Comparison between Outcomes of implementing shallow versus deep endotracheal tube suctioning among mechanically ventilated patients

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Article History:
Received:10/2/2025
Revised: 13\2\2025
Accepted: 2\3\2025
Published: 1\5\2025

Abstract

Background: *In Intensive Care Units (ICUs), the primary objective of nursing intervention for patients who are ventilated and intubated is to maintain a clean airway. Alveolar collapse, atelectasis, and infection are possible risks for patients undergoing intubation. Objective: To Compare between Outcomes of implementing shallow vs deep endotracheal tube suctioning among mechanically ventilated patients.* ***Settings:*** *The study was carried out at the Intensive Care Units of the following hospitals: Alexandria Main University Hospital (AMUH) that includes four 4 Critical care units namely: Unit (II) with a bed capacity of 12 beds unit (III) with a bed capacity of 18 beds (IV) with a bed capacity of 8 beds and unit (V) with a bed capacity of 12 beds.* ***Subjects:*** *Eighty 80 critically ill adult patients receiving invasive mechanical ventilation were selected for this analysis. Tools: two tools were used. Tool I: Adult endotracheal suctioning management tool " Tool II: pain assessment ".* ***Results:*** *The study showed that there was highly statistically significant difference found between the two groups regarding their catheter suction size, at (P <0.001). On the other hand, there were highly statistically significant differences found between the mean Glasgow coma scores differences among the studied patients' and the all items of their bio-demographic data, at (P <0.001).* ***Conclusion****: The application of the shallow suction system leads to fewer disturbances in the hemodynamic parameters especially, in respiratory rate, oxygen saturation, heart rate, mean arterial blood pressures compared to deep suction system in mechanically ventilated patients.* ***Recommendations:*** *Staff should take more protection procedure when they deal with critically ETT ill patients because this can help in determining how well the task is performed and identifying factors that help or hinder procedure achievement.*

Keywords: Endotracheal Tube , Intubated patients, Oxygen Saturation, Shallow and Deep. Suction,.

Introduction

Mechanically ventilated critically ill patients frequently retain tracheobronchial secretions because endotracheal tubes prevent the defense mechanisms of the upper airway such as filtration, humidification, air heating, and impair the cough reflex, thus decrease mucociliary clearance, and, probably, increase mucus production. mucus production and a compromised capacity to eliminate secretions. The patient may be susceptible to infection, atelectasis, and alveolar collapse if secretions are not adequately removed. When endotracheal intubation is performed on critically ill patients, appropriate intervention can reduce complications like length of stay and mechanical ventilation duration. (Kumar et al., 2019).

Mechanical ventilation and bronchial hygiene therapy both involve endotracheal tube suctioning. In this procedure, lung secretions from a patient with an artificial airway are mechanically aspirated. Placing a suction catheter through the artificial airway and applying negative pressure as the catheter is being removed make up the suction event. A suctioning event is defined as each time the suction catheter passes into the artificial airway (Schults et al., 2021).

A number of clinical signs and symptoms, including coughing, elevated inspiratory pressure on the ventilator, and adventitious noises (rhonchi, gurgling) during chest auscultation, indicate the need for ETT suctioning. To maintain airway patency, suctioning may also be done on a regular basis. Suctioning should never be done on a regular basis; it should only be done when required or when there is a clinical indication. Rather than at predetermined intervals, the choice to do suctioning must be made after a thorough evaluation of the patient. Palpation, auscultation, and a review of respiratory features should all be part of this evaluation (Solikin and Era, 2021).

One factor that helps minimize suction side effects is the depth at which the endotracheal tube is suctioned. Shallow and deep tube suctioning are the two varieties of endotracheal tube suctioning. The effectiveness of both shallow and deep suctioning techniques is greatly influenced by nursing professionals and the health of the patient (Eggen et al., 2022).

According to Mousa and Ahmed (2019), shallow endotracheal suctioning is the process of inserting a catheter till it emerges from the tracheal tube lumen, at which time stimulation of the carina should be avoided. Patients with a low risk of side effects, such as those with an unstable cardiovascular system, acute pulmonary hemorrhage, high intracranial pressure, coagulopathy, or a high risk of bronchospasm and lack of cough reflex, may require this type of endotracheal suction. (Misirlioglu et al., 2022).

