European Review for Medical and Pharmacological Sciences 2023; 27: 11771-11779

Indication, complication, and prognosis of fiberoptic bronchoscopy guided percutaneous dilatation tracheostomy opening in respiratory intensive care unit: a retrospective study

K. ULUÇ, E.A. ÖNGEL, N.K. İLKAYA, Ö. DEVRAN, H.K. ÖZÇELIK

Department of Intensive Care, Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital, Health Sciences University, Istanbul, Turkey

Abstract. – OBJECTIVE: Percutaneous dilatational tracheostomy (PDT) is a bedside applicable procedure in intensive care unit patients requiring long-term mechanical ventilation. Fiber optic bronchoscopy (FOB) makes it easier and reduces complications. Our study aimed to evaluate the indications, complications, and prognosis of PDTs performed with FOB.

PATIENTS AND METHODS: Our study included 114 patients undergoing PDT through FOB-guided Griggs method in the Respiratory Intensive Care Unit between January 01, 2018, and January 31, 2023.

RESULTS: Among the patients undergoing PDT with FOB, 81 (71.1%) were male. The mean age was 62.1±11.5. The median Glasgow Coma Scale (GCS) score was 9, the median Acute Physiology and Chronic Health Evaluation-II (APACHE-II) score was 19, and the median Sequential Organ Failure Assessment (SOFA) score was 8. Tracheostomy was opened for prolonged mechanical-ventilator requirement in 80 patients (70.2%), to protect the airway in 19 (16.7%), and for poor neurologic status in 15 patients (13.2%). Complications during the procedure included hypoxemia in 3 patients (2.6%), minor bleeding in 3 patients (2.6%), perforation of the FOB in one patient (0.8%), and perforation of the intubation tube cuff in one patient (0.8%). 79 patients (69.3%) were discharged, and 35 (30.7%) were exited. There was a significant difference between the GCS, APACHE-II, and SOFA scores of the patients discharged and those who exited ($p < 0.001$).

CONCLUSIONS: FOB-guided PDT application should be encouraged as it reduces complications but it is still limited because it requires experienced specialists and equipment for a standard approach.

Key Words:
Complications, Fiberoptic bronchoscopy, Intensive care units, Percutaneous dilatational tracheostomy.

Introduction

Tracheostomy is the creation of an opening in the anterior wall of the trachea and mouthing it to the skin. Prolonged intubation has complications such as laryngeal damage, vocal cord paralysis, glottic and subglottic stenosis, infection, and tracheal damage (tracheomalacia, tracheal dilatation, tracheal stenosis). Percutaneous dilatation tracheostomy (PDT) aims to provide a safe airway, reduce laryngeal damage, facilitate aspiration of the airways, increase patient comfort, enable oral feeding, and facilitate patient transfer from the intensive care unit[1].

For the first time in 3600 BC, the Egyptians thought of oralization by making an incision in the trachea and made attempts for this purpose. In 1909, the first standard surgical tracheostomy was opened by Jackson[2]. Shelden et al[3] performed the first PDT technique in 1955. Since carotid artery and esophageal injuries were observed in tracheostomies opened with the PDT technique, they were discontinued in a short time. Toye and Weinstein[4] developed PDT with the Seldinger method in 1969. The sequential dilatation method employing guide wire and dilators was used by Ciaglia[5] in 1985.

PDT is preferred in intensive care units because it can be performed at the bedside, does not require operating room costs, and does not require patient transfer. In the Griggs technique, one of the PDT methods, tracheal dilatation is performed with specially designed forceps, and the cannula is placed in the trachea. Since the use of a fiber optic bronchoscope (FOB) in tracheostomy opening is beneficial in terms of showing the physician that the correct range is available and preventing contact with the posterior wall of the trachea during dilatation, FOB use during

Corresponding Author: Kamuran Uluç, MD; e-mail: kamuranuluc@hotmail.com

the procedure has been recommended in studies[6]. The biggest disadvantage of FOB is hypoventilation, hypercarbia, and respiratory acidosis. To prevent these disadvantages, it is aimed to maintain mechanical ventilation during the procedure. For this purpose, the procedure should be completed as soon as possible using a wide-diameter endotracheal tube and a narrow-diameter FOB. We aimed to evaluate the indications, complications, and prognosis of PDTs performed FOB in the Respiratory Intensive Care Unit between January 1, 2018, and January 31, 2023.

