ISSN: 1607-8322, e-ISSN: 2220-5799 Anaesthesia, Pain & Intensive Care
Vol 29(7); October 2025 DOI: 10.35975/apic.v29i7.2964

ORIGINAL RESEARCH AIRWAY MANAGEMENT

Effect of open and closed endotracheal suction systems on cardiopulmonary parameters among mechanically ventilated patients: a comparative study

Israa Hassan Jaleel, MSc [1] , Hussam Abbas Dawood, PhD [2]

Authors affiliations:

1. Israa Hassan Jaleel, MSc, Adult Nursing, College of Nursing, University of Kerbala, Kerbala, Iraq; Email: israa.hasan@s.uokerbala.edu.iq
2. Hussam Abbas Dawood, Asst. Prof. Dr. Adult Nursing, College of Nursing, University of Kerbala; Nursing Department, Al-Zahrawi University College, Kerbala, Iraq; Email: hussam.a@uokerbala.edu.iq; hussam.abbas@alzahu.edu.iq

Correspondence: Israa H. Jaleel**; Email:** jaleelisraa025@gmail.com; **Mobile:** 964 7717959482

ABSTRACT

Background & objective: Endotracheal intubation is performed as a part of the majority of all general anesthesia cases, and periodic suction is a routine part of treatment. Intubation stimulates mucus production, which needs to be removed by suction. But suction has some serious side effects, including hypoxia and cardiovascular stimulation. To determine the least harmful method of endotracheal tube suction, we conducted this study to compare open and closed suction systems and their effect on cardiopulmonary parameters in patients on mechanical ventilation.

Methodology: For this research, a method known as quasi-experimental research methodology was used. Eighty patients from the intensive care unit (ICU) were included in a purposive sample. Three sections of the patient evaluation document—biodemographic information, health-related information, and the cardiopulmonary parameters (heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), respiratory rate (RR), and oxygen saturation (SpO_2) analysis sheet—were retrieved from the patients' history sheets.

Results: There were notable differences in the closed suction method in terms of SpO_2, HR, and RR based on the mean scores of cardiopulmonary parameters, between the readings before and after suctioning. However, MAP, DBP, and SBP did not significantly differ from one another.

Conclusion: The use of a closed suction system versus an open one, during mechanical ventilation, results in fewer changes in the cardiopulmonary parameters of the ventilated patients.

Abbreviations: ANOVA: One-way analysis of variance, CVA: cerebrovascular accident, DBP: diastolic blood pressure, DM: Diabetes Mellitus, ETT: endotracheal tube, MAP: mean arterial pressure, VAP: ventilator-associated pneumonia

Keywords: Cardiopulmonary Parameters; Closed suction system; Endotracheal intubation; Mechanical Ventilation; Open suction system

Citation: Jaleel IH, Dawood HA. Effect of open and closed endotracheal suction systems on cardiopulmonary parameters among mechanically ventilated patients: a comparative study. Anaesth. pain intensive care 2025;29(7):734-742. DOI: 10.35975/apic.v29i7.2964

Received: May 09, 2025; **Revised:** October 26, 2024; **Accepted:** January 01, 2025

1. INTRODUCTION

The heart and lungs are the two major organs of the human body. Due to an ongoing connection as a single system, the heart and respiratory systems are unable to function as separate organs. People cannot live normal, healthy lives absent both. A patient's cardiopulmonary runs is impaired by the post-anesthesia effect and any other negative impacts of the procedure, so after any cardiopulmonary operations, they are sent to the intensive care unit (ICU) for hemodynamic control,

appropriate volume therapy, and treatment with positive inotropes and vasopressors.[1]

For patients with respiratory distress, invasive ventilatory support and endotracheal tube placement are life-saving procedures, and pulmonary suction is crucial for sustaining airway integrity.[2] The ability of intubated patients to maintain their airways is generally reduced, and they frequently produce excess mucus. In addition to respiratory effort, hypoxemia, hypercapnia, and increased resistance to oxygen, this can raise the patient's risk of infection.[3] Endotracheal suction is a common invasive technique used by clinicians in order to help patients remove lung secretions and maintain open airways and the best oxygenation in patients in the intensive care unit (ICU) who have an endotracheal tube (ETT).[4] However, endotracheal suction (ETS) is a distracting procedure that carries a degree of risk. When ETS is used instead of evidence-based therapy, it may result in, among other effects, atelectasis, oxygen depletion, sympathetic stimulation, bradycardia, tracheobronchial injury, and increased pressure inside the skull when ventilation-associated pneumonia (VAP) occurs.[5]

