Comparison of laryngeal mask airway and endotracheal tube using percutaneous dilatational tracheostomy

Perkütan dilatasyonel trakeostomi uygulamasında laringeal maske havayolu ile endotrakeal tüp kullanımının karşılaştırılması

Nezir Yilmaz[1], Mehmet Duran[2], Fikret Ozerdem[2]

[1] Department of Anesthesiology and Reanimation, Adıyaman Training and Research Hospital

[2] Department of Anesthesiology and Reanimation, Faculty of Medicine, Adıyaman University

Abstract

Aim: The study's objective was to determine whether laryngeal mask airway (LMA) use in percutaneous tracheostomy applications is superior compared to classic endotracheal tube (ETT) use.

Methods: The study comprised patients who had percutaneous tracheostomy at Adıyaman Training and Research Hospital between 2013 and 2018. The patients were separated into two groups those who used ETT for airway management (group E) and those who used LMA instead of ETT (group L) during PT application. 4 patients were excluded from the study due to the lack of data from the 170 patient files obtained. The diagnosis for intensive care unit admission, age, gender, length of hospital stay, length of the procedure, number of attempts, complications, and mortality were compared between the two groups.

Results: Of the 166 patients involved in the study, 76 were female and 90 were male. All patients underwent successful tracheostomy procedures, but 20 patients had minimal bleeding, and 21 patients had a second attempt. The duration of the tracheostomy procedure was found to be significantly shorter in group L ($p<0.05$). In comparison to group E, group L had a significantly longer hospital stay ($p<0.05$).

Conclusion: It was considered that the use of LMA in percutaneous dilatational tracheostomy applications reduces the duration of the surgery. However, there is no significant difference between the use of ETT and LMA in terms of procedural success and complication rates.

Keywords: Airway management, laryngeal mask airway, tracheostomy

Öz

Amaç: Perkütan trakeostomi uygulamalarında laringeal maske kullanımının klasik endotrakeal tüp kullanımına üstünlüğünün olup olmadığının incelenmesi amaçlandı.

Yöntemler: 2013-2018 yılları arasında Adıyaman Eğitim ve Araştırma Hastanesi'nde perkütan trakeostomi uygulanmış olan hastalar çalışmaya dahil edildi. Hastalar PT uygulaması sırasında havayolu yönetiminde ETT kullanılanlar (grup E) ve ETT yerine LMA kullanılanlar (grup L)olmak üzere iki gruba ayrıldı. Ulaşılan 170 hasta dosyasından 4 hasta eksik bilgiler nedeni ile çalışma dışı bırakıldı. Hastaların yoğun bakıma yatış tanıları, yaş, cinsiyet, hastanede yatış süresi,işlem süresi, deneme sayısı, komplikasyonlar ve mortalite durumu kaydedilerek her iki grup arasında kıyaslandı.

Bulgular: Çalışmaya dahil edilen 166 hastanın 76'sı kadın ve 90'ı erkek olarak tespit edildi. Tüm hastalarda trakeostomi başarılı olup 20 hastada minör kanama ve 21 hastada 2. deneme tespit edildi. Trakeostomi işlem süresi grup L'de anlamlı düzeyde daha kısa olarak bulundu ($p < 0.05$). Grup L'de hastanede yatış süresi grup E'den anlamlı ($p < 0.05$) olarak daha yüksekti.

Sonuç: Perkütan dilatasyonel trakeostomi uygulamalarında LMA kullanımının işlem süresini kısalttığı ancak işlem başarısı ve komplikasyon oranları açısından ETT kullanımı ile anlamlı bir farklılığı olmadığını düşünmekteyiz.

