Effect of Body Position Changes on Endotracheal Tube Cuff Pressure Measurements for Mechanically Ventilated Patients

Nadia Mostafa Eleter[1], Soheir.M.Weheida[2], Rokia Ibrahim EL Nagar[3].
Lecturer of Critical Care and Emergency Nursing, Faculty of Nursing, Tanta University, Egypt [1].
Prof of Medical Surgical Nursing, Faculty of Nursing, Alexandria University, Egypt [2].
Lecturer of Critical Care and Emergency Nursing, Faculty of Nursing, Tanta University, Egypt [3].

Abstract

Background: Tracheal intubation is an important measure to rescue and treat critically ill patients. Tracheal cuff pressure management is an important part of artificial airway management, and is closely related to the prevention of aspiration, ventilator-associated pneumonia (VAP), and other complications. **Aim:** determine the effect of body position changes on endotracheal tube cuff pressure measurements for mechanically ventilated patients. **Study design:** A quasi-experimental design. **Setting**: This study was conducted at Surgical Intensive Care Unit of Emergency Tanta University Hospital and Surgical Intensive Care Unit of Tanta International Teaching Hospital. **Subjects**: A purposive sample of 100 adult mechanically ventilated patients who were meeting all inclusion criteria was selected. **Tools**: **Tool (I)**: mechanically ventilated patients' assessment. **Tool II:** endotracheal tube cuff pressure assessment**. Tool (III):** physiological parameters assessment. **Results**: revealed that significant differences were found between endotracheal tube cuff pressure mean scores measured in left lateral position and right lateral position post 10 minutes, 20 minutes, 45 minutes, and 90 minutes from each position change. **Conclusion**: The cuff pressure measurements were significantly changed with changing the patients' body positions at different timing. **Recommendations**: cuff pressure has to be checked post patients' body position changes and adjusted to the prescribed limits to prevent complications and replication of the study on large probability sampling.

Key words: Endotracheal tube cuff pressure, body position changes, mechanically ventilated patients.

Introduction

Endotracheal intubation is a standard and safe method to maintain an open airway and provide effective mechanical ventilation. Endotracheal tube cuff pressure must be maintained within 20–30 cmH_2O to prevent aspiration, maintain the airway and tracheal perfusion. Pressure variation outside this range causes some complications for patients (**Nasrolahzadeh, et al., 2023**).

Endotracheal tube cuff pressures of more than 30 cmH_2O are clinically important because they compromise the mucosal capillary perfusion and may lead to tracheal injury. In turn, these acute injuries may evolve into tracheal stenosis or formation of a fistula, sore throat and dysphonia, abrasion of the carotid artery, and the trachea softening; in addition, the injury rate increases over time. In addition, intubation-related tracheal injury contributes to health care costs via increased costs of care and length of hospitalization during the index admission and future costs for treatment and repair (**Mamuda et al., 2023**).

Insufficient endotracheal tube cuff pressure results in the micro-aspiration of the contents of the mouth, larynx, and stomach, especially during inhalation, which is a significant contributor to ventilator associated pneumonia. The risk of this complication increases by up to four times due to the pressure of less than 20 cmH_2O. Moreover, the inadequate cuff pressure leads to insufficient delivery of the determined vital capacity to the patient (**Urabe et al., 2024**).

Maintaining the endotracheal tube cuff pressure in the safe range is seen as a care challenge. Numerous and various factors are effective in changing endotracheal tube cuff pressure. These factors include changes in the patient's body position, anesthetic agents, changes in the tracheal muscle tone, decreasing and increasing of body temperature, the release of anesthetic gases into cuff, changing the head position and the position of the endotracheal tube in the mouth, and mode of mechanical ventilation (**Mohamed et al., 2024**).

Changing the patients' position is considered as the main care measures in the intensive care unit (ICU), which is done routinely at regular intervals usually every two hours. A close relationship has been found between patient's repositioning and endotracheal tube cuff pressure. Thus, the need to maintain the cuff pressure within safe range for the patient has been emphasized (**Park et al., 2023**).