In contrast, deep endotracheal suctioning entails inserting the catheter until resistance or coughing occurs, then carefully removing it 1-2 cm before to applying suction. If there are a lot of secretions, it can be important to hold the suction catheter in place for a while before carefully removing it from the airway to maximize ventilation and oxygenation (Kanwal Qaiser et al., 2020).

The catheter inserts to the endotracheal tube's tip in the shallow suctioning technique and enters the trachea in the deep suctioning technique. In this kind, the suction catheter only carried the catheter withdrawn after the patient was disconnected from the ventilator without any negative pressure being applied (Martins et al., 2019).

Negative pressure should not be provided in the deep suctioning method until the suction catheter has been put forward and resistance has been satisfied. At that point, the catheter should be pulled back one centimeter and suctioning should be done

while the catheter is being withdrawn (Li et al., 2021).

An important part of managing a severely ill patient's airway is effective suctioning. Critical care nurses should possess the necessary education and experience to properly determine whether suctioning is necessary before doing ETT suctioning, carry out the technique precisely, and appropriately assess the patient's condition following the procedure. To lessen its negative impacts, ETT suctioning must also be carried out in accordance with the appropriate norms and codes (Chen et al., 2021).

Aims of the Study

Compare between Outcomes of implementing shallow versus deep endotracheal tube suctioning among mechanically ventilated patients

Research hypotheses:

Critically ill patients who are subjected to shallow Endotracheal tube suctioning exhibit positive outcomes than those who are subjected to deep Endotracheal tube suctioning.

Materials and Method

Materials

Design: Quasi-experimental research design was used to conduct the current study.

Settings: The study was carried out at the intensive care units of Alexandria Main University Hospital (AMUH) that includes 4 Critical care units namely: Unit II with a bed capacity of 12 beds, Unit III with a bed capacity of 18 beds, Unit IV with a bed capacity of 8 beds, Unit V with a bed capacity of 12 beds.

Subjects: Convenience sample of 80 critically ill adult patients on invasive mechanical ventilation was included in this study. This estimation was based on the power analysis using Epi-Info 7 program, applying the following parameters

- Population size = 80 in 3 months
- Expected frequency = 50%
- Acceptance error =5%
- Confidence coefficient =95%

The participants were divided into two groups: 40 critically ill mechanically ventilated patients who had exposed to the deep endotracheal tube suctioning procedure (Study Group I), and 40 critically ill mechanically ventilated patients who had exposed to the shallow endotracheal tube suctioning technique (Study Group II).

Tools: Two tools were used in the current study namely:

Tool I: "adult endotracheal suctioning management tool". this tool was developed by the researcher after reviewing of relevant literatures *(Ahmed, et. al. (2017), La Vita, (2021), Sole, et. al (2018). It was used to assess the hemodynamic parameters of the patients attached with volume and/or pressure cycled mechanical ventilators before and after implementing the tracheal suction, it consisted of three parts:*

- **Part I:** Patients' demographic and clinical data, that include patients' age, sex, medical diagnosis, state of consciousness, and prior and current medical history.
- **Part II:** Hemodynamic parameter that include pulse, blood pressure, MAP; respiratory status assessment that include respiratory rate, oxygen saturation, auscultation of chest sound and use of accessory muscles before and after suction; and ventilator data assessment that include peak airway pressure, tidal volume, and plateau pressure.
- **Part III: Endotracheal tube data**; Endotracheal tube data that include endotracheal tube size, fixation point, and catheter size.
- **Tool II: Pain Assessment:** it includes the revised Nonverbal Pain Scale (NVPS), It is adapted from the

FLACC, it comprises five categories: guarding, activity, facial expression, Physiologic parameters (vital signs), (skin temperature, pupil dilatation), and each is scored from 0 to 2. The overall score ranges from 0 (no pain) to 10 (greatest pain). (Kabes et.al., 2009).

- **Method**

Approval of the Research Ethics Committee of the Faculty of Nursing Alexandria University was obtained. An official letter was issued from the administrative authorities of the Faculty of Nursing-Alexandria University to obtain approval from the hospital authorities of the pre mentioned settings to carry out the study. Two tools were used in the current study namely: “adult endotracheal suctioning management assessment”, and Pain Assessment.

