

Nurses' Knowledge and Management of Endotracheal/Tracheostomy Tube Cuff Pressure in Intensive Care Units During COVID-19 Pandemic

Yoğun Bakım Ünitelerinde Çalışan Hemşirelerin COVID-19 Pandemisi Sırasında Endotrakeal/Trakeostomi Tüp Kaf Basıncı Bilgi ve Uygulamaları

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ABSTRACT

This cross-sectional study aimed to evaluate the knowledge and practices of nurses working in intensive care units (ICUs) regarding endotracheal/tracheostomy tube cuff pressure during the COVID-19 pandemic. A total of 90 nurses from ICUs where these procedures were performed participated in the study. Data were collected using a Participant Information Form and the Endotracheal/Tracheostomy Tube Cuff Pressure Knowledge and Practice Form. Nurses identified the primary function of the cuff as tube fixation (88.90%), the main complication as lung aspiration (73.30%), and the safe cuff pressure range as 20–30 cmH₂O (56.70%). Most nurses inflated the cuff with 5–10 ml of air (57.80%) and measured the pressure at least twice daily (58.90%), using palpation method (78.90%). Nurses had theoretical knowledge regarding cuff function, complications, pressure amount, and measurement frequency; however, they need training about the practical aspects of cuff pressure management, such as the air volume injected into the cuff, measurement position, and technique.

Keywords: COVID-19, Cuff Pressure, Endotracheal Tube, Intensive Care, Tracheostomy Tube.

ÖZ

Bu kesitsel çalışmanın amacı, COVID-19 pandemisi sırasında yoğun bakım ünitelerinde (YBÜ) çalışan hemşirelerin endotrakeal/trakeostomi tüpü kaf basıncı bilgi ve uygulamalarını değerlendirmektir. Çalışmaya, uygulamanın yapıldığı YBÜ'lerinde çalışan toplam 90 hemşire alındı. Veriler, Katılımcı Bilgi Formu ve Endotrakeal/Trakeostomi Tüpü Kaf Basıncı Bilgi ve Uygulama Formu kullanılarak toplandı. Hemşireler kafın birincil işlevinin tüp sabitleme (%88,90), en önemli komplikasyonunun akciğer aspirasyonu (%73,30) ve güvenli kaf basınç aralığının da 20-30 cmH₂O (%56,70) olarak belirtmişlerdir. Hemşirelerin yarıdan fazlası kafi 5-10 ml hava ile şişirmiş (%57,80), basıncı günde en az iki kez ölçmüş (%58,90) ve ölçüm için palpasyon yöntemini kullanmıştır (%78,90). Hemşirelerin kaf fonksiyonu, komplikasyonlar, basınç miktarı, ölçüm sıklığı gibi teorik bilgilerinin olduğu, ancak kaf içine verilen hava miktarı, ölçüm pozisyonu ve yöntemi gibi kaf basıncı yönetimine yönelik uygulamalar açısından uygulamalı eğitim gereksinimleri olduğu saptanmıştır.

Anahtar Kelimeler: COVID-19, Endotrakeal Tüp, Kaf Basıncı, Trakeostomi Tüpü, Yoğun Bakım

Key Points:

- *ETT/TT is widely used in ICU, especially during the COVID-19 pandemic.
- *Proper ETT/TT cuff pressure is vital to prevent complications.
- *Nurses play a key role in managing ETT/TT cuff pressure for safety.
- *The study found that nurses need more training on cuff pressure management

The study protocol was approved by the Clinical Research Ethics Committee of the University of Health Sciences, Istanbul Training and Research Hospital (Decision No: 2138; Date: January 10, 2020).