The two methods currently used to remove sputum from patients on mechanical ventilation are open endotracheal suction and closed endotracheal suction.[6] When suctioning with an open system, the patient isn't connected to the ventilator; therefore, they do not get oxygenated air or airway pressure. In a closed system, the patient continues to get oxygenated air and pressure as long as he is connected to the ventilator during vacuuming.[7]

Closed suction systems, on the other hand, do not require separating, allowing PEEP and oxygen administration to continue while vacuuming, thus improving blood oxygenation. A few thoughts suggest that because CSS systems use a catheter that links to the ventilator circuit and endotracheal tube in a frequently sterile access, they protect patients from infection better than open suction (OS) systems.[8] Many studies assessed the impacts of open and closed suction systems on physiological indicators. Some of these studies showed that differences between the two suctioning devices were clinically significant, regarding hemodynamic parameters, including heart rate, SpO_2, and blood pressure.[9-11]

We conducted this study to find out the relationship between the effects of open and closed suction systems on cardiopulmonary parameters with demographic and clinical data.

2. METHODOLOGY

The study of the relationship was conducted on 80 patients on ventilation in the intensive care unit (ICU) of the Imam Al-Hussein Medical City in Holy Kerbala, as well as in the Kerbala Governorate's Imam Al-Hassan Al-Mujtaba Hospital. We included 40 patients in the closed suction group (CS Group) and 40 patients in the open suction group (OS Group). A closed-endotracheal suction system was used as an experimental technique, while the control group was given just standard care (open endotracheal suction system). A nonprobability (intended) sampling approach was used to select the sample.

From December 25, 2024, to February 28, 2025, participants were enrolled. G*Power calculator, was used to calculate the appropriate sample size,[2] with a confidence level of 95%, a 0.80 statistical power, and a 0.05 probability level.

The researcherd developed an experimental plan for this investigation. The patient identification group conducted an initial assessment to ensure that the patients matched the inclusion criteria. All selected patients were divided into two identical groups—the CS group and the OS group—by randomization using the coin toss method.

The vacuum procedure was performed in accordance with the guidelines set up by the American Association for Respiratory Care (AARC). The endotracheal suction was carried out by a researcher in the intensive care unit. Disposable catheters and full barrier measures (gloves and hand washing) were used for aspirating in the OTSS group. Patients were pre-oxygenated for two minutes before being aspirated. The CTSS group's respiratory system suction supplies, the 14 Fr Suction Catheter for Closed Suction Systems, were replaced. As with the other group, patients were pre-oxygenated, and suction was done without removing them from the ventilator.

The following VAP prevention techniques have been used for all patients: maintaining cuff pressure between 20 and 30 mmHg, continuously eliminating subglottic secretions, avoiding unnecessary intubation or extubation, elevating the head (30 to 40), using suction only when essential, and avoiding routine alterations to the respiratory circuitry unless essential. Every intervention was done by the researcher. Then, during the morning shift, each session lasted 25 to 30 minutes for approximately five patients per day. Between January 19th, 2025, and April 19th, 2025, data were collected. The primary investigator developed this tool after reviewing the appropriate research.[13-15] It consists of two parts.