Changing the patient's position from supine to lateral positions causes the displacement of the tracheal tube and changes of cuff pressure. Also, changing the positions of the head causes the displacement of the tracheal tube by influencing the position of the neck. It has been shown that changing the patient's position toward the ventilator or contrary to the ventilator direction is also effective in changing the endotracheal tube cuff pressure. In addition, the patient's rotation opposite the ventilator direction increases the endotracheal tube cuff pressure (**Laksono et al., 2023**).

Significance of the study

Despite the obvious risks associated with excessive pressure on the tracheal wall, in daily practice, clinicians in Tanta university hospitals rarely evaluate cuff pressure to be sure it is correct. Cuff pressures outside the target range are common and the frequency with which cuff pressure is measured and adjusted varies from never to at most every 8 hours. Additionally, cuff pressure is often evaluated by using finger palpation. Several investigators have reported the inability of clinicians to adequately estimate cuff pressure by using finger palpation, and this practice generally results in excessive pressures. Monitoring cuff pressure via a manometer results in fewer complications after intubation. So, this study aimed to determine endotracheal tube cuff pressure alterations after changes of body position in mechanically ventilated patients.

Aim of the study

The aim of study was to determine the effect of body position changes on endotracheal tube cuff pressure measurements for mechanically ventilated patients.

Research hypothesis:

Mechanically ventilated patients who are placed at right lateral and left lateral positions are expected to have more alterations of cuff pressure measurements than patients who are placed at semi-fowlers position.

I. Subjects and Methods

Study design:

A quasi-experimental design was utilized in this study.

Study Setting:

This study was conducted at:-

- Surgical Intensive Care Unit of Emergency Tanta University Hospital which is affiliated to Ministry of Higher Education and Scientific Research. It consisted of three units. The capacity of the three units was 15 beds.

- Surgical Intensive Care Unit of Tanta International Teaching Hospital which is affiliated to Ministry of Higher Education and Scientific Research. This unit contained 9 beds.

Subjects:

A purposive sample of 100 adult patients who fulfilled the inclusion criteria was selected from the previously mentioned setting. The sample size was estimated using Epi Info 7 Statistical Program, and the total patients admitted per year according to statiscal health records of Emergency Hospital of Tanta University in 2023 were 150 patients and the sample size calculated as the following:

- Total patients are 150 per year.
- Confidence level=99.9%.
- Expected frequency=50%.
- Accepted error=5%.
- Confidence coefficient=95%.

Inclusion criteria

- Adult Patients of both sex.
- Patients undergoing mechanical ventilation with orotracheal intubation in the first 24 hours.
- Patients with stable hemodynamic status.

Exclusion criteria

- Contraindications for changes in body position such as unstable spinal cord injury.
- History of neck stiffness, neck movement restrictions or neck surgery.
- Core temperature less than 35ºC or greater than 38°C
- Morbid obesity (body mass index >35)
- Patients with complicated intubation e.g tracheoesophageal fistula.
- Pregnancy and difficult intubation as evident from patients file.

Tools of data collection

Three tools were used in this study as the following:

Tool I: Mechanically Ventilated Patients' Assessment

This tool consisted of four parts as the following:

Part a: Patients' Demographic Characteristics: such as age and gender.

Part b: Patients' Health Relevant Data:

This part was developed by the researcher after extensive review of recent related literature (Mujoo et al., 2023) and it consisted of diagnosis, past medical history, use of sedation and muscle relaxant, body mass index, endotracheal tube size, and mouth corner of endotracheal tube fixation.

Part c: Glasgow Coma Scale

This scale was developed by Teasdale and Jennett., (1974) to assess neurological function and level of arousal. The scale is based on the numerical value assigned to an individual's eye opening, verbal and motor responses. Each response is scored separately and then totaled. Total scores ranged from 3 to 15, with score 3 indicating severe neurological deficits (deep coma) and score 15 representing no deficits (awake, alert, and oriented).