Patients and Methods

Our study included 114 patients who underwent PDT with the Griggs method guided by a fiber optic bronchoscope (FUJIFILM Corporation/ EB-530T 1B084K431, Japan) in the Respiratory Intensive Care Unit between January 01, 2018, and January 31, 2023. Patients over 18 years of age who were endotracheally intubated and in need of mechanical ventilation were included in the study. Patients with tracheal and neck deformity, soft tissue infection in the neck, palpated thyroid tissue, previous neck surgery, body mass index >40 kg/m^2, coagulation disorders, and patients requiring emergency surgery were excluded. The procedure was performed in patients with an activated partial thromboplastin time (aPTT) and prothrombin time (PT) less than 1.5 times the control value and a platelet count greater than 50,000/mm^3.

Feeding was stopped at least 8 hours before the procedure. Electrocardiogram (ECG), peripheral oxygen saturation (SpO_2), and invasive arterial pressure were monitored. Patients were ventilated on a mechanical ventilator in synchronized intermittent forced ventilation (SIMV) mode with a fraction of inspired oxygen (FiO_2) 100%. Dormicum 0.1 mg/kg and fentanyl 1 µg/kg were administered intravenously for sedation and analgesia. For muscle relaxation, rocuronium was administered intravenously at a dose of 0.6 mg/kg.

Patients were placed in a supine position before the procedure. The head was hyperextended by placing a support under the shoulder. The treated area was cleaned with 2% povidone-iodine and covered with a sterile drape. In PDT using FOB, an apparatus (catheter mount) with a small hole in the center allowed the bronchoscope to pass through the endotracheal tube. With FOB, secretion clearance was performed through the intubation tube. The endotracheal tube cuff was lowered so that the bronchoscope remained in the tube and pulled up to the second tracheal cartilage, and the cuff was inflated again. The tracheostomy access site was determined by utilizing the translumination effect of the bronchoscope tip light on the skin. The entry site was reconfirmed with FOB by finger pressure over the skin. The endotracheal tube cuff was lowered again and retracted to see the determined entry site. 3 ml of 2% prilocaine hydrochloride (60 mg) was applied as a local anesthetic. A 14G needle was inserted and advanced until the air was aspirated. "Percutaneous Tracheostomy Kit" (PORTEX®, Czech Republic) was used for the procedure. After the needle tip was seen with FOB, the guide wire was sent, slid over it with an 8F dilator, and the skin and trachea were expanded with forceps. Then, the appropriate tracheostomy cannula was inserted. The cuff of the tracheostomy tube was inflated. The patient's endotracheal tube was removed, and the mechanical ventilator was attached to the tracheostomy cannula. FOB was passed through the inserted tracheostomy cannula, and the position of the cannula in the trachea was checked. It was reaspirated depending on the need (bleeding, secretion). The cannula was fixed with a necktie. Bilateral respiratory sounds were listened to, and the patient was connected to a mechanical ventilator. Chest radiography was performed on all patients after the procedure.

Demographic data, comorbidities, Glasgow coma scale (GCS), Acute Physiology and Chronic Health Evaluation II (APACHE II) and Sepsis Related Organ Failure Assessment (SOFA) scores, number of intubation attempts, reason for tracheostomy opening, number of days intubated before tracheostomy, number of days on mechanical ventilation, days of hospitalization in the intensive care unit, complications related to tracheostomy opening (hypoxemia, hypotension/ hypertension, minor bleeding, major bleeding, perforation of the intubation tube, perforation of the FOB, bleeding around the stoma, subcutaneous emphysema, stoma site infection), and prognosis of the patients were retrospectively recorded from the patient files and the electronic database of the hospital.

Ethics Committee approval (Date-Decision No: 10.11.2022/ 2022 - 292) was obtained for the study at Health Sciences University Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital. The study was conducted following the Declaration of Helsinki.

Statistical Analysis

Descriptive statistics were used for demographic and clinical data, Chi-square analysis was used to show the relationship between categorical data, and Student *t*-test analysis was used for continuous variables. In the study, *p*-value < 0.05 was accepted as significant. Multivariate analysis was performed between variables. SPSS program Version 22 (IBM Corp., Armonk, NY, USA) was used for calculations.

