of 16.7%. In a review by Cabrini et al. (11), they reported more bleeding in the GWFD technique than in the BR technique. In this study, there was no significant difference between GWFD and BR in terms of minor bleeding.

Kumar M. et al. (12), reported GWFD procedure time as 11.68 ± 6.48 min in the study comparing GWFD and ULTRA-perc single-stage dilator technique. However, in the study of Pattnaik et al. (13) with the GWFD method, they reported the duration of the procedure as median 3.5 (2.5-8) min. In the study where José M Añón et al. (14), compared

the GWFD and BR techniques, they stated the processing time as 25 ± 3.8 minutes in the GWFD technique and 17.3 ± 1.9 minutes in the BR technique. They stated that the shortening of the processing time was significant in the GWFD technique. In this retrospective study, the mean duration of the procedure was Mean ± SD, 18.62 ± 6.92 mins in GWFD and 23.40 ± 5.37 mins in BR techniques. We believe that this difference in processing time results from the procedural time definition. The definition of processing time could not be found in these publications.

According to Richard et al. (8), mortality rate in tracheostomies is between 0.03-0.6%. In a review by Simon M. et al. (15), they stated that the mortality rate was 2.18% due to percutaneous dilatational tracheostomy, and that the highest mortality was due to bleeding (38%). In the study of José M Añón et al. (14), they stated that more mortality were seen in the GFWD technique, but this was not statistically significant. In this retrospective study, no complication of mortality related to both GWFD and BR method was observed.

Tracheostomy, which is a method used to reduce complications due to intubation in patients who are dependent on mechanical ventilator for a long time in ICUs, can be applied either by percutaneous methods or by surgical methods. Among the percutaneous techniques, the superiority of the techniques still seems to be worth investigating.

The fact that PT operation is an elective operation and that this procedure is performed in order to improve an already provided airway in patients suggests that the speed factor may be left behind a little more. A safer and less harmful method may be superior. However, it has been observed that studies in this area are inadequate and the results are confusing.

This study's results reveal that GWFD technique takes shorter time, but complication rates are higher than BR technique.

Another important result of this study; in the literature searches, it was observed that the definition of procedure-related mortality was not clear and the definition of the duration of the procedure was missing in many studies. We believe that this study may contribute to the literature by defining and analyzing these points.

After all, there is need to conduct further studies on this subject.

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