First Section: Health-Related Information and Sociodemographic Features: This section was used to gather data on the patients' sociodemographic profile, including age, sex, occupation, and smoking status. It also contained important health data about the patient, including the length of time spent in the intensive care

Table 1: Comparative socio-demographic characteristics of the two study groups

Variables		Open Suction (n = 40)	Closed Suction (n = 40)	Variance test
Age (year)	20 – 29	3 (7.5)	3 (7.5)	Λ = 1.495 P = .225
	30 – 39	1 (2.5)	1 (2.5)	
	40 – 49	3 (7.5)	1 (2.5)	
	50 – 59	5 (12.5)	3 7.5 (55)	
	60 – 69	14 (35)	22 (25)	
	70 – 79	10 (25)	10 (25)	
	80 –89	4 (10)	0 (0)	
	Mean ± SD	*62.8 ± 15.7*	*62.2 ± 14*	
Sex	Male	20 (50)	22 (55)	Λ = .394 P = .532
	Female	20 (50)	18 (45)	
Occupation	Doesn't work	20 (50)	19 (47.5)	Λ = 4.391 P = .039
	Employee	3 (7.5)	8 (20)	
	Free work	15 (37.5)	13 (32.5)	
	Retired	2 (5)	0 ()	
Smoking	Never	17 (42.5)	18 (45)	Λ = 11.854 P = .001
	1 – 20	23 (57.5)	13 (32.5)	
	21 – 40	0 (0)	9 (22.5)	

Data presented as n (%); Λ= Levene's Test; P < 0.05 considered as significant

unit, the kind of endotracheal suction system, the patient's current diagnosis, and any prior medical records.

The second section, Physiological Parameters, was drawn from [11,14], and used for recording respiratory rate, heart rate, systolic and diastolic blood pressure, mean arterial pressure, and oxygen saturation at four different points in time. The data from the current study were analyzed using Microsoft Excel 2010 and SPSS version 25, two data analysis tools. Both descriptive and inferential investigation techniques have been employed: analyzing the sample's general findings and comparing each variable. Tables have been developed using the frequency (F), percentage, and basic statistical data such as the mean ± SD. % = Percentage = Sample size 100 Frequencies. A-Score Average: The average score is used to assess each person's oxygen saturation level. The hypothesis of the study is tested using the following inferential statistics:A. One-way analysis of variance (ANOVA) was utilized in the calculations of variance statistics to evaluate the differences between two groups. B. The t-test for sample independence, which evaluates the study and control groups' pre- and post-experiment outcomes. C: If a p-value was less than 0.05, it was accepted as statistically significant. E. Point Biserial Correlation was applied to determine the significant correlations between the sociodemographic characteristics of patients' sex and the effects on the two open and CS systems. The impact of both open and CS systems on the patients' sociodemographic characteristics (age, occupation, chronic disease, smoking, and current diagnosis) has been investigated using the F. Spearman's rank correlation coefficient. The G. Kolmogorov Smirnov Test is used to decide if a sample is normally distributed.

3. RESULTS

The sociodemographic characteristics of the patients in this research study are descriptively displayed in Table 1. According to the findings, patients in the OS group are on average 62.8±15.7 years old, whereas those in the CS group are on average 62.2±14 years old. The 60–69 group reported the highest percentages for patients in the two categories (35% and 55%, respectively). The variance test indicates that there are no statistically significant differences in age between the two groups (Λ = 1.495, P = .225). Male patients (55%) predominate over female patients (45%) in the CS group, while the proportion of male and female patients matches that in the OS group (50%).

According to the variance test, there is no sex-based statistically significant variance among the two groups (Λ =.394, P =.532). Compared to those who have no job (37.5% in the OS group and 32.5% in the CS group, respectively), a larger percentage of patients in both groups are "not working" (50 and 47.5%, respectively). The two occupation-related groups differ significantly, based on the variance test (κ = 4.391, P = .039). 57.2% of patients in the OS group and 32.5% of patients in the CS group smoke "1–20" cigarettes, based on the results. The variance test shows a highly significant distinction between the two groups based on smoking patterns (Λ = 11.854, P = .001).