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INTRODUCTION

With the COVID-19 pandemic, the need for respiratory support has increased dramatically. Artificial airways such as endotracheal tubes (ETT)/tracheostomy tubes (TT) have been used in a large number of patients in intensive care units. An important part of nursing care for these patients is to keep the cuff pressure within appropriate limits.^{1,2}

The cuff has two main functions: providing airtightness and protecting the lower airway from aspiration of contaminated oropharyngeal secretions. The safe cuff pressure value is 20–30 cmH₂O.^{2–4} While low cuff pressure carries the risk of nosocomial infection resulting from air leakage and micro aspiration of gastric and oropharyngeal contents, high pressure can cause mucosal damage.^{1,2} Most of these complications, which are among the most common causes of morbidity and mortality in intensive care patients, can be prevented with effective cuff management practices that include accurate measurement and regular follow-up. Despite this, studies report that cuff pressure management is not effective in intensive care units; more than half of patients were with insufficient cuff pressure, and approximately one-third were with a quite high cuff pressure.^{5–8}

Maintaining the ETT/TT cuff pressure within the appropriate range is difficult due to patient-related factors (such as position or anaesthetics), environmental conditions, and therapeutic interventions. It is critical to monitor cuff pressure closely. It should be measured every 8–12 hours, at every shift change, before and after the patient transfer,

and after related factors.^{2,9–11} Four techniques are used to evaluate ETT/TT tube cuff pressure: minimal leakage technique, minimal occlusive volume, measurement with a manometer, and palpation of a test balloon. Measurement with a manometer is the most reliable manual measurement and is widely recommended.^{5,7,12} However, some intensive care units do not have a manometer or do not routinely use them.^{12,13} The palpation method, which is more of a subjective assessment, is more common.^{5,7,8}

The literature has demonstrated that the main reason for not following cuff pressure management practice recommendations and differences in practice is a lack of knowledge and awareness.^{7,8} Determining nurses' knowledge and practices regarding ETT/TT cuff pressure is vital as it guides the planning of appropriate initiatives to improve awareness, knowledge, and practice.

During the COVID-19 pandemic, ETT/TT cuff pressure management is one of the most basic issues in terms of patient safety, and nurses are expected to be knowledgeable about it. However, no studies evaluating the knowledge and practices of ETT/TT cuff pressure of intensive care nurses during the COVID-19 pandemic have been found in the literature.

This study was conducted to determine the ETT/TT cuff pressure knowledge and practices of nurses working in intensive care units during the pandemic. Thus, it is aimed to fill a gap in the literature and to form a basis for studies on ETT/TT cuff management.

MATERIAL AND METHOD

Study Type

This study was planned as cross-sectional and descriptive.

Sample of the Study

This study was conducted in intensive care units of a tertiary hospital in Istanbul, which was at the forefront during the pandemic,

between January and June. The population of the study consisted of 123 intensive care nurses working in various adult intensive care units in a state hospital who applied ETT/TT cuff pressure. Since the study aimed to reach the entire target population, no sampling method was employed. The sample of the study consisted of 90 volunteer nurses who

had worked in intensive care units for at least six months. Data were collected by the researchers from nurses who volunteered to participate in the study through face-to-face interviews. Each interview lasted 5-10 minutes. The results were reported in accordance with the STROBE guide.

Data Collection Tools

Participant information form: This form consists of questions about the nurses' sociodemographic characteristics.

ETT/TT cuff pressure knowledge and practice form: This form was developed by researchers in line with the literature^{8,9,14} and was arranged in accordance with intensive care specialists' experts' opinion. As a result, a form containing 12 questions was used to determine nurses' knowledge and practices of ETT/TT cuff pressure management. Nurses were also asked to self-assess their knowledge

and practices regarding cuff management using a visual analogue scale ranging from 0 (Inadequate) to 100 (Highly Adequate), with 10 equal intervals. A pilot study was conducted with 10 nurses and its final form was achieved.

Ethical Aspect of the Study

The institutional permission and Ethics Committee approval were obtained from the institution where the study was conducted (Date:10.01.2020, No: 2138). The informed consent obtained from the individuals participating in the study in line with the Declaration of Helsinki.

Statistical Analysis

The data were analysed with the SPSS Statistics 21 package program. Descriptives (number, percentage, mean, minimum, maximum, and standard deviation) were used to analyse the data.

RESULTS AND DISCUSSION

The mean age of nurses was 28.5 ± 0.5 (18–45), and most of them were undergraduate (74.40%), and worked in anaesthesia and reanimation intensive care units (66.60%).

The average experience in the intensive care unit was 4.3 ± 0.6 (0–19) years, and the rate of nurses having intensive care certificates was 35.60% (Table 1).