Part d: Ventilator Parameters

This part was developed by the researcher after extensive review of recent related literature (Nazari., et al 2020) and it consisted of mode of the ventilator and ventilator parameters such as fraction of inspired oxygen (Fio2), ventilator rate, tidal volume (TV), and positive end expiatory pressure (PEEP).

Scoring system

- For quantitative results: mean and standard deviation were calculated.

Tool II: Endotracheal Tube Cuff Pressure Assessment

This tool was developed by the researcher after extensive review of the recent related literature (Nazari, 2020 & Roy, et al, 2024) to assess the effect of body position changes on endotracheal tube cuff pressure measurements for mechanically ventilated patients. The cuff pressure measurements were recorded by the researchers using manometer at four time points, post 10 minutes, 20 minutes, 45 minutes, and 90 minutes from changing body position.

Scoring system

- Mean and standard deviation of the previous items were calculated.

Tool III: Physiological Parameters Assessment

This tool was developed by the researcher after extensive review of recent related literatures (Maleki,. et al 2022) and it included temperature, pulse, respiration, mean arterial pressure, and spo_2.

Scoring system

- Mean and standard deviation of the previous items were calculated.

Method

- **Administrative process:** Official permission to carry out the study was obtained from the director of Emergency Tanta University Hospital through official letters from the Faculty of Nursing explaining the purpose of the study and data were collected over a period of two months, started from the beginning of February to the end of April 2024.

Ethical consideration:

- Written informed consent was obtained from patients and/or their first class relatives after the explanation of the study purpose.
- Patients Privacy and data confidentiality were assured to participants.
- Anonymity and patient right to be withdrawn from the study at any stage were respected.
- Scientific research ethical committee approval of the Faculty of Nursing Tanta University was obtained with the code number 395-2-2024.

- **Tools development:** Tool I part a, b and d, tool II, and tool III of this study were developed by the researchers after reviewing the relevant literature (**Ethemoğlu., 2023**) and used to collect the data.

- All tools were tested for content validity by nine expertises in the field of emergency and critical care nursing, intensivists and medical biostatistics.

- **Reliability:** All tools of the study were tested for reliability using alpha Cronbach's test and found to be 0.896, 0.868, and 0.831respectively for the tool I, II, III which represent highly reliable tools.

- **A pilot study:** It was conducted before the actual study on 10% of the patients, to test the clarity, feasibility, and applicability of the different items of the tools. Data obtained from those patients were excluded from the current study.

- **Data collection**: The studied patients in the current study who fulfilled the inclusion and exclusion criteria had been interviewed and observed by the researchers. Baseline data (demographic, clinical data, & ventilator parameters) was collected from the studied patients within one hour of admission, endotracheal tube cuff pressure measurements were recorded post 10 minutes, 20 minutes, 45 minutes and 90 minutes from each position change. Hemodynamic parameters were measured 2 times post 20 minutes and 90 minutes from each position change.

The duration of data collection was extended from the period of the beginning of February 2024 until the end of May 2024.

- **Phases of data collection**

The present study was conducted on three phases as the following

I. Assessment phase:

- Patients' initial assessment within 1 hour of admission was performed for all studied patients using tool I to assess patients' demographic characteristics, clinical data, level of consciousness by Glasgow coma scale and to ventilator parameters and to determine patients who met the inclusion and exclusion criteria.

II. Implementation phase

- Patients receiving mechanical ventilation via endotracheal tube were placed in a baseline position (supine position) with the head of the bed elevated at 30° angle and head in a neutral position then endotracheal tube cuff pressure was adjusted to 25 cmH_2O using the calibrated manometer.

- Endotracheal tube cuff pressure of 25 cmH_2O was considered as the baseline, by which the changes in the endotracheal tube cuff pressure at other three positions were measured and compared.

