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Effect of Suctioning on Endotracheal Cuff Pressure Monitoring during Fixed Volume versus Minimal Leak Techniques among Mechanically Ventilated Patients

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Abstract

Background: Endotracheal cuff pressure monitoring is an essential part of airway management, especially in critically ill patients undergoing mechanical ventilation. **The aim:** was to evaluate the effect of suctioning on endotracheal cuff pressure monitoring during fixed volume versus minimal leak techniques among mechanically ventilated patients**. Design:** A quasi-experimental research design was used to conduct the current study using a pre post technique approach. **Setting:** This study was conducted at both Anesthesia and Surgical Intensive Care Units affiliated to Tanta University Hospitals, **Subjects:** A convenience sample of 60 adults who were newly admitted to Intensive Care Units within 48 hours and undergoing oral or nasal endotracheal tube. **Tools:** Two tools were utilized to collect data; (tool I) patients' bio-sociodemographic characteristics and (tool II) endotracheal cuff pressure assessment. **The results:** clarified that there were highly statistically significant differences regarding intra cuff pressure pre and post suctioning in both fixed volume and minimal leak techniques groups with a p-value <0.001. **Conclusions:** It was clarified that there was a moderate degree of positive statistical correlation regarding intra cuff pressure pre and post suctioning among patients in the fixed volume group. While there was a higher degree of positive statistical correlation regarding intracuff pressure pre and post suctioning among patients in the minimal leak group. Therefore, the minimal leak seems to be a more reliable technique to measure intracuff pressure than the fixed volume. **Recommendations:** it was recommended that endotracheal cuff pressure monitoring should be integrated into routine care for critically ill patients undergoing mechanical ventilation.

Keywords: Endotracheal cuff pressure, Fixed volume versus Minimal leak techniques, Suctioning & mechanically ventilated patients.

Introduction:

Endotracheal cuff pressure monitoring is an essential part of airway management, especially in critically ill patients undergoing mechanical ventilation. Endotracheal intubation (ETT) is a gold stander of airway support, providing airway protection, facilitating delivery of mechanical ventilation, and clearance of pulmonary secretions **Beccaria, et al., (2017)& Rahmani et al ., (2017).** Additionally, The ETT cuff must be sufficiently inflated post intubation to maintain a safe airway and create a positive pressure **Nazari et al., (2020); White et al., (2020)**.

Moreover, inadequate or excessive inflation of ETT may be associated with dangerous complications in mechanically ventilated patients; inadequate cuff pressure values lead to oropharyngeal content aspiration, on the other hand, an increase in the cuff pressure values causes declining airway capillary perfusion **Harvie et al., (2016).**

Additionally, potential injuries from cuff over-inflation include tracheal rupture, necrosis and stenosis, tracheoesophageal fistula, and recurrent laryngeal nerve palsy. Importantly, and probably more commonly, overinflation can result in post extubation stridor and sore throat. To prevent ETT cuff pressure complications the optimal pressure should be maintained within a normal range of 20 - 30 cmH_2O or 18 - 22 mmHg **Nazari et al., (2020); White et al., (2020)**.

There are several techniques used for cuff pressure fixation such as the fixed volume technique (FVM); and the minimal leak technique (MLT). During FVM; the ETT cuff inflation is performed by injection of fixed amount of air 7-10 ml by a syringe into endotracheal cuff is the most routine way. While MLT; the ETT is fully inflated using 7-10 ml of air, then air is withdrawn slowly from the cuff with auscultation over the trachea until a leak is heard **Carhart et al., (2016); Harvie et al., (2016)**

Many factors influence ETT cuff pressure values in both FMV and MLT techniques such as patient's condition, hemodynamic status, body temperature, airway anatomy, cuff location, cuff material and structure, size and volume, and peak inspiratory pressure [3,5] Additionally, nursing procedures including changing patients' position, head alignment and ETT suctioning can influence the intracuff pressure measurement. Therefore, the role of the critical care nurse is to attain the optimal breathing pattern in an intubated patient and prevent the side effects of intubation, assess EET cuff pressure changes pre and post suctioning, and maintain proper cuff inflation and monitoring technique **Khalil et al., (2018); Sanaie et al., (2019)**.