Results

Between January 01, 2018, and January 31, 2023, tracheostomy was opened in 152 out of 1,472 patients hospitalized in the intensive care unit. Surgical tracheostomy was performed on a total of 38 patients, while 114 patients underwent percutaneous dilatational tracheostomy (PDT) with the assistance of a fiberoptic bronchoscope (FOB) (Figure 1). Among the patients who underwent PDT with FOB, 81 (71.1%) were male, and 33 (28.9%) were female. The mean age of the patients was 62.1 ± 11.5 years. The demographic characteristics of the patients can be found in Table I. The median Glasgow Coma Scale (GCS) score was 9 [interquartile range (IQR) 12], the median Acute Physiology and Chronic Health Evaluation II (APACHE II) score was 19 (IQR 33), and the median Sepsis Related Organ Failure Assessment (SOFA) score was 8 (IQR 15). There were 30 patients (26.3%) with a Charlson Comorbidity Index (CCI) of 0, while 84 patients (73.7%) had a CCI greater than 1 (CCI >1).

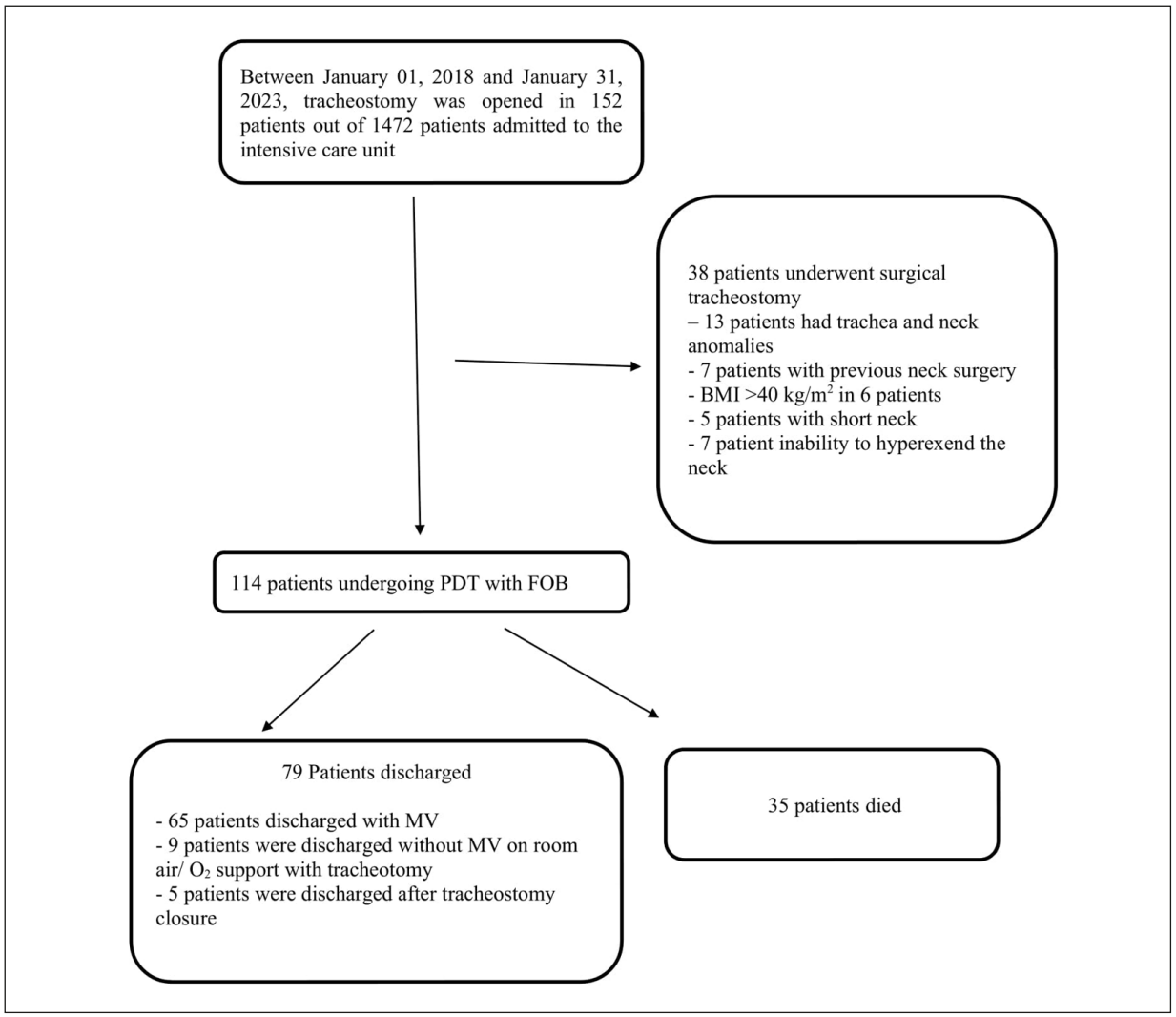

Figure 1. Workflow. BMI: Body mass index; PDT: Percutaneous dilatational tracheostomy; MV: Mechanical ventilation.