- The patients were then placed in the left lateral position and the endotracheal tube cuff pressure was measured and recorded post 10 minutes, 20 minutes, 45 minutes and 90 minutes.

- The patients were moved to the right lateral position. Then, the endotracheal tube cuff pressure was measured and recorded post 10 minutes, 20 minutes, 45 minutes and 90 minutes form changing the position to right lateral position.

- The patients were moved to the semi-fowler position. Then, the endotracheal tube cuff pressure was measured and recorded post 10 minutes, 20 minutes, 45 minutes and 90 minutes form changing the position to semi-fowler position.

- During each of the previous positions, patients head was maintained in the neutral position.

- Endotracheal tube cuff pressure was measured during expiration by using calibrated manometer.

- Endotracheal tube cuff pressure should not be measured during coughing, suctioning, or voluntary movement.

III. Evaluation phase:

- Evaluation was done for all studied patients using Tool II at four time points; post 10 minutes, 20 minutes, 45 minutes, d an 90 minutes form each position change to assess the effect of body position changes on endotracheal tube cuff pressure for mechanically ventilated patients.

- Hemodynamic parameters were measured for all studied patients at two time points; post 20 minutes and 90 minutes from each position change by using tool III.

Results

This table shows that more than one third (40%) of the studied patients had age ranged from (40-<50) years old with the mean age of 41.80±9.38. **Regarding gender**, it was found that about two third (66%) of studied patients were males.

Regarding diagnosis, the result shows that nearly half (46%) of the studied group had intracerebral hemorrhage. In relation to **past medical history**, it was revealed that nearly one quarter (21%) had diabetes mellitus. **In relation to sedation use**, it was revealed that nearly one third the studied patients received sedation. **On the other hand**, it was found that 20.0% of the studied patients received muscle relaxant.

Concerning Body mass index, it was observed that nearly half (43%) of the studied patients were overweight. While, more than one third (37%) of the studied patients had healthy weight.

Concerning endotracheal tube size, it was found that nearly half (46%) of the studied patients had ETT size of 7.5 mm. **While** nearly two thirds (63.0%) of the studied patients had ETT fixed at the right side (corner) of the mouth.

Regarding the Glasgow Coma Scale (GCS) score, the results showed that nearly one third (32.0%) of the studied patients had GCS score of (9-12). While, 19.0% of them had GCS score of 3-8.

This figure shows that more than one third (38.0%)of the studied patients were mechanically ventilated using SIMV mode, while 27.0%, 20.0% and 15.0% of them were mechanically ventilated using CPAP mode, control mode, and assist control mode.

Regarding ventilator parameters, the current results showed that the mean FiO_2 was 49.00 ±12.753. While the mean tidal volume (TV) was 252.60 ± 232.103. Additional the mean ventilator rate was found to be 9.89 ± 9.158. Additionally the mean Positive end expiratory pressure (PEEP) was 6.45± 1.828.

This table reveals that highly statistical significant differences were found between mean scores of endotracheal tube cuff pressure measured in the left lateral position and right lateral position post 10 minutes, 20 minutes, 45 minutes, and 90 minutes where p value

=0.000 for each. While, no statistical significant differences were found between mean scores of endotracheal tube cuff pressure measured in semi-fowler position post 10 minutes, 20 minutes, 45 minutes, and 90 minutes where p value = 0.054.

This table shows that no statistical significant differences were found among the studied patients regarding temperature, pulse, respiration, systolic and diastolic blood pressure where p< 0.05 for each. While, highly statistically significant differences were found between the studied patients regarding SPO2 reading while p value =0.000.

Table (1): Percentage distribution of the studied patients undergoing mechanical ventilation regarding their demographic characteristics.

Characteristics	The studied patients (n=100)	
	N	%
Age (in years)		
▪ (21-<30)	14	14.0
▪ (30-<40)	29	29.0
▪ (40-<50)	40	40.0
▪ (50-<60)	17	17.0
Range **Mean ± SD**	**(22-60)** **41.80±9.38**	
Gender		
▪ Male	66	66.0
▪ Female	34	34.0

Table (2): Percentage distribution of the studied patients undergoing mechanical ventilation according to their Health relevant data.