Anahtar Sözcükler: Havayolu yönetimi, laringeal maske havayolu, trakeostomi

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Corresponding author/*Yazışma yazarı*

Nezir Yılmaz

Adıyaman Üniversitesi Eğitim ve Araştırma Hastanesi, Anesteziyoloji ve Reanimasyon Kliniği, Yunus Emre Mahallesi, 1164 Sokak, No:13, Adıyaman, Türkiye.
E-mail: yilmaznezir@hotmail.com

ORCID

Nezir Yılmaz: 0000-0002-4351-6256
Mehmet Duran: 0000-0001-7568-3537
Fikret Özerdem: 0000-0003-0503-9513

INTRODUCTION

One of the earliest surgical procedures in history is the tracheostomy. It is claimed that the Egyptians utilized it for the first time about 3600 BC. With the polio epidemic in the 1950s, Jackson's 1909 definition of tracheostomy applications became popular in use in intensive care units. Ciaglia et al. first described successive dilator-assisted percutaneous dilatational tracheostomy (PDT) in 1985. Griggs and other modified this technique and used a forceps to perform it in 1990 (1).

Percutaneous dilatational tracheostomy applications are commonly preferred in intensive care units for their advantages which include being able to be performed at the patient's bedside, applying in less time, causing fewer complications and fewer stomal infections, requiring less sedation, early mobilization, and physiotherapy, and more (2). PDT is one of the most widely used invasive techniques, with over 100,000 reported cases reported each year in the United States (3).

Airway management during the PDT procedure is traditionally provided by endotracheal tube (ETT). The tube is pulled out of the application area throughout the procedure. It is possible for this practice to cause unintended extubation and significant air leakage if the patient or practitioner moves improperly during it. Regarding the reported incidence of that possible problems (0.1%–3.3%), they can be fatal (4,5).

In the literature, it has been reported that the use of laryngeal mask airway (LMA) in PDT applications is superior to the use of ETT in terms of safety, procedure time and complications (6,7).

This study aimed to compare the use of LMA and ETT in PDT procedures in a university hospital based on their effects on procedure times, complications, and the number of attempts.

MATERIALS AND METHODS

After obtaining approvals from the clinical research ethics committee at Adıyaman University, the study was launched on December 18th, 2018 (date: 18.12.2018, decision no: 2018/9-15). The records of 199 patients who had PDT in the intensive care units of Adıyaman University Training and Research Hospital between 2013 and 2018 were retrospectively reviewed.

For patients who were intubated orotracheally in intensive care units, due to prolonged mechanical ventilation (>15 days), informed consent was obtained from the relatives of the patients, and percutaneous tracheostomy was performed under the conditions of stable hemodynamics, and appropriate coagulation parameters were included in the study.

Patients who underwent PDT using a technique other than the Griggs method, had a difficult airway (short neck, obesity, cervical trauma), and emergency PDT applications were all excluded from the study.

The study comprised patients who had routine ASA (American Society of Anesthesiologists) monitoring during the operation. Records of arterial pressure readings, peripheral oxygen saturation, and cardiac rhythm using a 5-lead electrocardiogram were acquired.

The patients were divided into two groups based on the airway equipment used during the procedure: those utilizing LMA (group L) and those using ETT (group E). In group L, the endotracheal tube was removed before the procedure started, and a 3, 4, or 5 laryngeal mask (based on ideal body weight) was placed supraglottically while mechanical ventilation was continued.

After the patients were administered intravenous (iv) 2 mg/kg propofol (Diprivan 200 mg/20 mL, AstraZeneca, Istanbul, Turkey), 1 mcg/kg fentanyl (Talinat 0.5 mg/10 mL, Vem Ilac, Cerkezkoy, Turkey) and 0.6 mg/kg rocuronium (Esmeron 50 mg/5 mL, Schering-Plough, Istanbul, Turkey), the procedure was completed using a percutaneous tracheostomy kit (Portex, Blueline Ultra SmithsMedical, North America) and using the Griggs method from the level of the 2nd cricoid ring on the trachea on the anterior neck wall.

The diagnosis for intensive care unit admission, age, gender, length of hospital stay, length of the procedure, number of attempts, complications, and mortality were recorded. Both groups' data were compared.