Table I. Demographic characteristics of the patients.

Age (years) (mean ± SD)	62.1 ± 11.5	
Gender Male/Female n (%)	81/33; 71.1/28.9	
GKS†	9	
APACHE II score†	19	
SOFA score†	8	
Number of days intubated before tracheostomy	15.1 ± 9.2	
Number of days on mechanical ventilation	32.6 ± 16.5	
Number of hospitalization days in intensive care unit	35.5 ± 15.8	
Charlson Comorbidity Index (CCI) 0	30 patients (26.3%)	
CCI > 1	84 patients (73.7%)	
	Yes	**No**
Alzheimer's/Dementia/Parkinson's	19 (16.7%)	95 (83.3%)
DM	35 (30.7%)	79 (69.3%)
HT	52 (45.6%)	62 (54.4%)
IHD	30 (26.3%)	84 (73.7%)
CVD	16 (14.0%)	98 (86.0%)
COPD	55 (48.2%)	59 (51.8%)
CHF	19 (16.7%)	95 (83.3%)
CRF	5 (4.4%)	109 (95.6%)
ALS	5 (4.4%)	109 (95.6%)
Post CPR	10 (8.8%)	104 (91.8%)
Malignancy	27 (23.7%)	87 (76.3%)

†Median. GCS: Glasgow Coma Scale, APACHE II: Acute Physiology and Chronic Health Evaluation II, SOFA: Sequential Organ Failure Assessment, DM: Diabetes mellitus, HT: Hypertension, IHD: Ischemic heart disease, CVD: Cerebrovascular disease, COPD: Chronic obstructive pulmonary disease, CHF: Congestive heart failure, CRF: Chronic renal failure, ALS: Amyotrophic lateral sclerosis, CPR: Cardiopulmonary resuscitation, SD: Standard deviation, n: Number of patients, %: Percentage, IQR: İnterquartile range.

While 93 patients (81.5%) underwent tracheostomy without attempted extubation, 13 (11.5%) underwent tracheostomy after one failed extubation. Eight patients (7%) underwent tracheostomy after two or more failed extubations (Table II).

When the reasons for tracheostomy were evaluated, it can be observed that tracheostomy was opened in 80 patients (70.2%) for prolonged mechanical ventilator requirement, in 19 patients (16.7%) to protect the airway, and in 15 patients (13.2%) due to poor neurologic status (Table II).

The number of days intubated before tracheostomy was 15.1 ± 9.2 days, the number of days on mechanical ventilation was 32.6 ± 16.5 days, and the number of days in the intensive care unit was 35.5 ± 15.8 days.

Seventy-nine patients (69.3%) were discharged, and 35 (30.7%) exited. Prognostic factors affecting mortality are presented in Table III. There was a significant difference between the GCS, APACHE II score, and SOFA score of patients discharged from the intensive care unit and those exited ($p < 0.001$).

When multivariate analysis was performed, the APACHE II score was found to be significant (Table IV).

Discussion

PDT is commonly applied in the intensive care unit. During the PDT procedure, FOB provides benefits such as showing the site of needle entry into the trachea, accurate guidewire advancement, monitoring the dilated tracheal area, and rechecking the airway after tracheostomy cannula placement. Using FOB reduces the number of needle puncture attempts, thus decreasing tissue injury. However, FOB is not available in every intensive care unit. The use of FOB requires technical knowledge and experience. In addition, procedure cost increases[7]. In a study conducted by Marchese et al[8] in which many respiratory intensive care units in Italy participated, it was observed that percutaneous tracheostomy was performed more frequently than surgical trache-

Table II. Reasons for tracheostomy opening, number of extubation attempts, tracheostomy complications, and final status of discharged patients.