A panel of five critical care and emergency nursing specialists reviewed the instruments to ensure content validity. Cronbach alpha test was used to assess the reliability. the value was 0.87, which is sufficient. **A pilot study** was conducted on eight patients on mechanical ventilation, 10% of the patients and excluded of the study sample.

The study was conducted in three phases:
Phase I: Preparatory phase: selection of the patients and assessment and recording the patients' demographic and clinical data that included the age, sex, and severity of illness, admission diagnosis and comorbidities and the consciousness level.

Patients` assessment; Patients in both groups was assessed during the morning shift to be enrolled in the study. Then the patients who meet the inclusion criteria were randomly allocated. The included patients were be assigned to two groups (40 patients in each(Study Group I) was subjected to deep suction and (Study Group II) was subjected to shallow suction.

The researcher assessed the patients need for tracheal suctioning according to clinical assessment; (Respiratory rate (RR), Peripheral capillary oxygen saturation (Spo2), heart rate (HR), Frequency of suction passes.

The pain intensity was assessed by Revised Nonverbal Pain Scale (NVPS), Level of consciousness (LOC) was assessed by Glasgow Coma Scale (GCS).

For the suction procedure, patients were assessed for suction procedure during three times:

1) Time one: right before the aforementioned process, at rest.
2) The second time: during the process.
3) The third time was twenty minutes following the procedure; this was chosen as the post-procedure rest assessment interval because norepinephrine and adrenaline, the stress hormones, need to be released and eliminated during that time. Norepinephrine and adrenaline have a brief half-life of one to three minutes, and within fifteen to twenty minutes, they are totally gone (Gélinas & Arbour, 2009).

Phase II: Implementing the procedure: (performing tracheal suction). Every critically ill ventilated patient was hyperoxygenated with 100% oxygen for two minutes prior to, during, and after the suctioning process throughout this phase. In order to reduce negative pressure, avoid hypoxia, and avoid right upper lobe collapse or atelectasis, the suction catheter's diameter should not exceed 50% of the endotracheal tube's internal diameter. Additionally, it reduces the possibility of mucosal damage.

Because high pressures can harm the airway's mucosa and epithelial cilia, a negative pressure of 120 mmHg is advised. Suction time should not be longer than 10 to 15 seconds to reduce the risk of trauma, atelectasis, and hypoxia. In order to maintain oxygen levels and get them back to baseline, a recovery period is necessary when many catheter passes are required, although no more than three passes should be made in a single suctioning session.

- **In study group A (Deep endotracheal suctioning group),** The researcher halted any negative pressure and unplugged the patient from the ventilator when resistance or coughing was seen. After inserting the suction catheter into the endotracheal tube and drawing it back 1-2 cm, suctioning was carried out as the catheter was being taken out.

- Only when the critically ill patient was disconnected from the ventilator without negative pressure was the suction catheter moved to the end of the tracheal tube **in study group B (the shallow endotracheal suctioning group).** In order to verify airway patency and to quickly assess for any drops in oxygen saturation levels, heart rate, blood pressure, respiratory rate, ABG, and PIP that would suggest hypoxemia, the patient's chest was heard after the tracheal tube suctioning procedure was finished.

- **Phase III: Evaluating the phase:** Comparison between the three clinical assessment outcomes of pain intensity during deep suction and shallow suction was done by the researcher. The collected data was analyzed and compared using appropriate statistical tests.

Ethical considerations:

Following an explanation of the study's purpose, the selected nurses provided their informed written consent. Data confidentiality was guaranteed and upheld throughout the study's execution. The privacy of nurses was taken into account and honored. It was stressed that nurses might quit from the study at any point and that participation was entirely optional.

Statistical Analysis

The statistical program SPSS version 23 was used to conduct the analysis. The range, mean, and standard deviation were computed for quantitative data. The Chi-square test was used to compare groups before and after the intervention in order to analyze qualitative data. When two means were compared, the independent t-test was computed. A one-way ANOVA test was computed for comparisons between more than two means. $P<0.05$ was used as the significance level for interpreting the findings of significance tests.