Minor bleeding was regarded as a complication of the procedure, and bleeding that would necessitate blood transfusion was accepted as procedure-related complication. The length of the hospital stay was determined as the time from the first day of hospitalization to the day of discharge or death. The duration of the procedure was calculated as the time from the beginning of the proce-

Table 1. Descriptive characteristics of the patients

		Min-Max	Median	Mean±SD / n-%
	Age	16.0-103.0	72.0	67.2±20.1
Gender	Female			76 45.8%
	Male			90 54.2%
CVD				73 44.0%
PCAS				30 18.1%
Cardiovascular Diseases				17 10.2%
Respiratory Failure				23 13.9%
Malignancy				9 5.4%
Neuromuscular diseases				7 4.2%
Other				7 4.2%
Duration of hospitalization		11.0-346.0	53.0	71.3±57.6
Duration of procedure		2.0-15.0	7.0	7.4±2.5
Number of attempts	I			145 87.3%
	II			21 12.7%
Complication	No			146 88.0%
	Minor bleeding			20 12.0%
Mortality	Exitus			119 71.7%
	Discharge			47 28.3%

CVD: Cerebrovascular disease, max: Maximum, min: Minimum,: n: Number, PCAS: Post cardiac arrest syndrome, SD: Standard deviation

Table 2. Comparison of groups

		Group E		Group L		*p* value
		Mean ±SD /n-%	Median	Mean±SD/n-%	Median	
Age		68.7±19.4	73.0	65.5±20.8	70.0	0.367 [m]
Gender	Female	41 47.7%		35 43.8%		0.612 [x²]
	Male	45 52.3%		45 56.3%		
Duration of hospitalization		60.8±50.2	47.0	82.5±62.9	62.5	**0.022**[m]
Duration of procedure(min)		8.4±2.7	8.5	6.2±1.6	6.0	**0.000**[m]
Number of Attempts	I	74 86.0%		71 88.8%		0.601 [x²]
	II	12 14.0%		9 11.3%		
Complications	No	72 83.7%		74 92.5%		0.803 [x²]
	Minor Bleeding	14 16.3%		6 7.5%		
Mortality	Exitus	64 74.4%		55 68.8%		0.418 [x²]
	Discharge	22 25.6%		25 31.3%		

Group E: Endotracheal tube group, Group L: Laryngeal mask airway group, m: Mann-Whitney U test, n: Number, SD: Standard deviation, x^2: Chi-square test

dure until airway safety is ensured and the confirmation that the tracheostomy cannula is in the trachea.

Statistical Analysis

The following values were used in the descriptive statistics of the data: mean, standard deviation, median minimum, median maximum, frequency, and ratio. The Kolmogorov-Smirnov test was used to measure the distribution of the variables. All variable data did not follow the normal distribution. In order to analyze quantitative independent data, the Mann-Whitney U

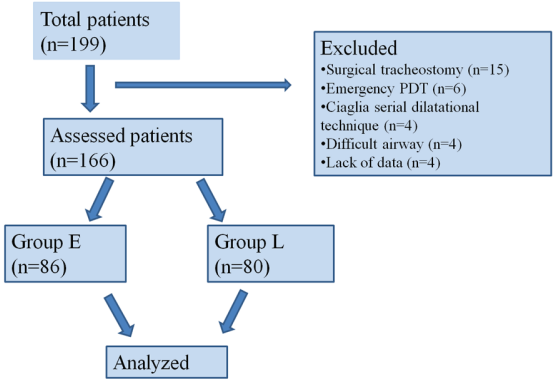

Figure 1. Flow diagram, Group E: Endotracheal tube group, Group L: Laryngeal mask airway group

test was applied and to analyze qualitative independent data, Chi-square test was performed. Statistical Package for the Social Sciences package program, version 27.0 (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis..

RESULTS

A total of 199 patient data were obtained, but 33 patients were excluded from the study according to the exclusion criteria (**Figure 1**). Of the 166 patients that were evaluated, it was determined that ETT was used in 86 patients and LMA was used in 80 patients.

Of the patients included in the study, 90 were male and 76 were female. It was determined that PDT was most frequently used in patients with cerebrovascular disease (CVD) (44%), post-cardiac arrest syndrome (PCAS) (18.1%), respiratory failure (13.9%), cardiac problems (10.2%), malignancy (5.4%) and neuromuscular disease (4.2%).