Significance of the study:

From extensive experience at different intensive care units (ICUs) in Tanta University Hospitals; it was observed that a fixed volume is the only technique used for endotracheal cuff pressure monitoring. Moreover, there were no comparisons between cuff pressure values pre and post suction technique. Additionally, few studies were done to evaluate the effect of tracheal suctioning on different techniques of cuff pressure monitoring techniques.

Aim of the study:

This study aimed to evaluate the effect of suctioning on endotracheal cuff pressure monitoring during fixed volume versus minimal leak techniques among mechanically ventilated patients.

Research hypothesis:

Mechanically ventilated patients who were exposed to cuff pressure monitoring with both fixed volume and minimal leak techniques exhibit an increase in mean scores of cuff pressure values pre than post suctioning.

Method:

Research design:

A quasi-experimental research design was utilized to conduct the current study using a pre post technique approach.

Study Setting: This study was conducted at:

- The Anesthesia Intensive Care Unit in Tanta Emergency Hospital is affiliated to Tanta University Hospitals. It is prepared and equipped with 4 words each word equipped with 6 beds, the total number of beds is 24.
- The Surgical Intensive Care Unit in International Educational Hospital is affiliated to Tanta University Hospitals. It is prepared and equipped with one word which includes 9 beds.

Both Anesthesia and Surgical Intensive Care Units receive critically ill patients with the same diagnosis and have similar resources and nursing staff qualifications.

Subjects:

A convenience sampling of 60 adult patients from the previously mentioned settings. The sample size was calculated based on the Epi info program according to the total population admitted per year to the Anesthetic ICUs and the sample size was calculated as the following:

Z= confidence level 95%, d= Error proportion (0.05), P= population (80%), assuming total numbers of patient's admission in the following:

- The Anesthetic Intensive Care Unit in Tanta Emergency Hospital is equipped with 24 mechanical ventilation machines, 220 patients are admitted per year, and only 120 of them are mechanically ventilated.
- In the Surgical Intensive Care Unit in International Educational Hospital only 95 patients are ventilated per year.
- The number of each group was selected from both Surgical and Anesthetic Intensive Care equally.

The patients were divided randomly and alternatively into two equal groups; 30 patients each as follows:

- **Group one (Fixed Volume technique**): The ETT cuff was inserted and filled with a fixed 10 cc of air.
- **Group two (Minimal Leak technique):** The ETT cuff was inserted, then the air was withdrawn slowly from the cuff with auscultation over the trachea until a leak was heard.

The patients enrolled in the study according to the following inclusion criteria; Adult patients of both sexes, newly admitted to ICUs within 48 hours, and undergoing oral or nasal ETT.

Tools of the study:

Two tools were utilized to collect data based on reviewing of the relevant literatures **Beccaria, et al. (2017); Hosseinzadeh Maleki et al., (2021); Rahmani et al. (2017); Nazari et al., (2020); Turner et al., (2020)** as the following;

Tool I: Patient demographic characteristics:

This tool was developed by the researcher post reviewing the relevant literature **Hosseinzadeh Maleki et al., (2021)** ; **Turner et al., (2020);** It included 2 parts as the following;

Part one: Patients' demographic data; to assess data related to patient's code age and gender.

Part two: Patient clinical data; to assess data related to patients' diagnosis, heart rate, blood pressure, mean arterial pressure, temperature, respiratory rate, and oxygen saturation.

Tool II: Endotracheal cuff pressure assessment

This tool was developed by the researcher post reviewing the relevant literature **Beccaria, et al. (2017; Rahmani et al. (2017); Nazari et al., (2020)**. It included 3 parts as follows:

Part one: Data related to suctioning; such as suctioning technique, catheter size, frequency of suctioning per day, and total suction time. Additionally, indications for suction includes decreased Spo_2, irritability, abnormal respiratory sound, visible secretions, and increased work of breathing.

Part two: Endotracheal tube assessment; to assess data related to size of ETT, site of ETT insertions, and causes of ETT insertion such as unconsciousness, air embolism, pneumonia, Chronic obstructive pulmonary disease (COPD), head or/ spinal cord injury, status epileptics, cerebral accident, decreased sao2 or pao2, respiratory acidosis, multiple organ failure.

Part three: Endotracheal cuff pressure monitoring techniques schedule:

Minimal leak technique and fixed volume technique of cuff inflation and pressure monitoring were be monitored pre and post suctioning **Carhart et al., (2016); Rahmani et al. (2017); Nazari et al., (2020)** using an aneroid manometer from 3 to 6 times during the day with 4-6 hours interval between each reading according to patient's assessment.