Results

Table 1 represents the distribution of the studied patients (group A & group B) according to their demographic data. Eighty patients were recruited in this study. Concerning the studied patients' age, 42.5% and 37.5% of both group (A & B) their age ranging between 51 and 60 years old with a mean age of 44.17±13.79 and 43.75±12.13 years respectively. Regarding the studied patients' sex, this table shows that 67.5% and 72.5% of them were males respectively and 32.5 and 27.5. of them were females respectively Concerning the studied patients' diagnosis, 37.5% of group A were suffering from pulmonary edema, while 7.5% of them were suffering from subdural hematoma, and 45.0% of group B were suffering from chronic obstructive pulmonary disease, while 7.5% of them were suffering from myocardial infarction. As for the studied patients' length of stay in hospital, this table represents that the mean length of stay for both group (A & B) were 5.92± 3.53 and 7.75 ± 5.59 days respectively.

In relation to the studied patients' duration of mechanical ventilation, this table shows that the mean duration of mechanical ventilation for both group (A & B) were 5.87 ± 2.66 and 5.57 ± 3.96 days respectively. According to the studied patients' Glasgow coma scale score, this table illustrates that 47.5% and 37.5% of both group (A & B) had mild and sever Glasgow coma scale score with a mean score of 9.77 ± 4.11 and 9.85 ± 4.07 respectively. The same table also describes that there were highly statistically significant differences found between the two groups (A & B) regarding to their length of stay in hospital and the duration of mechanical ventilation, at ($P < 0.001$).

Table 2 illustrates the relationships between the mean Glasgow coma scores

differences among the studied patients' (group A & group B) and their bio-demographic data. It can be distinguished that there were highly statistically significant differences found between the mean Glasgow coma scores differences among the studied patients' (group A & group B) and the all items of their bio-demographic data, at (P <0.001).

Table 3 describes the relationships between the mean pain intensity scores differences among the studied patients' (group A & group B) and their bio-demographic data. It can be noted that there were highly statistically significant differences found between the mean pain intensity scores differences among the studied patients' (group A & group B) and the all items of their bio-demographic data, at (P <0.001).

Table 4 shows multivariate regression analysis of factors increasing pain intensity among the studied patients' (group A & group B). This table represents the results of (the length of stay in hospital, the duration of mechanical ventilation, the Glasgow coma score, and the current diagnosis/co-morbidities) as a factor which may affect the studied patients' (group A & group B) pain intensity, so that a multiple linear regression analysis was used to determine which factors can affect the studied patients' pain intensity score. Hence, it is noted that the Glasgow coma score, and the current diagnosis/co-morbidities are the most significant factors which affecting the studied patients' (group A & group B) pain intensity score at, (t=5.734 & p=0.001**), (t=6.986 & p=0.001**), and (t=3.945 & p=0.001**), (t=3.887 & p=0.001**) respectively, followed by the duration of mechanical ventilation at, (t=1.870 & p=0.077), and (t=1.310 & p=0.089) respectively, then the length of stay in hospital at, (t=0.750 & p=0.830), and (t=0.596 & p=0.660).

Table (5): Illustrates the mean score of the studied patients (group A & group B) according to their pain assessment scale. As prescribed in this table, there were highly statistically significant differences found between the two groups (A & B) regarding their pain assessment scale, at (P <0.001), and it was noted that the total mean pain score of group A was 10.45±0.904, while the total mean pain score of group B was 9.85±0.975.

Table (6): Illustrates the relationships between the mean Glasgow coma scores differences among the studied patients' (group A & group B) and their bio-demographic data. It can be distinguished that there were highly statistically significant differences found between the mean Glasgow coma scores differences among the studied patients' (group A & group B) and the all items of their bio-demographic data, at (P <0.001).

Table (7): Describes the relationships between the mean pain intensity scores differences among the studied patients' (group A & group B) and their bio-demographic data. It can be noted that there were highly statistically significant differences found between the mean pain intensity scores differences among the studied patients' (group A & group B) and the all items of their bio-demographic data, at (P <0.001).

Discussion

One of the most important treatments provided to patients in the intensive care unit (ICU) is mechanical ventilation via an endotracheal tube (ETT). Because ETTs are linked to biofilm formation, patients are more likely to get ventilator-associated pneumonia (VAP). ETT suctioning lowers the pace of biofilm development, decreases bacterial colonization, and eliminates secretions (Blakeman et al., 2022). In addition to altering hemodynamic parameters and producing pain, deep and superficial endotracheal suctioning shielded patients against respiratory problems. The depth of the catheter affected the suction's

effectiveness and complications (Kostekli et al., 2022)..