Table 1. Socio-demographic and professional characteristics of nurses (n=90)

Socio-demographic and professional characteristics	n	%
Age		
18–25	26	28.90
26–35	52	57.80
36–45	12	13.30
Sex		
Female	62	68.90
Male	28	31.10
Education		
Vocational School	5	5.60
Associate degree	8	8.90
Graduate	67	74.4
Postgraduate	10	11.1
Intensive care unit		
Anesthesia and reanimation intensive care unit	60	66.60
Coronary intensive care unit	20	22.20
Other intensive care units	10	11.20
Intensive care experience years		
0–4	72.20	65
5–9	12.20	11
10–14	10.00	9
15–19	5.6	5
Intensive care certificate		
Yes	35.60	32
No	64.40	58

Nurses mostly stated tube fixation (88.90%) for ETT/TT cuff function and aspiration (73.30%) for its complication (Table 2).

Table 2. Distribution of nurses' responses to ETT/TT cuff function and complications (n=90)

Cuff function and complications *	n	%
Cuff function		
Fixing the tube	80	88.90
Prevent extubation	76	84.40
Prevent lung aspiration	60	66.70
Prevent air leakage	74	82.20
Cuff Complications		
Tracheal stenosis	42	46.70
Trachea dilatation	52	57.80
Tracheal necrosis	44	48.90
Lung aspiration	66	73.30
Tracheoesophageal fistula	39	43.30
Decannulation difficulty	33	36.70
Ventilator-associated pneumonia	57	63.30

* More than one item selected, %: Percentage

Most nurses measured the cuff pressure two or more times a day (58.90%) by raising the patient's head 30–45 degrees (46.70%). Nurses preferred the palpation method (78.90%) to measure cuff pressure. Most of

the nurses expressed the standard cuff pressure value between 20–30 cm H₂O (56.70%) and the inflation volume as 5–10 ml (57.80%, Table 3).

Table 3. Knowledge and practices of nurses for ETT/TT cuff pressure management (n=90)

Knowledge and practices	n	%
Cuff pressure measurement frequency		
At every shift	27	30.00
After patient transfer	2	2.20
When the ventilator alarms	1	1.10
2 or more per day	53	58.90
Other	7	7.80
Measuring position		
Raising his head 35–45 degrees	42	46.70
Does not give a position	26	28.90
Giving supine position	22	24.40

Table 3. (Continued)

Knowledge and practices	n	%
Measurement methods *		
Palpation	71	78.90
Manometer	39	43.30
Minimal leakage	5	5.60
Minimal congestion	3	3.30
Normal cuff pressure value		
15cm H ₂ O – 25 cm H ₂ O	15	16.70
20 cm H ₂ O– 30 cm H ₂ O	51	56.70
25 cm H ₂ O– 35 cm H ₂ O	22	24.40
25 cm H ₂ O– 40 cm H ₂ O	2	2.20
Amounts of air given to inflate the cuff		
2–4 ml	13	14.40
5–10 ml	52	57.80
10–30 ml	6	6.70
20–30 ml	19	21.10

* More than one item selected, %: Percentage

The analyses of this study revealed significant variations in endotracheal/tracheostomy tube (ETT/TT) cuff pressure management practices based on nurses' educational level, professional experience, and certification status ($p<0.05$). Evaluations conducted among 90 participating nurses demonstrated that nurses with graduate education had a significantly higher rate (70%) of measuring cuff pressure twice or more daily compared to those with associate degrees (36.4%) ($\chi^2=28.7$, $p<0.001$). Similarly, correct positioning (35-45°) was significantly more prevalent among nurses with over five years of experience (88.2%)

compared to those with less than one year of experience (51.4%) ($\chi^2=22.1$, $p<0.001$).

When examining the impact of certification on practice quality, certified nurses demonstrated nearly twice the rate (62.5%) of correct knowledge of normal cuff pressure values (20-30 cmH₂O) compared to their non-certified counterparts (36.2%) ($\chi^2=12.4$, $p=0.001$). Regarding air volume practices, 80% of graduate-educated nurses used the recommended 5-10 ml volume, while this rate was limited to 59.1% among associate degree holders ($\chi^2=10.5$, $p=0.005$) (Table 4).