Method

1. An approval from the ethical committee was taken from the director of the Tanta Emergency Hospital and International Educational Hospital, Tanta University Hospitals through official letters from the faculty of nursing explaining the purpose of the study pre data collection.
2. **Ethical consideration:**

- Written informed consent was taken from the relatives of mechanically ventilated patients pre their patients' participation in this study and post clarification of the current study aim.
- Patients' privacy was respected.
- Data confidentiality was assured to all studied patients.
- The studied patient's family members were secure that everyone had the right to withdraw from the present study at any time of the research process with no penalty.
- Relatives were assured that both FVM and MLT used in the current study are safe for the studied patients.

3. **Tools development:** All tools were developed by the researchers based on a review of the relevant literature.
4. All tools of the study were tested for content validity by five experts (3) in the field of critical care nursing specialists, (1) anesthesiologists, and (1) medical biostatistics to ensure validity.
5. All tools of the study were tested for reliability and the Cronbach alpha technique was used and found to be 0.811 for the tool I and 0.796 for tool II which represented reliable tools.
6. A pilot study was carried out on 6 critically ill mechanically ventilated patients to technique the clarity, possibility, and applicability of the different items of the developed tools.
7. **Data collection:**

- Each patient who participated in the current study and met the inclusion criteria was observed by the researchers.
- Data collection was conducted within the period from the end of July 2021 to the beginning of February 2022.

The study was carried out in four phases; assessment, planning, implementation, and evaluation phases.

Assessment Phase:

Patients' sociodemographic and clinical data such as diagnosis and vital signs were assessed using tool I. Also, ETT cuff pressure was monitored using tool II.

Planning phase:

This stage was developed based on reviewing of literature, assessment phase, priorities, goals, and expected outcome criteria were taken into consideration when planning patients' care. The expected outcomes included; Evaluating changes in ETT cuff pressure pre and post suctioning in both minimal leak and fixed volume techniques groups.

Implementation Phase:

- In this phase, the ETT cuff pressure of both the FVM and MLT groups was monitored from 3 to 6 times during the morning, post noon, and evening shifts pre, post suctioning for the studied patients with 4-6 hours intervals between each reading according to patient's assessment. During ETT cuff pressure monitoring, the researchers put the patient in a supine position and avoid changing the patient's position during monitoring.
- Post the three EET cuff pressure monitoring, the mean value of both FVM and MLT groups were recorded by the researchers (using tool II) and agreed upon by the treating physician in the Anesthesia ICUs as the following:

Group one (Fixed volume technique): ETT cuff inflation was performed by injection of a fixed amount of air 7-10 ml by a syringe into the ETT cuff is the most routine way.

Group two (Minimal Leak Technique): The patient was positioned supine, the bed inclined at one side unless any restrictions of the movement were in place. The air was then slowly withdrawn from the re-inflated cuff, with auscultation over the trachea until a leak was heard, at this point intracuff pressure was recorded.

The endotracheal cuff pressure monitoring pre suctioning:

- Firstly, the ETT cuff pressure was measured for each patient of both groups pre suction by the aneroid manometer pre any intensive interventions such as; position change to prevent an extensive change of cuff pressure.
- The aneroid manometer was connected to the pilot balloon of the ETT cuff via a three-way stopcock.
- ETT cuff pressure was measured and recorded
- The cuff pressure was adjusted by manometer immediately post inflating in both techniques. When the cuff pressure was higher than normal.
- The manometer was not removed from the pilot of the cuff.

Endotracheal suctioning was performed by the researcher via open or closed technique.

Endotracheal cuff pressure monitoring post suction:

The cuff pressure was measured and recorded in the same way as measurement pre suction.

Evaluation phase:

Evaluation of cuff pressure values of both FVM and MLT groups pre and post suctioning among intubated patients were done using tool II part 3. This was done pre and post suctioning from 3 to 6 times in the morning, afternoon, and night shifts. The mean of the measurements of both the FVM and MLT groups were obtained separately.

Statistical analysis:

Collected data were coded, computed, and statistically analyzed using SPSS (statistical package of social sciences), version 23. For categorical data, the number and percent were calculated and the differences between subcategories were tested by chi-square χ^2. For numerical data, the mean ± SD was calculated. An independent t-technique was used to compare the two techniques. The difference was considered a statistically significant difference at $P \leq 0.05$.