Health relevant data	The studied patients (n=100)	
	N	%
Diagnosis		
▪ Acute respiratory failure	20	20
▪ Intracerebral hemorrhage	46	46.0
▪ Subdural hemorrhage	34	34.0
# Past medical history		
▪ None	20	20.0
▪ DM	21	21.0
▪ Hypertension	20	20.0
▪ Cardiac	9	9.0
▪ Renal diseases	14	14.0
▪ Liver disorder	11	11.0
▪ GIT diseases	8	8.0
▪ Respiratory diseases	13	13.0
▪ Neurological diseases	4	4.0
Sedation use		
▪ **No**	68	68.0
▪ **Yes**	32	32.0
Muscle relaxant use		
▪ No	80	80.0
▪ Yes	20	20.0

More than one answer was chosen

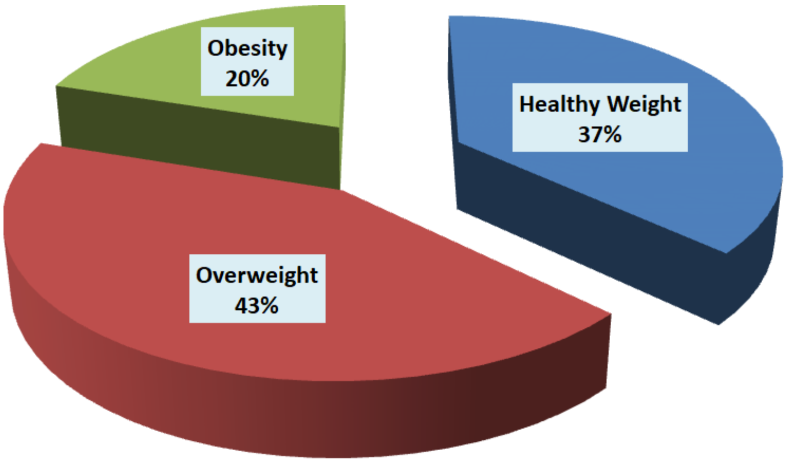

Figure (1): Percentage distribution of the studied patients undergoing mechanical ventilation regarding body mass index

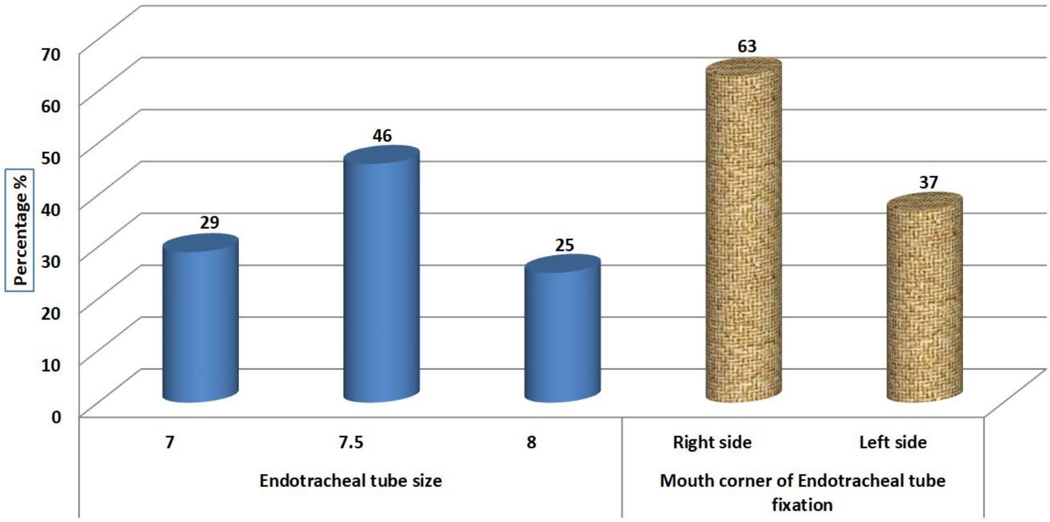

Figure (2): Percentage distribution of the studied patients undergoing mechanical ventilation regarding endotracheal tube (ETT) size and mouth corner fixation