The physiological characteristics of the patients are presented in Table 2. It is found that 62.5% of the patients in the CS group remained "4–6" days in the hospital, while 62.5% of the patients in the OS group stayed "7–12" days in the intensive care unit (ICU). The

Table 2: Comparison of clinical characteristics of the two groups

Characteristics		Open Suction (n = 40)		Closed Suction (n = 40)		Variance test
Duration of ICU stay (Days)		7 – 12	25 (62.5)	1 – 3	9 (22.5)	Λ = 5.563 P = .021
		13 - 18	10 (25)	4 - 6	25 (62.5)	
		19 – 23	5 (12.5)	7 – 9	6 (15)	
		Total	**40 (100)**	**Total**	**40 (100)**	
Chronic Diseases	DM	1 (2.5)		1 (2.5)		Λ = 1.172 P = 282
	Hypertension	4 (10)		10 (25)		
	CVA	2 (5)		1 (2.5)		
	Breast tumor	1 (2.5)		1 (2.5)		
	DM + HT	8 (20)		10 (25)		
	DM+HT+CVA	7 (17.5)		3 (7.5)		
	HT+CVA	5 (12.5)		2 (5)		
	Kidney + HT	1 (2.5)		2 (5)		
	HF	4 (10)		4 (10)		
	HF + DM	1 (2.5)		0 (0)		
	No disease	6 (15)		3 (7.5)		
	Others	0 (0)		3 (7.5)		
Current Diagnosis	CVA	27 (67.5)		31 (77.5)		Λ = 044 P = .834
	Hematoma	4 (10)		1 (2.5)		
	Brain tumor	2 (5)		1 (2.5)		
	Lung cancer	1 (2.5)		2 (5)		
	Shock	5 (12.5)		3 (7.5)		
	IHD	1 (2.5)		2 (2.5)		

Data presented as n (%); Λ= Levene's Test; P < 0.05 considered Significant

variance test shows that the two groups vary significantly in how long they spent in the intensive care unit (Λ = 5.563, P = .021). While the OS group observed greater rates of DM+HT+ cerebrovascular accident (CVA) (17.5% vs. 7.5%) and HT+CVA (12.5% vs. 5%), the CS group exhibited significantly higher rates of DM+HT comorbidity (20% vs. 25%) and hypertension (10% vs. 25%) for chronic conditions. The physiological characteristics of the patients are presented in Table 2. It is found that 62.5% of the patients in the CS group remained "4–6" days in the hospital, while 62.5% of the patients in the OS group stayed "7–12" days in the intensive care unit (ICU). The variance test shows that the two groups vary significantly in how long they spent in the intensive care unit (Λ = 5.563, P = .021). While the OS group observed greater rates of DM+HT+CVA (17.5% vs. 7.5%) and HT+CVA (12.5% vs. 5%), the CS group exhibited significantly higher rates of DM+HT comorbidity (20% vs. 25%) and hypertension (10% vs. 25%) for chronic conditions.

Table 3 demonstrates the relationship between the effect of the OS system and a number of patient demographic characteristics. In the OS system, there is an important association between smoking and sex; males have a mean score that is lower (82.25) than females (89.90), and this relationship is highly significant (P = .019, Sig = S). In addition, patients who do not smoke have a higher average score (89.65) than smokers (P = .047, Sig = S). However, there are no significant correlations identified between occupation (P = .100, Sig = N.S.) and age (P = .054, Sig = N.S.).

Table 4 indicates that the effect of the CS equipment is related to the sociodemographic characteristics of the patients. The substantially higher mean score (97.67) for patients in the 20–29 age group suggests that patients who are younger may benefit more from the CS system than older ones (P = .014, Sig = S). Smoking (P = .949), sex (P = .288), and occupation (P = .415) were not significantly related, suggesting that these factors had little effect on the CS system's performance.

Table 3: The relationship between the effect of open suction system and sociodemographic parameters

Variables		Open Suction System	
		Mean ± SD	Relationship
Age (year)	20 – 29	95.33 ± 2.309	r^s =.307 P = .054
	30 – 39	95.00 ± 2.039	
	40 – 49	94.67 ± 12.858	
	50 – 59	89.80 ± 3.493	
	60 – 69	79.86 ± 17.146	
	70 – 79	86.60 ± 14.308	
	80 +	86.25 ± 12.010	
	Total	86.08 ± 14.014	
Gender	Male	82.25 ± 11.530	r^* = .369 P = .019
	Female	89.90 ± 15.471	
	Total	86.08 ± 14.014	
Occupation	Doesn't work	88.45 ± 15.336	r^s =.264 P = .100
	Employee	90.67 ± 2.309	
	Free work	83.93 ± 12.997	
	Retired	71.50 ± 12.021	
	Total	86.08 ± 14.014	
Smoking	Never	89.65 ± 16.632	r^s =.316 P = .047
	1 – 20	83.43 ± 11.393	
	Total	86.08 ± 14.014	

r^s: Spearman Correlation coefficient, r^*: Biserial correlation coefficient, P < 0.05 considered as significant