Results:

Table (1): Percentage distribution of patients of both studied groups according to personal characteristics and clinical data (no = 60)

Variable	FVM Group (no= 30)		MLT Group (no=30)		X^2	P- value
	n	%	n	%		
Age Group/ years					19.7	0.842
• <35	12	40.0	10	33.3		
• 35 < 40	5	16.7	8	26.7		
• ≥40	13	43.3	12	40.0		
Mean± SD	**45.17±17.3**		**45.37±13.9**			
Sex					0.317	0.573
• Male	22	73.3	20	66.7		
• Female	8	26.7	10	33.3		
Diagnosis					1.76	0.41
• Medical Disease	13	43.3	12	40.0		
• Postoperative	4	13.3	8	26.7		
• Trauma	13	43.3	10	33.3		
Pulse					14.14	0.863
• 70-99 b/m	16	53.3	18	60.0		
• 100-130 b/m	14	46.7	12	40.0		
Mean± SD	**104±16.6**		**97.27±17.97**			
Blood Pressure					4.84	0.774
• ≤ 120/80 mmHg	22	73.3	20	66.7		
• ≥ 130/90 mmHg	8	26.7	10	33.3		
Mean± SD	**120/80±20/15**		**110/70±20/15**			
Temperature					12.118	0.518
• 36-37.5 °c	14	46.7	13	43.3		
• 37.6-39 °c	16	53.3	17	56.7		
Mean± SD	**37.46±0.73**		**37.52±0.60**			
Respiration					17.486	0.785
• 12-19 c/m	5	16.7	4	13.3		
• ≥ 20 c/m	25	83.3	26	86.7		
Mean± SD	**27±7.2**		**25±5.8**			
SPO_2						
• < 95	10	33.3	11	36.7	11.141	0.133
• ≥ 95	20	66.7	19	63.3		
Mean± SD	**94.9±2.49**		**94.2±3.15**			

*FVM: Fixed Volume Technique, MLT: Minimal Leak Technique, and * P≤0.5= not significant*

Table (2): Percentage distribution of patients of both studied groups according to suction indicators (No = 60)

Suction indicators	FVM Group (no= 30)		MLT Group (no=30)	
	n	%	n	%
Suction technique				
• Open	19	63.3	22	73.3
• Closed	11	36.7	8	26.7
Size of suction				
• 12	9	30.0	11	36.7
• 14	16	53.3	19	63.3
• 16	5	16.7	0	0.0
Frequency of suction/day				
• < 3 times	11	36.7	7	23.3
• 3-5 times	10	33.3	15	50.0
• > 5 times	9	30.0	8	26.7
Total suction time				
• <10 sec	14	46.7	14	46.7
• 10-15 sec	12	40.0	14	46.7
• > 15 sec	4	13.3	2	6.6

FVM: Fixed Volume Technique; MLT: Minimal Leak Technique

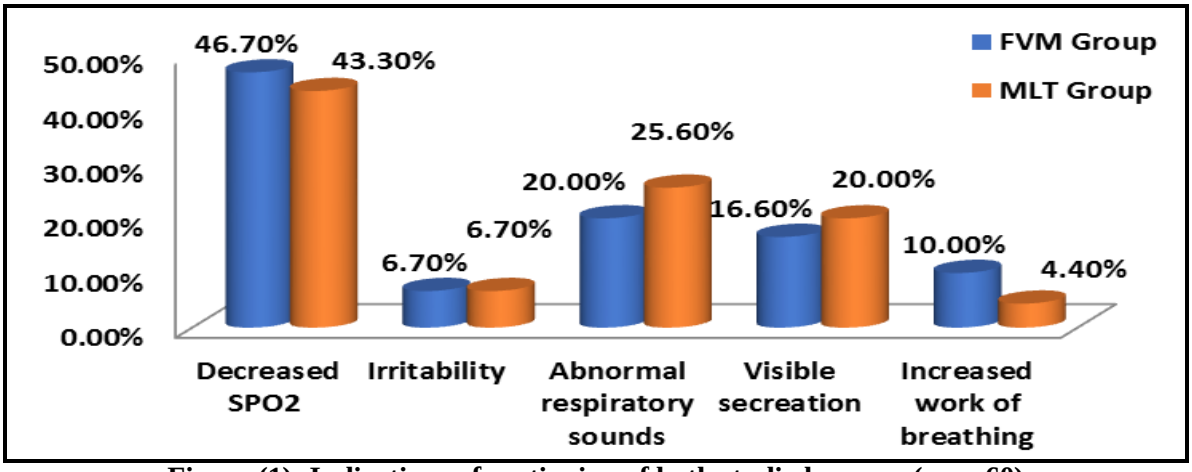

Figure (1): Indications of suctioning of both studied groups (no = 60)