Table (3): Mean scores of Glasgow coma scale (GCS) for the studied patients undergoing mechanical ventilation

	The studied patients (n=100)	
	N	**%**
Glasgow Coma Scale (GCS) score		
▪ (3-8)	19	19.0
▪ (9-12)	32	32.0
▪ (13-15)	17	17.0
▪ Not assessed	32	32.0

GCS cannot be assessed due to sedation use

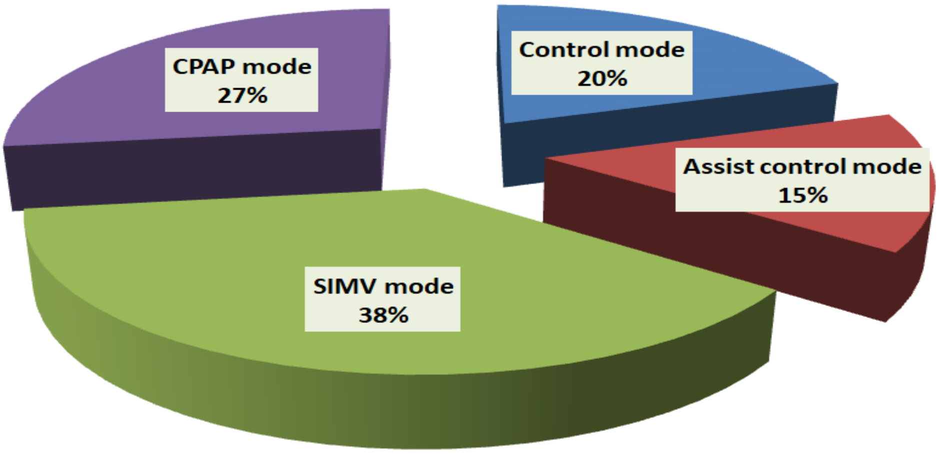

Figure (3): Percentage distribution of the studied patients undergoing mechanical ventilation regarding mode of the ventilator

Table (4): Mean scores of ventilator parameters of the studied patients undergoing mechanical ventilation

Ventilator parameters		The studied patients (n=100)			
		Min	Max	Mean	SD
1.	FiO_2	40	80	49.00	12.753
2.	TV	0	600	252.60	232.103
3.	Ventilator rate	0	22	9.89	9.158
4.	PEEP	5	10	6.45	1.828

Table (5): Mean scores of endotracheal tube cuff pressure of the studied patients undergoing mechanical ventilation regarding body position changes throughout periods of implementation.

Position		The studied patients (n=100) Range Mean ± SD				F P
		Post 10 mins	Post 20 mins	Post 45 mins	Post 90 mins	
1.	**Left lateral**	(38-60) 46.34±5.575	(32-52) 38.72±4.952	(28-45) 32.30±3.786	(25-35) 28.02±2.292	**339.08 0.000***
2.	**Right Lateral**	(35-59) 44.10±5.484	(30-50) 36.37±4.559	(26-42) 30.94±3.130	(25-33) 27.09±1.764	**341.24 0.000***
3.	**Semi-fowler**	(34-57) 42.30±5.502	(29-48) 35.24±4.209	(27-39) 30.17±2.225	(25-37) 26.96±1.752	2.49 0.054
Body position changes F P-value		**13.443 0.000***	**15.001 0.000***	**12.001 0.000***	**8.769 0.000***	

P-value represents significance induced from body position changes

* Significant at level P<0.05

Table (6): Mean scores of physiological parameters of the studied patients undergoing mechanical ventilation regarding body position changes throughout periods of implementation.

