Endotracheal tube cuff pressure in comparison with the standard pressure in intensive care unit intubated patients

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Abstract

Background and aim: The balance of endotracheal tube (ETT) cuff pressure is necessary to prevent complications and to perform a proper therapeutic treatment on the patient. The aim of this study was to determine ETT cuff pressure in comparison with the standard level in intensive care unit (ICU) intubated patients.

Methods: In this descriptive-analytical study conducted in Kashani Hospital in Shahrekord, southwestern Iran in 2014-2015, the 200 ICU patients intubated for any reason participated. All measurements of ETT cuff pressure were conducted by researchers using a manometer, and were expressed as mmHg. In this study, a checklist was used to record the data and then the data were analyzed by the SPSS version 16 using descriptive statistics, ANOVA, t-test, and chi-square test.

Results: Mean cuff pressure was 30.97 ± 16.53 mmHg. The cutoff point of cuff pressure with 95% confidence interval was obtained 28.66-33.28 mmHg. Since this range overlaps the standard range (30-25 mmHg) for cuff pressure, it can be said, with 95% confidence, that the cuff pressure in the target population is in concordance with the standard range. Gender, height, the mean number of intubation days, level of consciousness and decrease of oxygen saturation, lung pharyngeal reflex, and work experience of the cuff filler were not significantly associated with cuff pressure ($P > 0.05$), but there was a significant association between weight and cuff pressure ($P = 0.01$).

Conclusion: Although in this study, the cuff pressure in a number of patients was outside the standard range, the cuff pressure was generally in concordance with the standard range.

Key words: Endotracheal tube; Cuff pressure; Intubation

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Introduction

Airway management is the first step in treating all patients who are in critical, life-threatening conditions and who have a depressed level of consciousness or a respiratory problem.

To achieve this purpose, various measures are taken, including the insertion of an endotracheal tube (ETT) in the patient's trachea, by a skilled person, thereby providing a safe airway tract for the patient, apart from the gastrointestinal tract, and serving as a respiratory and ventilatory support and exerting positive airway pressure (1, 2).

Despite the great benefits of this therapeutic measure for patients who need it, as with other therapeutic measures, if the complications are not addressed, there may be dangerous and sometimes irreversible complications, one of the most important of which is mucosal injury due to excessive dilation of the ETT, causing certain complications such as erosion, inflammation, softening of the articular cartilage, tracheal dilation, bleeding and infection, and tracheal stenosis. On the other hand, insufficient dilation of ETT cuff leads to pulmonary aspiration and upper airway secretions (3-5).

In order to deal with these complications, the use of the ETTs with low-pressure and high-volume cuffs and adjustment of the pressure inside the cuff to 20-30 cm of H2O is an appropriate and efficient support to prevent aspiration (6, 7).

Due to the known complications of inappropriate ETT cuff pressure, maintenance of cuff pressure during hospital stay at appropriate intervals is important for intensive care unit (ICU) patients.

Therefore, considering the importance of appropriate ETT cuff pressure, to prevent the occurrence of the injuries due to very high or very low cuff pressure, we decided to study the effect of ETT cuff pressure in comparison with the standard range in ICU intubated patients.

Materials and methods

In this descriptive-analytical study conducted in Kashani Hospital in Shahrekord, southwestern Iran in 2014-2015, the participants were the 200 ICU patients intubated for any reason, aged over 8 years, and admitted to the hospital during the study.

History of trachea disease, according to their medical records, the age of under 8 years, and lack of volunteering to participate in the study were considered the exclusion criteria. The participants were selected using convenience random sampling and the sample size was determined to be 200 using a sample size calculation formula.

In this study, a manometer, specifically designed for measuring cuff pressure, was connected to the outer cuff of the ETT and fixed. Pressure was expressed as mmHg, and in all shifts, cuff pressure was recorded. In this study, the measurements of ETT cuff pressure measurements were conducted randomly and subtly by a medical student using a manometer for the 200 patients. The results were expressed as mmHg and then compared with the standard range [25-30 mmHg] (8).

In this study, a checklist was used including information such as age and sex of the patient, height and weight of the patient, systolic and diastolic blood pressure, cause of intubation, the mean number of intubation days, pulse rate, level of consciousness, lung pharyngeal reflex, the work experience of the cuff filler in the ICU, and the level of cuff pressure (9, 10). In this study, the cuff pressure above 30 mmHg was considered to indicate over-inflation and the pressure between 30 and 25 mmHg was considered normal pressure (8).

Data were analyzed by the SPSS version 16 using descriptive statistics, ANOVA, t-test, and chi-square test.

Results

Mean cuff pressure was 30.97 ± 16.53 (range: 9-91) mmHg. 44% of the patients had lower-than-standard range cuff pressure, 16% had standard cuff pressure, and 40% had higher-than-standard range cuff pressure.