The average hospital stay of the patients was 53 days, and each procedure took an average of 7 minutes. In all PDT procedures used, the airway was effectively guaranteed, 21 patients required two attempts, and 20 patients had mild bleeding detected. While 119 (71.9%) of the patients who underwent PDT died, only 47 (28.3%) of the patients who underwent PDT were discharged from the intensive care unit (**Table 1**).

Between the two groups, there was no difference in terms of gender. It was observed that patients in Group L had significantly higher rates of CVD, cardiac issues, and cancer (p 0.05). The procedure duration was 6.2±1.6 minutes in group L and 8.4±2.7 minutes in group E. A statistically significant difference was found between the groups (p< 0.005). Duration of hospitalization was 82.5±62.9 days in group L and 60.8±50.2 days in group E. A statistically significant difference was found between the groups (p= 0.022).

The number of attempts performed throughout the procedure, the occurrence of mild bleeding, the release from the intensive care unit, and the number of fatalities did not significantly differ across the groups. (p>0.05) (**Table 2**)

DISCUSSION AND CONCLUSION

Traditionally, ETT is utilized during the PDT procedure to secure the airway. The feeling of hitting the ETT during percutaneous intervention into the trachea with the needle prompts the removal of the tube, advancement of the needle, and continuation of the surgery. Another approach uses a laryngoscope to pull the tube just above the vocal cords while deflating the tube balloon. The ETT is used as a supraglottic airway device using this technique, though. The risk of extubation during the procedure can be reduced by utilizing a supraglottic device, such as LMA instead of ETT. It has been demonstrated that using LMA instead of ETT is equally safe and does not lengthen the operation. (10)

Evaluating the primary diagnosis of PDT patients reveals the most prevalent cerebrovascular illness. The most frequent diagnosis in the study by Silvester et al. was found to be CVD (31.5%), followed by respiratory tract disorders (28%) (11). Another study indicated that 56% of participants had CVD, while 22% had respiratory failure (12). In a study conducted in our country, the top three diagnoses for admission were CVD (51.7%), cardiac issues (27.5%), and respiratory diseases (13.8%). (13). According to the literature and our analysis, respiratory failure (13.9%), PCAS (18.1%), and CVD (44%), respectively, were the most prevalent diagnoses.

Dosemeci et al. in his study, bleeding complications were reported as 3.8% in the LMA group, while it was reported as 3.3% in the ETT group (14). In another study, it was reported that there was no significant difference between the groups (4.92%-3.28%) in terms of

bleeding complications (15). Strametz et al. in his review and Linstedt et al. similarly, no significant difference was found between the groups in terms of complications (6,7). In our study, no significant difference was found between the groups in terms of bleeding, which is one of the most common complications observed during and after the procedure (16.3% -7.5%).

Dosemeci et al. in their study, while the mean procedure time was 4.5 minutes in the LMA group, it was reported as 5.6 minutes in the ETT group (14). Kaya et al. reported the mean procedure time to be 4.5 minutes in the LMA group and 7.1 minutes in the ETT group (16). In a similar study, it was shown that the procedure time (2.5 min) in the LMA group was shorter than that in the ETT group (3.6 min) (15). In a review by Stramerz et al., it was reported that the procedure time was shorter in the LMA group, but it was not statistically significant (6).In our study, when the groups were compared in terms of processing times, it was found that the processing time was significantly shorter in Group L than in Group E(8.5 mins-6.0 mins), in line with the literature.

In the literature, there is no study comparing the length of hospital stay between LMA and ETT use in percutaneous tracheostomy applications. We think that the difference between the groups obtained in our study is related to the fact that in unstable patients, replacement of airway safety with LMA is avoided, whereas, in stable patients, replacement with LMA is more common.

Our study's primary limitations were its single-center design and retrospective planning. We believe that since the study was designed retrospectively in a university hospital, practitioners with varying degrees of experience (research assistants, lecturers) may have had an impact on the report's results.

Therefore, we believe that the use of LMA in PDT applications reduces the procedure time in the literature and in our study. We also believe that more reliable results can be obtained with prospective randomized controlled and multicenter studies to be conducted on this particular subject.

Conflict-of-interest and financial disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

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