Table (3): Percentage distribution of patients of both studied groups according to endotracheal tube indicators (no = 60)

Variables	FVM Group (no= 30)		MLT Group (no=30)	
	n	%	n	%
Causes of endotracheal tube insertion				
• Unconsciousness	10	33.3	15	50.0
• Air embolism	2	6.7	0	0.0
• Pneumonia	2	6.7	2	6.7
• COPD	3	10.0	0	0.0
• Head or/ Spinal cord injury	2	6.7	4	13.3
• Status epileptics	1	3.3	0	0.0
• Cerebral accident	2	6.7	0	0.0
• Decreased Sao2 or Pao2	0	0.0	3	10.0
• Respiratory acidosis	4	13.3	2	6.7
• Multiple organ failure	4	13.3	4	13.3
Size of endotracheal tube catheter				
• 7	4	13.3	4	13.3
• 7.5	17	56.7	24	80.0
• 8	9	30.0	2	6.7
Site of insertion				
• Oral	30	100.0	30	100.0

Nasal endotracheal tube site insertion=0, Endotracheal: ETT, FVM: Fixed Volume Technique, and MLT: Minimal Leak Technique

Table (4): Comparison between FVM and MLT groups regarding endotracheal cuff pressure pre and post suction (no = 60)

Group	Intra cuff Pressure Pre Suction (no= 30)		Intra cuff Pressure Post Suction (no=30)		Independent -t technique	P-Value
	n	%	n	%		
FVM						
• 20-30	12	40.0	17	56.7	9.017	0.000**
• > 30	18	60.0	13	43.3		
Mean± SD	**43.7±7.6**		**32.1±5.7**			
MLT						
• 20-30	11	36.7	26	86.7	3.137	0.000**
• > 30	19	63.3	4	13.3		
Mean± SD	**29.3±4.3**		**28.1±3.8**			

FVM: Fixed Volume Technique; MLT: Minimal Leak Technique
***High statistical significant difference p-value <0.001*

Table (5): Correlation between FVM and MLT groups and endotracheal cuff pressure pre and post suction (No = 60)

Group	Intra cuff Pressure Pre Suction (No.= 30)	Intra cuff Pressure Post Suction (No.=30)	r	P-Value
	Mean± SD	Mean± SD		
FVM	**43.7±7.6**	**32.1±5.7**	0.621	0.000**
MLT	**29.3±4.3**	**28.1±3.8**	0.867	0.000**

Table (1): presents that the mean age of the studied group patients in both FVM and MLT groups were 45.17±17.3 and 45.37±13.9 respectively. Regarding their sex, more than two-thirds (73.3%, 66.7%) of both studied groups were males. As well regarding their medical diagnosis, the most common diagnosis (43%) among patients undergoing FVM was medical disease and trauma, while the most common diagnosis (40%) among patients undergoing MLT was medical disease.

In relation to vital signs, higher percentages (53.3% and 60.0%), (73.3% and 66.7%), and (66.7% and 63.3%) of both FVM and MLT had normal pulse of 70-99 b/m, blood pressure ≤ 120/80 mmHg, and SpO_2 ≥ 95 respectively. on the other hand, higher percentages (53.3% and 56.7%) and (83.3% and 86.7%) of both FVM and MLT had an increase in temperature of 37.6-39 ^{o}C and respiration ≥ 20 c/m.

There were no statistically significant differences between FVM and MLT groups regarding age, sex, diagnosis, pulse, blood pressure, temperature, respiration, and SPO_2.