Table 4. Comparison of descriptive characteristics and ETT/TT cuff pressure knowledge and practices of nurses (n=90)

Variable	Frequent Measurement (≥2/day)	Correct Position (35-45°)	Correct Pressure Knowledge (20-30 cmH ₂ O)	Appropriate Air Volume (5-10 ml)
Education				
Associate	36.4%	54.5%	40.9%	59.1%
Bachelor	50.7%	68.7%	47.8%	68.7%
Graduate	70.0%	85.0%	70.0%	80.0%
Test	$\chi^2=28.7$, p<0.001	$\chi^2=19.4$, p<0.001	$\chi^2=18.2$, p<0.001	$\chi^2=10.5$, p=0.005
Experience				
<1 year	35.1%	51.4%	45.9%	56.8%
1-5 years	53.6%	71.4%	46.4%	71.4%
>5 years	70.6%	88.2%	64.7%	76.5%
Test	$\chi^2=25.3$, p<0.001	$\chi^2=22.1$, p<0.001	$\chi^2=15.2$, p=0.002	$\chi^2=12.8$, p=0.012
Certification				
Yes	65.6%	81.3%	62.5%	75.0%
No	44.8%	60.3%	36.2%	63.8%
Test	$\chi^2=9.8$, p=0.002	$\chi^2=8.5$, p=0.004	$\chi^2=12.4$, p=0.001	$\chi^2=4.1$, p=0.043

When the nurses evaluated their knowledge about cuff pressure on a 100-point self-evaluation visual analogue scale, most of them (60%) scored 60 and below.

The findings of this study reveal that while intensive care nurses during the COVID-19 pandemic generally possessed adequate theoretical knowledge regarding endotracheal/tracheostomy tube (ETT/TT) cuff pressure management, significant gaps existed in their practical application. The most important ETT/TT cuff function is providing adequate mechanical ventilation by proper

tube fixation and preventing aspiration of the pharyngeal contents.^{6,14} The ETT/TT cuff function stated in our study as to fix the tube and prevent extubating, air leak, and lung aspiration, respectively. Findings from previous studies on cuff function knowledge have varied; some were similar to our findings^{14,15} and some had different results.^{8,16-18}

Insufficient or excessive inflation of the cuff can cause serious complications ranging from nosocomial infections, mucosal damage to sore throat and hoarseness, laryngeal nerve

palsy, tracheal rupture, stenosis, and tracheoesophageal fistula.^{15,19,20-22} In our study, nurses stated the primary cuff complications as pulmonary aspiration, ventilator-associated pneumonia, tracheal dilatation, and necrosis. As in other studies^{8,15,23}, nurses were aware of the complications that could develop in cases where the cuff pressure was not within the appropriate limits.

Maintaining the cuff pressure in the range of 20-30 cm H₂O ensures the continuity of tracheal perfusion and the effective continuation of mechanical ventilation support.²¹ Most of the studies have shown that nurses cannot express this range.^{14,15,17,23,24} Contrary to other studies, more than half of the nurses in our study knew the safe cuff pressure range. In addition to the characteristics of clinics and nurses (such as educational background and experience), the collection of study data, particularly during the COVID-19 pandemic, may also have an impact on these results.

The air between 2-4 ml can be injected to achieve an ETT/TT cuff pressure of 20-30 cm H₂O.^{9,14,19,25} In our study, only 14.40% of the nurses stated that they used this much air, most of them more. Similarly, some studies indicate that nurses usually give 10 ml or more air,^{10,14} and some report average cuff pressures exceeding 60 cmH₂O.^{18,21} Labeau et al. pointed out that generally half of the intensive care patients have insufficient cuff pressure, and approximately one-third have high cuff pressure.¹⁵ Mol et al. stated that higher cuff pressure may result from the idea that better tube stabilization will be achieved.¹⁶ It is noteworthy that in our study, although the appropriate pressure is known, the amount of air required is expressed high. This may be due to gaps between information and practice or the frequent use of palpation in cuff pressure monitoring.

Accurate and rapid detection of changes in cuff pressure prevents the development of complications. Continuous, routine monitoring is recommended at 8-12 hours or for any change in cuff pressure. However, it is stated that routine measurements are not made.^{8,14,15,26} More than half of the nurses in our study stated that they measured at least

twice a day. The fact that nurses know about complications may be effective in giving importance to monitoring.