The current study's primary conclusions showed that physical and psychological outcomes improved when the acute cardiac rehabilitation (ACR) procedure was applied to acute coronary syndrome (ACS) patients during the acute period. Numerous research, including those by Annett Salzwedel et al. (2019), Zongyue & Peo (2021), and Idris et al. (2021), which examined the impact of the ACR phase on ACS patients, support these conclusions. According to their findings, early ACR phase adoption in ACS patients improves cardiac function, reduces the incidence of adverse events, and improves quality of life—all of which have therapeutic significance for application and promotion.

The results of the current study showed that the mean age of the studied patients in both groups (A & B) was (44.17±13.79) and (43.75±12.13) years respectively. More than two thirds of them were males, respectively.. As well, more than one third of group A were suffering from pulmonary edema, while less than half of group B were suffering from chronic obstructive pulmonary disease. Also, the mean length of stay in hospital of the studied patients in both groups was (5.92± 3.53) and (7.75 ± 5.59) days respectively

In addition, more than half of the studied patients in group A, and less than half of group B connected to the ventilator for a period of 5 to 10 days with mean duration of (5.87 ± 2.66) and (5.57 ± 3.96) days respectively. As well, less than half of group A and more than half of group B admitted to the hospital due to medical problems. There were no statistically significant differences found among two groups (A & B) regarding to their demographic data.

According to health history of the studied patients in group A and group B, the present study clarified that less than three quarters of both groups (A & B) had no previous history of surgery, respectively. While more than one third of group A and half of group B who had a previous history of surgery performed cardiac stent and cardiac catheterization, respectively. Moreover, less than three quarters of them were suffering from respiratory disorder, respectively.

Regarding the studied patients' Glasgow coma scale score, less than half of group A and more than one third of group B had a sever degree of Glasgow coma score with mean score of (9.77 ± 4.11) and (9.85 ± 4.07), respectively. Furthermore, there were no statistically significant differences between the two groups (A & B) regarding to their health history, except in case of their Glasgow coma sore there was a highly statistically significant difference.

Considering relation between the studied patients' (group A & group B) total Glasgow coma score and their demographic data, the present study declared that there were highly statistically significant differences with their demographic data as age, sex, diagnosis, length of stay in hospital, duration of mechanical ventilation and admission category. This can be interpreted as the demographic characteristics of the patients played a crucial role in determining the total Glasgow coma score among the deep endotracheal tube suctioning group (Group A) and shallow suctioning group (Group B). Also, these demographic factors may have influenced the patients' neurological status and overall clinical outcomes.

These findings were parallel with a study carried out by Liao et al., (2019) affirmed that there was significant association between the studied patients in open and closed suction groups' demographic data as age, diagnosis and duration of mechanical ventilation and their Glasgow coma score. Likewise, Vijaysabari et al., (2024) reported that there was significant relation between sociodemographic data of the studied

patients in both groups and their Glasgow coma score. On contrary, Rashwan et al. (2022) whose study found that there was no significant association between demographic data of patients in both suction methods groups and their Glasgow coma score.

Pertaining relation between the studied patients' (group A & group B) total pain intensity score and their demographic data, the present study revealed that there were highly statistically significant differences with their demographic data as age, sex, diagnosis, length of stay in hospital, duration of mechanical ventilation and admission category. This can be explained as older patients, female patients, those who were diagnosed with Subdural hematoma and stayed in the hospital for more than 10 days and their admission category was trauma are more likely to have lower pain intensity score than others.

Such findings mirrored those of Bozkurt et al., (2024), in which significant association was found between the studied patients' pain intensity score and their age and diagnosis. Also, Dastdadeh et al., (2016) whose study reported that there was significant relation between sociodemographic data of the studied patients in both groups and their pain intensity score. On the other hand, Bozkurt & Eroglu, (2024) and Shamali et al., (2017) mentioned that there was there was no significant association between sociodemographic data of the studied patients in both groups of suction methods and their pain intensity score.

Regarding correlation between the studied patients' (group A & group B) total Glasgow coma score and total pain intensity score, it was noticed that there was highly statistically significant positive correlation found between the studied patients' (group A and group B) total Glasgow coma score and total pain intensity score. This may be due to the intricate interplay between the neurological responses to pain and the level of consciousness in the studied patients. As the Glasgow Coma Score reflects the degree of consciousness, higher scores indicating better consciousness, it's plausible that patients with higher levels of consciousness are more cognizant of pain stimuli, resulting in higher pain intensity scores.