Table (2): Reflects that the most common suctioning techniques (63.3% while 73.3%) used for both FVM and MLT groups were open techniques respectively and suction catheter size (53.3% and 63.3%) for both FVM and MLT groups was 14 respectively. Additionally, the frequency of suctioning / day among the FVM group was < 3 times in about 36.7% while 50.0% of the MLT group was suctioned 3-5 times/day. Also, both FVM and MLT groups were equaled in the total suction time as it was less than 10 sec in 46.7%.

Figure (1): Reveals that the most common indication of suctioning (46.7% and 43.3%) in both FVM and MLT groups was decreased Spo_2, while the least common indications of suctioning (6.7% and 4.4%) in both FVM and MLT groups were irritability and increased work of breathing respectively.

Table (3): Demonstrates that the main cause of ETT tube insertion (33.3%, 50.0%) was unconsciousness in both FVM and MLT groups respectively. Regarding the size of ETT, it was observed that 56.7% and 80.0% of both FVM and MLT groups were 7.5 respectively, and orally inserted for all the studied patients (100.0%) in both groups

Table (4): Explains that a higher (60.0% and63.3%) of patients in both FVM and MLT groups had high intracuff pressure of more than 30 mmHg pre suctioning compared to a lower percentage (43.3% and13.3%) post suctioning respectively. On the other hand, a lower percentage (40.0% and 36.7%) of patients in both FVM and MLT groups had normal intracuff pressure of 20-30mmHg pre suction compared to a higher percentage (56.7% and 86.7%) respectively. There were highly statistically significant differences between intracuff pressure pre and post suctioning among FVM and MLT groups with a p-value <0.001.

Table (5): Clarifies that there was a moderate degree of positive statistical correlation regarding intracuff pressure pre and post suctioning among patients in the FVM group with r= 0.621 and p-value = 0.000**.

Discussion

The use of a cuffed endotracheal tube is essential for a patient who needs a protected airway. Endotracheal cuff pressure monitoring is an important step in the management of airway post intubation, especially in critically ill patients who undergo mechanical ventilation. Insufficient cuff pressure causes pulmonary aspiration of oropharyngeal content and excessive amounts of cuff pressure lead to decreased tracheal capillary perfusion **Rahmani, et al., (2017)**.

Regarding the studied patients' age and sex; the results of the current study showed that more than one-third of the studied patients in both groups were more than forty years old and more than two-thirds of them were males. This may be attributed to this age group being more reliable to medical diseases and road traffic accidents especially males than females. This result was matched with certain studies which revealed that the majority of the studied patients were males with no significant difference between the two groups **Faraji et al., (2015); Sanaie et al., (2019)**. This finding is inconsistent with **Harvie et al., (2016)** study results which revealed that the majority of the studied patients were old.

Regarding patients' vital signs; the current study findings depicted that more than half of the studied patients had normal pulse rates. Moreover, most of the patients in both studied groups had a higher respiratory rate. Additionally, nearly three-quarters of the FVM group and two-thirds of the MLT group had normal blood pressure. These results were inconsistent with the findings of **Rahmani et al., (2017)**.

Furthermore, according to this study results more than half of the studied patients had slight hyperthermia. This finding is matched with a study conducted by **Sanaie et al., (2019) & Rahmani et al., (2017)** they revealed that the mean body temperature between the two studied groups had hyperthermia and were nearly the same mean in their study.

The current study finding revealed that nearly two-thirds of both studied groups had normal oxygen saturation. It may be due to patients' connection with mechanical ventilation and friction of inspired oxygen of more than three-fifths. This result is in harmony with the results of **Faraji et al., (2015)**, who compared the effect of the open and closed suctioning techniques on the arterial blood gas values in patients undergoing open-heart surgery. The authors noted that the mean SaO_2 in the two groups pre suctioning was 96.25 ± 1.88, and 96.13 ± 2.11, respectively.

Additionally, there was a high degree of positive statistical correlation regarding intracuff pressure pre and post suctioning among patients in the MLT group with r = 0.867 and p-value = 0.000**.

Concerning patients' diagnosis: the current results indicated that nearly half of the FVM group was admitted with trauma and medical disease while more than one-third of the MLT group was admitted with the medical disease. This is because major or severe trauma constitutes a public health problem that increases due to motorization, violence, and criminal activities. So, major trauma remains a major cause of hospitalization and intensive care utilization. Current results correspond with **Shamali et al., (2019)** who showed that half of the FVM group was diagnosed with trauma. Also, a study conducted by **Anand et al., (2021)** showed that nearly half of both studied groups were admitted with the medical disease.