The cutoff point of cuff pressure with 95% confidence interval was obtained at 28.66-33.28 mmHg. Since this range overlaps the standard range (30-25 mmHg) for cuff pressure, it can be said, with 95% confidence, that the cuff pressure in the target population is in concordance with the standard range.

Age, height, and the mean number of intubation days, were not significantly associated with cuff pressure ($P > 0.05$), but there was a significant association between weight and cuff pressure ($P = 0.01$) (Table 1).

Table 1: Correlation Coefficients and P Values for Relationship between Cuff Pressure and Variables

Variable	Age	Weight	Height	The average of the days of intubation
The correlation coefficient	0.08	0.18	0.11	-0.01
p-value	0.09	0.01	0.09	0.15

The results showed that gender, level of consciousness and decrease of oxygen saturation, lung pharyngeal reflex, and work experience of the cuff filler were not significantly associated with cuff pressure (P > 0.05) (Table 2).

Table 2: Distribution of mean cuff pressure in terms of gender, decrease of oxygen saturation and level of consciousness, work experience of the cuff filler, and lung pharyngeal reflex

Variable		Cuff pressure (MmHg)	p-value
		Mean±SD	
Sex	Male	29.32±17.22	0.12
	Female	28.56±15	
Reduced oxygen levels and consciousness	Reduced oxygen levels in patients	30.96±93.15	0.99
	Reduced consciousness levels in patients	30.98±17.41	
Work experience	1-5 years	27.08±14.23	0.43
	5-10 years	32±17.92	
	>10 years	31±14.89	
Laryngopharyngeal reflux	Intact	32.55±17.99	0.35
	Non-Intact	30.21±15.79	

Discussion

The general objective of this study was to determine ETT cuff pressure in comparison with the standard level in the ICU intubated patients in Ayatollah Kashani Hospital in Shahrekord.

The analysis of the results showed that 95% of the recorded results of cuff pressure in these patients were within the standard range. Therefore, it is necessary to measure and record other vital variables in patients admitted to ICU to measure ETT cuff pressure at appropriate intervals.

A study by Sole et al. to investigate the factors influencing cuff pressure, showed that cuff pressure was within the recommended range in 60% of the patients, but the rest of the patients had a cuff pressure higher or lower than normal range. That study emphasized frequent cuff pressure monitoring to reduce false positives (11).

The study of Vyas et al., showed that in 32 ICU patients, the measured ETT cuff pressure was higher than the recommended range in 62% of these patients (12).

In the study of Sharifi et al., in Hamedan Hospital, 65% of the ETT cuff pressure measurements for the patients were higher than the recommended range (13). It is obvious that several factors affect the ETT cuff pressure. For example, with an increase in the duration of the intubation, the ETT cuff pressure is gradually reduced.

The result of our study showed that there was not any significant association between cuff pressure and height (P = 0.09), age (P = 0.9), duration of intubation (P = 0.15), and gender (P = .12), but the cuff pressure was significantly associated with the weight of the patients (P = 0.01) so that cuff pressure was observed to increase with increasing weight of the patient. Ezri et al. also emphasized, in their study, that according to their results, the incidence of intubation increased in male patients with overweight (BMB/BMG > 35 kg/m2) (14).

In the study of Sengupta et al., the relationship between the ETT cuff pressure and demographics was investigated in 93 patients.

The results of that study showed that there was no significant relationship between age and height of the patient and even the place of admission (private or public hospital) and the size of the ETT, and the ETT cuff pressure.

In addition, in that study, 27% of the cuff pressure measurements were within the standard range, and 27% of the measurements exceeded the standard range (15).
In our study, the work experience of the cuff filler and cuff pressure were not significantly associated (P = 0.43).
In a similar study by Hoffman et al., they determined the correct level of cuff pressure adjusted by the experienced physicians in emergency departments, and concluded that the physicians were not able to estimate the ETT cuff pressure and recommended that more precise instruments be used to evaluate this pressure (16).

In our study, it was found that there was no significant relationship between cuff pressure and the level of consciousness, heart rate, systolic pressure, and diastolic pressure in the patients (P < 0.05). In addition, changes in the ETT cuff pressure were investigated by the patient's activity and position on the bed.

The results showed that in patients with more in-depth anesthesia and lower GCS score, the cuff pressure was lower than the patients with less in-depth anesthesia and higher GCS score.

As these patients are more active, this study recommends more frequent monitoring of the cuff pressure in patients with a higher level of consciousness, because the changes in cuff pressure are more pronounced in these patients. The height of the head from the bed and the neck position also affects the cuff pressure (11).

Conclusion

Although in this study, the cuff pressure in a number of patients was outside the standard range, the cuff pressure was generally in concordance with the standard range.

Therefore, precise monitoring of the ETT cuff pressure at proper intervals is necessary, which, necessitates, an efficient and defined management in the ICU. It is suggested that future studies assess the incidence rate of pulmonary complications and pulmonary function.

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