Physiological parameters		The studied patients (n=100 Body position changes Range Mean ± SD				F P
		Baseline Position	Left lateral Position	Right lateral Position	Semi-fowler position	
1.	**Temperature**	(36.5-38.5) 37.35±0.459	(36.5-38.2) 37.27±0.407	(36.6-38.0) 37.28±0.288	(36.5-37.8) 37.27±0.275	1.107 0.346
2.	**Pulse**	(59-109) 80.97±1.407	(66-103) 82.08±8.342	(63-97) 82.40±7.336	(66-95) 82.12±7.378	0.557 0.644
3.	**Respiration**	(0-28) 9.59±1.170	(0-27) 9.48±1.150	(0-25) 9.33±0.863	(0-25) 9.51±0.632	0.015 0.998
4.	**Systole**	(90-160) 126.52±16.233	(90-150) 125.48±11.773	(100-150) 126.80±9.143	(110-150) 127.59±8.477	0.545 0.651
5.	**Diastole**	(50-100) 75.06±11.703	(60-100) 76.05±10.108	(60-100) 78.03±8.871	(60-100) 77.83±7.749	2.170 0.091
6.	**SpO_2**	(89-99) 96.26±3.080	(90-99) 96.63±2.411	(92-99) 96.74±2.135	(98-99) 98.98±0.141	**30.720 0.000***

* Significant at level P<0.05

Discussion

Critically ill patients often require intubation with an endotracheal tube to provide an artificial airway for mechanical ventilation. Management of the artificial airway is an important part of care rendered by critical care nurses and respiratory therapists. One aspect of airway management is maintenance of an adequate endotracheal tube cuff pressure. The cuff is inflated to seal the airway to deliver mechanical ventilation. A cuff pressure between 20 and 30 cm H2O is recommended to provide an adequate seal and reduce the risk of complications (**Diaz et al., 2023**). Serious complications can occur when endotracheal tube cuff pressure exceeds 30 cm H2O such as tracheal stenosis, mucosal ischemia, paralysis of vocal cords and impaired tracheal perforation. On the other hand, endotracheal tube cuff pressure less than 20 cm H2O causes aspiration of bronchial secretions and leads to ventilator-associated pneumonia **(Maddumage et al., 2022).**

The current study revealed that mean age of the studied patients were 41.80±9.38. This finding was justified by this aged group is more exposed to trauma which associated with invasive ventilation. This finding was in line with **Yadav et al., (2022)** who found that the mean age of the studied sample was 42.2±18.1 years.

Regarding gender, it was found that nearly two thirds of studied patients were males and this finding may be due to more exposure of male to stress and accidents. This result was supported by **Fialkow et al., (2022)** who found that about two thirds of the studied patients were males. On the other hand, the findings of the present study were contradicted by the findings of **Saiphoklang and Auttajaroon (2022)** who emphasized that the majority of studied patients were male**.**

Concerning body mass index, it was found that nearly one half of the studied patients were overweight. This may be due to the increasing prevalence of overweight and obesity among the critically ill patient, mechanical ventilation of this type of patients has almost become a daily practice due to pathophysiological features of respiratory system in overweight and obese patients which make the risk of ventilator induced lung injury is highly elevated. This result was in the same line with **Halasz et al., (2021)** who revealed that the presence of overweight represented nearly two thirds among the studied sample. While, this finding was in contrast with **Girard et al., (2022),** who found that two thirds of the studied patients had normal BMI.

Regarding the current diagnosis, the results of the present study showed that about half of the studied group had cerebral hemorrhage. This may be due to trauma. The result was agreement by **Jalali1 et al., (2022)** who found that about half of participants included in the study had cerebral hemorrhage. However, it was disagreed **by Zamzam et al., (2019)** who mentioned that nearly half of the studied patients had respiratory failure.