Reasons for opening a tracheotomy	N	%
Prolonged mechanical ventilator requirement	80	70.2
Protecting the airway	19	16.7
Poor neurological status	15	13.2
Number of extubation attempts		
Tracheostomy opened without attempted extubation	93	81.5
Extubation was attempted once	13	11.5
Two or more extubations attempted	8	7.0
Tracheostomy complications		
Hypoxemia	3	2.6
Hypotension/hypertension	2	1.7
Minor bleeding	3	2.6
Major bleeding	1	0.8
Perforation of the intubation tube cuff	1	0.8
FOB piercing	1	0.8
Bleeding around the stoma	1	0.8
Subcutaneous emphysema	2	1.7
Stoma site infection	2	1.7
Current status of discharged patients		
Discharged with MV	65	82.3
Discharged with tracheotomy on room air/O_2 support without MV	9	11.4
Tracheostomy closed and discharged	5	6.3

FOB: Fiberoptic bronchoscopy, MV: Mechanical ventilation, n: Number of patients, %: Percentage.

ostomy. Almost 80% of the tracheostomies in our respiratory intensive care unit are opened with PDT under FOB guidance.

The most common indication for tracheostomy in intensive care units is the need for prolonged mechanical ventilation. In the study by Vargas et al[9], the most common indication was prolonged mechanical ventilation with 53.7%, while tracheostomy was opened to protect the airway in 4.3% of patients. The need for prolonged mechanical ventilation as an indication for tracheostomy opening was found in 95% and 90% of the studies in the literature[10,11]. In the study of Özçelik et al[12], 13 of 59 patients (22%) needed prolonged mechanical ventilation due to respiratory reasons, and 42 (72%) had tracheostomy opened with FOB because of poor neurologic status. In our study, tracheostomy was opened in 80 patients (70.2%) because of the need for prolonged mechanical ventilation, 19 (16.7%) because of airway protection, and 15 (13.2%) because of poor neurologic status.

In the study by Cırık et al[13], 52 (54%) of 96 patients had never attempted extubation, tracheostomy was planned to be opened in 22 (22.9%) patients after attempted extubation once, and in 22 (22.9%) patients extubation was attempted at

Table III. Factors affecting mortality.

Variable	Mortality				*p*-value
	No		Yes		
	N	%	N	%	
CCI Group					
CCI 0	23	29.1%	7	20.0%	
CCI > 1	56	70.9%	28	80.0%	
Number of extubation attempts					
0	64	81.0%	29	82.9%	0.815
1	9	11.4%	4	11.4%	
2 and above	6	7.6%	2	5.7%	
Number of days intubated before tracheostomy†	14 (10)		16 (9)		0.027
Number of days on mechanical ventilation†	29 (17)		31 (15)		0.204
Number of hospitalization days in intensive care unit†	30 (18)		34 (12)		0.172
Age†	61 (13)		64 (12)		0.070
APACHE II†	17 (7)		28 (9)		< 0.001*
GKS†	10 (5)		7 (4)		0.001*
SOFA†	7 (2)		10 (4)		< 0.001*

*Statistically significant difference, †Median (IQR). IQR: Interquartile range, CCI: Charlson Comorbidity Index, GCS: Glasgow Coma Scale, APACHE II: Acute Physiology and Chronic Health Evaluation II, SOFA: Sequential Organ Failure Assessment, n: Number of patients, %: Percentage.

Table IV. Evaluation of risk factors affecting mortality by multivariate analysis.

			95% CI	
	p-value	HR	Lower	Upper
Age	0.726	0.993	0.952	1.035
APACHE II	0.026*	1.167	1.018	1.338
SOFA	0.209	1.227	0.891	1.690
Number of days on mechanical ventilation	0.672	1.008	0.970	1.048
Number of days intubated before tracheostomy	0.922	1.003	0.936	1.076

*: Statistically significant difference. HR: Hazard ratio, 95% CI: 95% Confidence interval, APACHE II: Acute Physiology and Chronic Health Evaluation II, SOFA: Sequential Organ Failure Assessment.

least two times and tracheostomy was opened as a result of failed weaning. In our study, there were 93 (81.5%) patients in whom tracheostomy was opened without attempted extubation, 13 (11.5%) in whom extubation was attempted once, and 8 (7%) in whom extubation was attempted two or more times. Spontaneous breathing was attempted in patients who met the extubation criteria, and tracheostomy was opened without extubation in patients who failed. In the intensive care unit of our hospital, the need for prolonged mechanical ventilation is encountered in many patients since patients are mostly admitted due to respiratory failure, and chronic obstructive pulmonary disease (COPD) ranks first among the causes of respiratory failure. Therefore, considering the need for high pressure and FiO_2, low muscle mass, high amount of secretions, and prolonged stay in mechanical ventilation in our patients followed up with mechanical ventilation, tracheostomy opening with FOB without extubation was preferred more.