As regards to suctioning technique; the open suction was the most used suctioning technique among both studied groups in the present study. This may be related to the closed suction catheter being highly expensive and the lack of trained nurses on the closed suction procedure. This is not consistent with a study conducted by **Ardehali, et al., (2020),** who revealed that open and closed suctioning were equally among the participants due to the nature of their investigations. Also, a suction catheter size of 14 was the most common size for both groups. Similarly, **Eid, (2021)** in the study entitled **"**The effect of suction system flushing with chlorhexidine on the occurrence of VAP among mechanically ventilated patients**"** revealed that slightly more than two-thirds of patients in the intervention group and slightly more than half of the control group patients utilized suction catheter sized 14 Fr.

As regards to suction time; the results of the present study revealed that more than one-third of the FVM group had three times suctioning per day, while half of the MLT group had from three to five-time suctioning per day. It may be related to suctioning decisions taken according to chest assessment especially auscultation of the chest sound. Contradicting current findings, **Mahmoodpoor et al., (2020)** showed that the frequency of suctioning was 12 times per day.

Moreover, in the current study, nearly half of both studied groups had a suction time every insertion of fewer than ten seconds. It may be attributed to the nurses following evidence-based practice related to endotracheal tube suctioning. These results are inconsistent with the findings of **Eid, (2021)** who revealed that total duration time for suctioning procedure consumed between 30-60 seconds. On the contrary, these results were inconsistent with the findings of **Gilder et al., (2019)** revealed that nearly

two-thirds of their participants were suctioning due to the presence of audible secretions.

As regards to causes of endotracheal intubation: the present study showed that the most common cause of intubation among patients of both studied groups was the loss of consciousness. In my opinion, the most common admission to ICU was traumatic patients who had declined level of consciousness. This was supported by the findings of **Sanaie et al., (2019)** who reported that the main cause of intubation in the fixed volume group was the loss of consciousness. Conversely, a study conducted by **Anand et al., (2021)** revealed that the most common cause of intubation among their two studied groups was respiratory failure.

Regarding suction catheter size; the most common suction catheter size used was 7.5. This may be attributed to all the studied patients being in middle age. This is in line with **Chokhachian, (2019)** who showed that the average tracheal tube size did not differ significantly in their studied groups

Regarding intracuff pressure pre and post suctioning; the present study showed that most of the FVM group had intracuff pressure of more than 30 mmHg pre suction, while this pressure was reduced to the normal range among more than half of the same group with a highly statistically significant difference pre and post suctioning. Moreover, nearly two-thirds of the MLT group had intracuff pressure of more than 30 mmHg pre suction, while this pressure was reduced to the normal range among more than two-thirds of the same group with a highly statistically significant difference pre and post suctioning. Consistent with the results of the present study findings, **Beccaria et al., (2017**) reported that the mean cuff pressure pre aspiration of the endotracheal tube was 20.35 ± 3.93 and this number decreased to 19.32 ± 3.61 post aspiration of the endotracheal tube in morning shift with a highly statistically significant difference.

Moreover, the mean ± SD of intracuff pressure among the FVM group pre and post suctioning was 43.7±7.6 and 32.1±5.7, respectively. While the cuff pressure pre and post suction among the MLT group was 29.3±4.3 and 28.1±3.8, respectively with a high degree of correlation with r= 0.867 and p-value = 0.000. On the other hand, **Sanaie et al., (2019)** reported that MLT produces more acceptable pressure than FVM.

Conclusion:

Based on the findings of the present study, it can be concluded that;

- There was a moderate degree of positive statistical correlation regarding intracuff pressure pre and post suctioning among patients in the FVM group. While, there was a higher degree of positive statistical correlation regarding intracuff pressure pre and post suctioning among patients in the MLT group.
- The MLT seems to be a more reliable technique to measure intracuff pressure than the FVM.

Recommendations:

In the light of the current study findings the following recommendations are suggested:

- Endotracheal cuff pressure monitoring should be integrated into routine care for patients undergoing mechanical ventilation.
- The minimal leak technique can be used instead of the fixed volume technique of ETT cuff inflation because it produces acceptable pressure.
- Further studies will be needed to confirm the reliability of the larger probability sample.
- Further studies will be needed to compare between effect of open versus closed suction on ETT cuff pressure.

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