In this regard, endotracheal suctioning raised intracranial pressure (ICP) and caused secondary problems, according to Kostekli et al. (2022). As a result, they stressed the importance of brief and painless endotracheal suctioning. This was in line with Shamali et al. (2019), who stated that endotracheal suctioning should be used in the least traumatic manner possible for patients whose health is negatively impacted, particularly in the smallest changes in brain perfusion, as it has a significant impact on the hemodynamic parameters and pain conditions of the patients.

Conclusion

According to the study's findings, when a shallow suction system is used on mechanically ventilated patients, it causes fewer disruptions in hemodynamic parameters, particularly respiratory rate, oxygen saturation, heart rate, and mean arterial blood pressures, than when a deep suction system is used. This is because the shallow suction system does not deprive the patients of mechanical ventilation or oxygen supply. For critically ill patients in general intensive care units, the shallow suction system is therefore the most effective suctioning technique.

Recommendations

In line with the findings of the study, the following recommendations are made:

- Staff should take more protection procedure when they deal with critically ill patients because this can help in determining how well the task is performed and identifying factors that help or hinder procedure achievement.

• To reduce side effects, use the shallow suction system on severely ill patients in the general intensive care units.

• It is advised to repeat the study using a sizable probability sample in order to generalize the results.

Author contributions

Omnea mohamed Aboelyazed ,clinical instractor : Played a significant role in data collection, analysis, and interpretation. Assisted in drafting and revising the dissertation and contributed to the methodology and statistical analysis.

Nadia Taha Mohamed Ahmed, Professor : Supervised the research and provided expert guidance throughout the study. Contributed to the conceptualization, study design, and final review of the dissertation.

Masya Abdallah Elbaiaa, **Assistant Professor**: Offered critical revisions and expertise in the interpretation of results. Provided insights into the clinical application of the findings and assisted in the overall scientific content of the dissertation.

Haitham Mokhtar Mohamed Abdallah , Lecturer : Contributed to the study design, data analysis, and interpretation. Assisted in writing and revising the dissertation and provided guidance on the literature review and discussion sections.

Table (1): Frequency distribution of the studied patients (group A & group B) according to their demographic data, (n=80).

Demographic data	Group (A) (n=40).		Group (B) (n=40).		Significance test	
	No.	%	No.	%	Chi square test	P-value
Age (Years):						
18 - 28	7	17.5	5	12.5	0.926	> 0.05
29 - 39	6	15.0	8	20.0		
40 - 50	10	25.0	12	30.0		
51 - 60	17	**42.5**	15	**37.5**		
Range	(60-18) =42		(60-18) =42			
Mean ± SD	**44.17± 13.79**		**43.75 ± 12.13**			
Sex:						
Male	27	**67.5**	29	**72.5**	0.238	> 0.05
Female	13	32.5	11	27.5		
Diagnosis:						
COPD	11	27.5	18	**45.0**	0.538	> 0.05
Pulmonary edema	15	**37.5**	10	25.0		
Post arrest	6	15.0	5	12.5		
Myocardial infarction	5	12.5	3	**7.5**		
Subdural hematoma	3	**7.5**	4	10.0		
Length of stay in hospital (days):						
Mean ± SD	5.92± 3.53		7.75 ± 5.59		**t. test**	**P-value**
					12.69	<0.001**
Duration of mechanical ventilation (days):						
Mean ± SD	5.87 ± 2.66		5.57 ± 3.96		**t. test**	**P-value**
					13.91	<0.001**
Glasgow coma scale score:						
Mild (13-15)	19	**47.5**	12	30.0	**t. test**	**P-value**
Moderate (9-12)	10	25.0	13	32.5	17.94	<0.001**
Severe (3-8)	11	27.5	15	**37.5**		
Mean ± SD	9.77 ± 4.11		9.85± 4.07			

Table (2): The relationships between the mean Glasgow coma scores differences among the studied patients' (group A & group B) and their bio-demographic data, (n=80).