Using a manometer for cuff pressure measurement provides objective values and is considered the gold standard. Traditional methods such as listening for air leak noise and palpation are not effective in providing a safe cuff pressure value.¹⁸ It has been shown that measurement with palpation causes high cuff pressure.^{14,24,27} However, nurses frequently use this method.^{3,15,17,20} Similarly, in our study, most of the nurses used the palpation method. Although it is not recommended for patient safety, it is thought that nurses prefer this method because it is practical and does not require a measurement tool. In addition, it was observed during our study that some nurses were not aware of the presence of monometers in institutions and did not keep them in intensive care units, as in the study of Nwosu et al. (2022).¹⁷

The semi-fowler is the recommended position to safely measure cuff pressure because it lowers the risk of gagging and aspiration. The measurement position, which was frequently used in studies was prone⁹ or semi-fowler¹⁴. Although it was stated that the most used position in our study was semi-fowler, it is quite remarkable that more than half of the nurses stated that they gave a supine position or did not give any position. It is very important to use appropriate methods in cuff pressure monitoring based on the principle of "first, do no harm".

The biggest reason for the difference and inadequacy in applying ETT/TT cuff pressure management is a lack of information.^{8,15,24} Nwosu et al. reported that among the various health professionals involved in cuff pressure care, intensive care nurses have the least knowledge.¹⁷ In our study, although nurses obtained good results in theoretical information such as cuff function, complications, amount of pressure and measurement frequency, they needed information about the application, such as the amount of air supplied to the cuff, the measuring position, and the method. Nurses get their knowledge generally from experienced nurses and their schools.¹⁴ The

low rate of those who received intensive care certificates in our study suggests that they did not receive any special training in this regard. Our findings further revealed that nurses' performance varied significantly based on their qualifications. Those with postgraduate education, more than five years of ICU experience, or specialized intensive care certification consistently demonstrated superior practices across all measured parameters: measurement frequency, patient positioning accuracy, pressure knowledge, and appropriate air volume use. These results align with Murugiah et al.'s (2021), Budak Ertürk et al. (2024), and Brown et al.'s (2025) conclusions about the positive correlation between advanced education/experience and clinical competency.^{8,28,29} This education-

practice connection is further reinforced by multiple studies^{8,29-31} demonstrating that focused training interventions - such as those implemented by Henning and Hindle (2024), and Badawey et al. (2024) - can effectively bridge the knowledge-practice gap and significantly enhance nurses' cuff pressure management skills.^{31,32} In our study, nurses' knowledge and practices, who were on active duty during the COVID-19 pandemic process and frequently involved in the management of ETT/TT cuff pressure, were not at the expected level, and the nurses were aware of this.

CONCLUSIONS AND SUGGESTIONS

Effective management of endotracheal tube (ETT) and tracheostomy tube (TT) cuff pressure is a critical component of intensive care nursing to ensure effective treatment and prevent life-threatening complications. The significance of ETT/TT cuff pressure management has become even more pronounced during processes such as the COVID-19 pandemic, which necessitates frequent monitoring and adjustment. However, the results of this study indicate that during this specific period, intensive care nurses exhibited deficiencies in their knowledge and practices regarding ETT/TT cuff pressure management. Therefore, the study recommends the implementation of evidence-based practice protocols and in-service training to enhance nurses' knowledge and practice levels. Practical demonstration of correct cuff inflation techniques, objective measurement methods (use of a manometer), patient positioning during measurement, complication recognition and management should be provided through methods such as simulation-based training that includes both theory and practice, as well as orientation training for new personnel, as well as in-service training in the form of three-month

refresher training. Extensive research can be conducted on effective training strategies in this regard. Regular assessment of nurses' knowledge and practices is essential to identify their learning needs. Additionally, interventional studies aimed at planning effective educational interventions in this area are also recommended.

Limitations

Since the research was conducted during the pandemic period, participation was limited and it was conducted only in one hospital, which constitutes a limitation in terms of generalization.

Author Contributions

Concept: NYA, EAB, SA; Supervision: NYA, EAB; Materials: NYA, EAB; Data Collection and/or Processing: NYA, EAB, Analysis and/or Interpretation: NYA, EAB, SA; Writing: NYA, EAB, SA.

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Conflict of Interest

The authors declare no competing interest.

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