The timing of tracheostomy varies in intensive care units, and the optimal time for tracheostomy is unknown. It is a decision made by the responsible intensive care specialist after evaluating the patient and the clinical situation. It is recommended to open tracheostomy immediately after intubation in patients not expected to be extubated quickly. A study by Veenith et al[14] found that tracheostomy was performed in 6-10 days with a rate of 71%. In the study by Blot et al[10], the median time for tracheostomy opening was 20 days. In studies conducted in our country, the mean number of days of intubation until tracheostomy opening varies between a minimum of 8.20 ± 5.44 days and a maximum of 19.51 ± 10.23 days[15,16]. In our study, the mean day of tracheostomy opening was 15.1 ± 9.2 days after intensive care unit admission. In some patients, the tracheostomy opening time was prolonged due to delays in the consent of the patient's relatives. In our SVO, Alzheimer's/Dementia/Parkinson's and ALS patients with poor neurologic status, tracheostomy was opened earlier.

In the study by Cheung et al[17], the mean length of stay in the intensive care unit was 24.3 ± 20.7 days, and in the study by Combes et al[18], the median length of stay in the intensive care unit was 35 days. In our study, the mean total intensive care unit length of stay in patients who underwent tracheostomy was 35.5 ± 15.8 days. The mean number of intensive care unit stays in our discharged patients was 30, and the mean number of intensive care unit stays in our deceased patients was 34. When compared with similar studies, we assume that the reason for the prolonged length of stay in the intensive care unit is that patients who become care patients cannot be sent home, cannot be referred to an appropriate care center, there are not enough palliative care centers in our country, and tracheostomized patients are not followed up properly in normal inpatient services. Marchese et al[8] found that the intensive care unit mortality rate was 10%. In the study by Combes et al[18], the intensive care unit mortality rate was 33% in the group in which tracheostomy was performed. The mortality rate was 79.3% in the study by Atlas et al[19], 65.8% in the study by Öncül et al[20], and 48.5% in the study by Karasu et al[21]. In our study, the mortality rate in patients who underwent tracheostomy was 30.7%, which was lower than the mortality rate in studies performed in our country. In studies with a lower mortality rate, we attributed this to the short intensive care unit stay due to the early opening of the tracheostomy. In the study by Shen et al[6], the patients' mean APACHE II score was 24 ± 7. In the study by Atlas et al[19], the mean APACHE II

score was 23.2 ± 3.6. We associated the lower mean APACHE II score of 19.7 in our study with the fact that our intensive care unit was a respiratory intensive care unit, and our mortality rate was lower. We attributed the lower mortality rate compared to the studies in our country to the lower APACHE II scores of the patients and the fact that we opened tracheostomy in an earlier period.

Many studies on percutaneous tracheostomy opening using FOB have been reported to be a very useful method, especially in preventing complications[7]. Despite these advantages, studies also report that airway obstruction and hypoventilation may occur during FOB placement[22]. Kost et al[23] reported that they did not encounter pneumothorax and pneumomediastinum in their 500-patient study in which they opened percutaneous tracheostomy using FOB and attributed this to the use of FOB. Our study did not encounter pneumothorax and pneumomediastinum in any of the patients. Complications occurred in 9 of 45 patients (20%) in the PDT procedure with FOB by Shen et al[6]. All of these were minor bleeding; no major bleeding and pneumothorax developed. In the same study, complications occurred in 18 of 45 patients (40%) in PDT without FOB; 15 (33.3%) were minor bleeding, 2 (4.4%) major bleeding, and 1 (2.2%) pneumothorax. Complication rates in patients who underwent PDT with FOB by Atlas et al[19] were hypoxia at 10.3%, hypotension at 6.9%, and minor bleeding at 10.3%. In the study by Sarıtaş et al[24], complications occurred in 4 (13.3%) of 30 patients in PDT with FOB; minor bleeding occurred in 1 (3.3%) patient, and major bleeding occurred in 3 (10%) patients. In the same study, complications developed in 18 (60%) of 30 patients who underwent standard PDT; tube dislodgement in 6 (20%) patients, endotracheal cuff rupture in 5 (16.6%) patients, minor bleeding in 3 (10%) patients, major bleeding in 2 (13.3%) patients, and posterior wall damage in 2 (13.3%) patients. In a study by Topcu et al[25], hypoxemia occurred in 7 (15.9%) of 44 patients who underwent PDT without FOB. In our study, hypoxemia occurred in 3 (2.6%) patients, hypotension/hypertension in 2 (1.7%) patients, minor bleeding in 3 (2.6%) patients, major bleeding in 1 (0.8%) patients, perforation of the intubation tube cuff in 1 (0.8%) patient, 1 (0.8%) patient had FOB perforation, 1 (0.8%) patient had bleeding around the stoma, 2 (1.7%) patients had subcutaneous emphysema, and 2 (1.7%) patients had stoma site infection. We attributed the low complication rates in our study compared to other studies to the fact that our intensive care unit is a respiratory intensive care unit and our knowledge and experience in FOB procedure.