Bio-demographic data	Group A		Group B		Significance test
	No.	Glasgow coma score	No.	Glasgow coma score	
		Mean ± SD		Mean ± SD	
Age (Years):					
- 18 – 28	7	8.62±4.16	5	8.88±3.70	H = 4.70 P= 0.001**
- 29 – 39	6	7.41±3.11	8	8.17±3.18	
- 40 – 50	10	7.12±2.17	12	9.10±3.65	
- 51 – 60	17	6.77±1.80	15	9.45±3.99	
Sex:					
- Male	27	7.80±4.01	29	9.00±2.99	U = 5.12 P= 0.001**
- Female	13	6.53±3.20	11	8.78±2.82	
Diagnosis:					
- COPD	11	7.90±4.00	18	9.84±3.90	

- Pulmonary edema	15	8.42±4.12	10	9.27±3.64	U = 5.31 P= 0.001**
- Post arrest	6	7.50±3.90	5	8.19±2.73	
- Myocardial infarction	5	6.80±2.81	3	7.45±2.76	
- Subdural hematoma	3	5.80±2.00	4	7.36±2.50	
Length of stay in hospital (days):					
- < 5	17	7.91±4.02	12	8.69±3.56	U = 5.42 P= 0.001**
- 5 – 10	14	7.55±4.00	15	8.98±3.80	
- 10 +	9	6.22±3.70	13	9.19±3.72	
Duration of mechanical ventilation (days):					
- < 5	15	8.35±4.11	16	8.60±2.71	U = 5.97 P= 0.001**
- 5 – 10	21	5.60±1.99	18	8.67±2.88	
- 10 +	4	5.45±1.70	6	7.81±2.91	

U, p: U and p values for Mann Whitney test. H, p: H and p values for Kruskal Wallis test.
*: Statistically significant at p ≤ 0.05. **Highly significant at p < 0.001.

Table (3): The relationships between the mean pain intensity scores differences among the studied patients' (group A & group B) and their bio-demographic data, (n=80).

Bio-demographic data	Group A		Group B		Significance test
	No.	Pain intensity score Mean ± SD	No.	Pain intensity score Mean ± SD	
Age (Years):					
- 18 – 28	7	8.80±0.977	5	7.77±0.970	H = 3.66 P= 0.001**
- 29 – 39	6	8.77±0.960	8	7.80±0.982	
- 40 – 50	10	9.49±0.980	12	8.84±0.966	
- 51 – 60	17	10.16±0.900	15	9.70±0.960	
Sex:					
- Male	27	10.20±0.880	29	9.17±0.951	U = 5.57 P= 0.001**
- Female	13	9.33±0.940	11	8.70±0.984	
Diagnosis:					
- COPD	11	10.00±0.893	18	9.65±0.957	U = 3.3 P= 0.001**
- Pulmonary edema	15	10.31±0.870	10	9.43±0.971	
- Post arrest	6	9.91±0.943	5	8.74±0.989	
- Myocardial infarction	5	8.44±0.921	3	8.30±0.983	
- Subdural hematoma	3	8.15±0.903	4	8.10±0.991	
Length of stay in hospital (days):					
- < 5	17	10.25±0.902	12	9.59±0.980	U = 3.27 P= 0.001**
- 5 – 10	14	9.23±0.992	15	9.77±0.943	
- 10 +	9	8.08±0.994	13	7.81±0.100	
Duration of mechanical ventilation (days):					
- < 5	15	9.53±0.960	16	8.78±0.964	U = 3.61 P= 0.001**
- 5 – 10	21	10.20±0.901	18	9.68±0.925	
- 10 +	4	7.69±0.965	6	7.40±0.103	

U, p: U and p values for Mann Whitney test. H, p: H and p values for Kruskal Wallis test.
*: Statistically significant at p ≤ 0.05. **Highly significant at p < 0.001.

Table (4): Multivariate regression analysis of factors increasing pain intensity among the studied patients' (group A & group B), (n=80).

Factors affecting pain intensity	Group A		Group B	
	t	P-value	t	P-value
Length of stay in hospital.	0.750	0.830	0.596	0.660
Duration of mechanical ventilation.	1.870	0.077	1.310	0.089
Glasgow coma score.	5.734	0.001**	6.986	0.001**
Current Diagnosis/Co-morbidities.	3.954	0.001**	3.887	0.001**
R2 = 0.476, SE = 1.5, p = 0.001**				

t, p: t and p values for t-test *: Statistically significant at $p \leq 0.05$
**Highly significant at $p < 0.001$. R_2: Regression coefficient. SE: standard error.