In relation to **past medical history**, nearly one quarter of the studied patients had diabetes mellitus and hypertension. This finding was supported by **Alemayehu, (2022)** who revealed that nearly one quarter of the studied sample had diabetes mellitus and hypertension.

Concerning the endotracheal tube size, it was found that more than one third of the studied patients had ETT size of 7.5 mm. This finding was justified by intensivists providers should select the largest tube that is appropriate for the patient; this is critically important to the spontaneously of breathing especially for patients whose breathing have to work harder to overcome the increased resistance. Additionally the mean depth of ETT at trachea (in cm) was 21.87. Regarding the mouth corner of ETT fixation, it was found that nearly two thirds of the patients had ETT fixed at the right corner of the mouth. This finding was in agreement with **Varshney et al., (2019)** who concluded that the average depth of fixation of oral ETT was 21.26 cm while two thirds of the patients had ETT fixed at the right corner of the mouth.

Regarding the Glasgow Coma Scale (GCS) score, the current results showed that more than one third of the studied patients had conscious level of (9-12). This result was in consistent with **Moghaddam et al., (2023)** who mentioned that all patients with GCS ≤10 underwent endotracheal intubation. In relation to **Agitation**, it was revealed that nearly two third of the studied patients didn't receive sedation. This result was in agreement with **Wang et al., (2022)** who found that the majority of the studied patients didn't receive sedation.

The findings of the present study revealed that more than one third of the studied patients were mechanically ventilated using SIMV mode .This result was agreed by **Sole et al.,(2021)** who reported that nearly all patients were ventilated with synchronized intermittent mandatory ventilation.

The findings of the present study revealed that highly statistical significant differences were found in the mean scores of endotracheal tube cuff pressure in the left lateral, right lateral post10 minutes, 20 minutes, 45 minutes, and 90 minutes. This result was in the same line with **Liu et al., (2019)** who found significant increase of the endotracheal tube cuff pressure of in 40% of cases and emphasized that frequent changes in a patient's body position may cause harmful cuff elevation and recommended for a strict monitoring of this pressure.

Therefore, the cuff pressure finding pre and post changing position was very dangerous and was prone to develop complications. Also, this finding was supported by **Efrati et al., (2019)** who stated that inflation of the endotracheal cuff more than 30 cm H2O destroys the tracheal mucosa by interfering with the capillary perfusion and when pressures are more than 50 cm H2O, total occlusion of tracheal blood flow takes place. This finding was in accordance with **Sole and Bennett (2024)** who mentioned that the changes in the pressure of the tracheal tube after repositioning are often transient and becomes normal within 90 minutes.

Regarding hemodynamic parameters, it was found that no statistical significant differences were existed among the studied patients regarding temperature, pulse, and respiration, systolic and diastolic blood pressure. However, there were statistical significant differences between the studied patients regarding SpO_2. This result was in agreement with **Frownfelter** and **Dean** (**2021**) who found that there was increment in SpO_2 value in all positions from 0 minutes to end of 90 minutes in right-side, left-side, and Semi flower's. While, other parameters (PR, RR, and BP) were not signifantly changed. This finding also emphasizes the need for monitoring and continuous adjustment of the endotracheal tube cuff pressure post patients' body position changes.

Conclusions

Based on the results of the current study, it can be concluded that endotracheal tube cuff pressure was influenced by two important factors, including body position changes and the passage of time. Endotracheal tube cuff pressure increased as the position changed, and these changes were varied in different positions. Moreover, the changes decreased over the passage of time, that is, the endotracheal tube cuff pressure was high at minute 10 and declined until the minute 90.

Recommendations:

Based on the finding of the current study, the following recommendations are derived:

1.Endotracheal tube cuff pressure monitoring using a cuff pressure manometer is mandatory before patients' body position changes.

2.Endotracheal tube cuff pressure must be monitored post patients' body position changes and adjusted to the safe range (20-30 cm H_2O).

3.A protocol for the ETT cuff pressure measurement should be developed.

4.Replication of the study on large probability sampling.

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