In the study by Fernandez et al[26], 23% of the patients were discharged with closed tracheostomy and 54% with tracheostomy cannula. In the study by Atlas et al[19], 8 (13.8%) of 58 patients in whom a tracheostomy was opened were discharged with MV, and 4 (6.9%) were discharged with a closed tracheostomy. In our study, 65 (82.3%) of 79 patients were discharged with MV, 9 (11.4%) were discharged with tracheotomy in room air / O_2 support without MV, and 5 (6.3%) were discharged with closed tracheostomy. We attributed the low complication rates in our study compared to other studies to our knowledge and experience in FOB procedure, as our intensive care unit is a respiratory intensive care unit.

Limitations

The limitations of our study include that it was the experience of a single center, the study was observational, the number of patients was small, it did not include a control group and long-term follow-up could not be performed to evaluate late complications after tracheostomy.

Conclusions

FOB-guided PDT application is limited as it requires experienced specialists and equipment to be a standard approach. FOB-guided PDT should be encouraged as it reduces complications.

Conflict of Interest

The authors declare that they have no conflict of interests.

Ethics Approval

Ethics Committee approval was obtained for the study at Health Sciences University Yedikule Chest Diseases and Thoracic Surgery Training and Research Hospital. The date/No. of approval: 10.11.2022/ 2022-292.

Funding

There is no funding for this study.

Authors' Contribution

The concept for research or article/hypothesis generation: Kamuran Uluç, Esra Akkütük Öngel, Özkan Devran. Planning the methods to generate hypothesis: Kamuran Uluç,

Esra Akkütük Öngel, Nazan Köylü İlkaya. Supervision and responsibility for the organization and course of the project and manuscript preparation: Kamuran Uluç, Esra Akkütük Öngel, Hatice Kutbay Özçelik. Supplying equipment, space, and personnel vital to the Project: Kamuran Uluç, Özkan Devran. Discussion of the results and approval of the final version of the work: Kamuran Uluç, Nazan Köylü İlkaya, Hatice Kutbay Özçelik.

ORCID ID

Kamuran Uluç: 0000-0001-6128-0462;
Esra Akkütük Öngel: 0000-0003-0129-6336;
Nazan Köylü İlkaya: 0000-0002-4891-0818;
Özkan Devran: 0000-0002-1498-8609;
Hatice Kutbay Özçelik: 0000-0001-5048-7118.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Data Availability

The data generated and analyzed during the study are available from the corresponding author. They are not available publicly.