Table (5): The mean score of the studied patients (group A & group B) according to their pain assessment scale, (n=80).

Pain assessment scale	Group (A) n=(40).	Group (B) n=(40).	Significance test	
	Mean ± SD	Mean ± SD	T-test	P-value
Total	10.45±0.904	9.85±0.975	62.72	0.001**

*Significant at $p \leq 0.05$. **Highly significant at $p < 0.001$

Table (6): Illustrates the relationships between the mean Glasgow coma scores differences among the studied patients' (group A & group B) and their bio-demographic data. It can be distinguished that there were highly statistically significant differences found between the mean Glasgow coma scores differences among the studied patients' (group A & group B) and the all items of their bio-demographic data, at (P <0.001).

Bio-demographic data	Group A		Group B		Significance test
	No.	Glasgow coma score	No.	Glasgow coma score	
		Mean ± SD		Mean ± SD	
Age (Years):					
- 18 – 28	7	8.62±4.16	5	8.88±3.70	H = 4.70 P= 0.001**
- 29 – 39	6	7.41±3.11	8	8.17±3.18	
- 40 – 50	10	7.12±2.17	12	9.10±3.65	
- 51 - 60	17	6.77±1.80	15	9.45±3.99	
Sex:					
- Male	27	7.80±4.01	29	9.00±2.99	U = 5.12 P= 0.001**
- Female	13	6.53±3.20	11	8.78±2.82	

Diagnosis:					
- COPD	11	7.90±4.00	18	9.84±3.90	U = 5.31 P= 0.001**
- Pulmonary edema	15	8.42±4.12	10	9.27±3.64	
- Post arrest	6	7.50±3.90	5	8.19±2.73	
- Myocardial infarction	5	6.80±2.81	3	7.45±2.76	
- Subdural hematoma	3	5.80±2.00	4	7.36±2.50	
Length of stay in hospital (days):					
- < 5	17	7.91±4.02	12	8.69±3.56	U = 5.42 P= 0.001**
- 5 – 10	14	7.55±4.00	15	8.98±3.80	
- 10 +	9	6.22±3.70	13	9.19±3.72	
Duration of mechanical ventilation (days):					
- < 5	15	8.35±4.11	16	8.60±2.71	U = 5.97 P= 0.001**
- 5 – 10	21	5.60±1.99	18	8.67±2.88	
- 10 +	4	5.45±1.70	6	7.81±2.91	

Table (7): Describes the relationships between the mean pain intensity scores differences among the studied patients' (group A & group B) and their bio-demographic data. It can be noted that there were highly statistically significant differences found between the mean pain intensity scores differences among the studied patients' (group A & group B) and the all items of their bio-demographic data, at (P <0.001).

Bio-demographic data	Group A		Group B		Significance test
	No.	Pain intensity score Mean ± SD	No.	Pain intensity score Mean ± SD	
Age (Years):					
- 18 – 28	7	8.80±0.977	5	7.77±0.970	H = 3.66 P= 0.001**
- 29 – 39	6	8.77±0.960	8	7.80±0.982	
- 40 – 50	10	9.49±0.980	12	8.84±0.966	
- 51 - 60	17	10.16±0.900	15	9.70±0.960	
Sex:					
- Male	27	10.20±0.880	29	9.17±0.951	U = 5.57 P= 0.001**
- Female	13	9.33±0.940	11	8.70±0.984	
Diagnosis:					
- COPD	11	10.00±0.893	18	9.65±0.957	U = 3.3 P= 0.001**
- Pulmonary edema	15	10.31±0.870	10	9.43±0.971	
- Post arrest	6	9.91±0.943	5	8.74±0.989	
- Myocardial infarction	5	8.44±0.921	3	8.30±0.983	
- Subdural hematoma	3	8.15±0.903	4	8.10±0.991	

Length of stay in hospital (days):					
- < 5	17	10.25±0.902	12	9.59±0.980	U = 3.27 P= 0.001**
- 5 – 10	14	9.23±0.992	15	9.77±0.943	
- 10 +	9	8.08±0.994	13	7.81±0.100	
Duration of mechanical ventilation (days):					
- < 5	15	9.53±0.960	16	8.78±0.964	U = 3.61 P= 0.001**
- 5 – 10	21	10.20±0.901	18	9.68±0.925	
- 10 +	4	7.69±0.965	6	7.40±0.103	

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