References

1) Friedman Y, Fildes J, Mizock B, Samuel J, Patel S, Appavu S, Roberts R. Comparison of percutaneous and surgical tracheostomies. Chest 1996; 110: 480-485.
2) Jackson C. Tracheotomy. Laryngoscope 1909; 19: 285-90.
3) Shelden CH, Pudenz RH, Freshwater DB, Crue BL. A new method for tracheotomy. J Neurosurg 1955; 12: 428-431.
4) Toy FJ, Weinstein JD. A percutaneous tracheostomy device. Surgery 1969; 65: 384-389.
5) Ciaglia P, Firsching R, Syniec C. Elective percutaneous dilatational tracheostomy: a new simple bedside procedure; preliminary report. Chest 1985; 87: 715-719.
6) Shen G, Yin H, Cao Y, Zhang M, Wu J, Jiang X, Yu T, Lu W. Percutaneous dilatational tracheostomy versus fibre optic bronchoscopy-guided percutaneous dilatational tracheostomy in critically ill patients: a randomised controlled trial. Ir J Med Sci 2019; 188: 675-681.
7) Peris A, Linden M, Pellegrini G, Anichini V, di Filippo A. Percutaneous dilatational tracheostomy: a self-drive control technique with video fiberoptic bronchoscopy reduces perioperative complications. Minerva Anestesiol 2009; 75: 21-25.
8) Marchese S, Corrado A, Scala R, Corrao S, Ambrosino N. Tracheostomy in patients with long-term mechanical ventilation: a survey. Respiratory Medicine 2010; 104: 749-753.
9) Vargas M, Servillo G, Arditi E, Brunetti I, Pecunia L, Salami D, Putensen C, Antonelli M, Pelosi P. Tracheostomy in ıntensive care unit: a national survey in Italy. Minerva Anestesiol 2013; 79: 156-164.
10) Blot F, Melot C. Indications, timing, and techniques of tracheostomy in 152 French ICUs. Chest 2005; 127: 1347-1352.
11) Fischler L, Erhart S, Kleger GR, Frutiger A. Prevalence of tracheostomy in ICU patients. A nation-wide survey in Switzerland. Intensive Care Med 2000; 26: 1428-1433.
12) Özçelik Z, Gültekin Y. Comparison of percutaneous tracheostomy procedure performed with or without fiberoptic bronchocopy guidance in general intensive care units. J Anesthesiol Reanim Spec Soc 2020; 28: 163-169.
13) Cırık MÖ, Eraslan Doğanay G. Retrospective evaluation of percutaneous tracheostomies applied with fiberoptic broncoscopy in the intensive care unit. Med J Ankara Train Res Hosp 2021; 54: 232-237.
14) Veenith T, Ganeshamoorthy S, Standley T, Carter J, Young P. Intensive care unit tracheostomy: a snapshot of UK practice. Int Arch Med 2008; 1: 21.
15) Cangül TT, Şebnem Türk H, Sayın P, Ünsal O, Çınar S, Oba S. Percutaneous tracheotomy practices in our intensive care unit (ICU). The Medical Bulletin of Sisli Etfal Hospital 2013; 47: 11-15.
16) Çanakçı E, Kılıç K, Elbir Şahin A. Percutaneous tracheostomy with Grigss dilating forceps technique: retrospective analysis of 60 intensive care patients. Ege J Med 2016; 55: 184-189.
17) Cheung NH, Napolitano LM. Tracheostomy: epidemiology, indications, timing, technique, and outcomes. Respiratory Care 2014; 59: 895-915.
18) Combes A, Luyt CE, Nieszkowska A, Trouillet JL, Gibert C, Chastre J. Is tracheostomy associated with better outcomes for patients requiring long-term mechanical ventilation? Crit Care Med 2007; 35: 802-807.
19) Atlas A, Altay N. Our percutaneous tracheostomy experience in our ıntensive care unit: a retrospective analysis. Journal of Harran University Medical Faculty 2021; 18: 104-108.
20) Öncül S, Yılmaz M, Gaygusuz EA, Oysu DA, Esen O, Şimşek T, Aytekin MH, Alcal HD, Bay B. Our experience in percutaneous tracheostomy which performed by griggs method: 38 cases. Kocaeli Medical Journal 2014; 3: 1-4.
21) Karasu D, Yılmaz C, Baytar Ç, Korfalı G. Retrospective analysis of percutaneous tracheostomi cases in ıntensive care unit. Turkish Journal of Intensive Care 2018; 16: 83-87.
22) Chiu CT, Chung YH, Lu HI, Lin MC. Weaning of long-term mechanically-ventilated patients following video bronchoscopy-guided percutaneous dil-

atational tracheostomy. Chang Gung Med J 2005; 28: 829-836.

23) Kost KM. Endoscopic percutaneous dilatational tracheotomy: a prospective evaluation of 500 consecutive cases. Laryngoscope 2005; 115: 1-30.

24) Saritas A, Saritas PU, Kurnaz MM, Beyaz SG, Ergonenc T. The role of fiberoptic bronchoscopy monitoring during percutaneous dilatational tracheostomy and its routine use into tracheotomy practice. J Pak Med Assoc 2016; 66: 83-89.

25) Topcu H, Ozçiftçi S, Şahiner Y. Comparative effectiveness of real-time ultrasound-guided tracheostomy and anatomic landmark percutaneous dilatational tracheostomy: a retrospective cohort study. Eur Rev Med Pharmacol Sci 2022; 26: 7883-7891.

26) Fernandez R, Tizon AI, Gonzalez J, Monedero P, Garcia-Sanchez M, De-La-Torre MV. Intensive care unit discharge to the ward with a tracheostomy cannula as a risk factor for mortality: a prospective, multicenter propensity analysis. Crit Care Med 2011; 39: 2240-2245.