Table 5 shows the correlation between the CS system's effect and patient clinical parameters. The highest average score (106.50) was found in patients with ischemic heart disease (IHD), establishing a possible link between specific conditions and the effectiveness of the CS system. For the current diagnosis, a significant link has been identified (P = .034, Sig = S). There were no significant correlations between the length of hospital admissions in the intensive care unit (ICU) (P = .849) and chronic illnesses (P = .105).

4. DISCUSSION

The lungs of patients are two spongy structures in the chest that gather oxygen when you breathe in and produce CO2 when you're breathing the opposite.[16] One of the most essential operations critical care nurses perform in intensive care units (ICUs) to eliminate lung secretions is endotracheal suction. This procedure makes breathing more comfortable and raises oxygenation levels. It also prevents secretion collection, lung infections, and atelectasis.[9] Endotracheal aspirations can be performed in one of two ways: open suction, which includes detaching the patient from the ventilator, or closed suction, which involves placing a sterile tube into the ventilation system without detaching the patient. When OS is applied, a sudden reduction in airway pressure caused by detaching from the ventilator and negative pressure aspiration could result in alveolar decruitment and rupture.

The patient continues to be attached to the ventilator during closed aspiration, which restricts alveolar decruitment and lowers volume reduction.[17] Imam Al-Hussein Medical City in Holy Kerbala's intensive care unit (ICU) and the Imam Al-Hassan Al-Mujtaba Teaching Hospital's intensive care unit in the Kerbala Governorate in both we used open and closed endotracheal suction systems for evaluating the cardiopulmonary parameters in mechanically ventilated patients. provided information based on sociodemographic variables. The 60–69 age group accounted for 35% and 55% of the patients in the CS system and the OS system, respectively. Based on an earlier analysis by Mohamad H, et al (2023).[9] In both the CS and OS systems, almost all of the patients (61.7% and 53.25%, respectively) were over 60 years. The researcher justified these findings by pointing to the increasing demand for mechanical ventilation in older individuals, which is caused by an elevated risk of chronic illnesses, including diabetes and hypertension, as well as an increased risk of CVA and decreased level of consciousness.

A control group (open suction) encompassed 50% men and 50% women, while an experimental group (closed suction) had 55% males and 45% women, depending on the study's sex variable. This study's findings are supported by research carried out by Sagheer ZS, et al (2023).[18] There were 23.3% women and 76.7% men in the intervention group, while there were 73.3% men and 26.7% women in the control group. The researcher justified these findings by pointing to the increasing demand for mechanical ventilation in older individuals, which is caused by an elevated risk of chronic illnesses, including diabetes and hypertension, as well as an increased risk of CVA and decreased level of consciousness.

Table 4: The Relationship between the effect of the closed suction system and sociodemographic parameters

Variables		Closed Suction System	
		Mean ±SD	Relationship
Age (year)	20 – 29	97.67 ±14.742	rs = .385
	30 – 39	84.00 ± 0	P = .014
	40 – 49	73.00 ± 0	
	50 – 59	95.67 ±3.786	
	60 – 69	97.45 ±16.315	
	70 – 79	106.60 ±16.208	
	Total	98.68 ±15.999	
Sex	Male	95.18 ±17.754	r* = .172
	Female	102.94 ±12.758	P = .288
	Total	98.68 ±15.999	
Occupation	Doesn't work	95.21 ±14.902	rs =. 133
	Employee	108.38 ±15.684	P = .415
	Free work	97.77 ±16.513	
	Total	98.68 ±15.999	
Smoking	Never	101.06 ±11.435	rs = .010
	1 – 20	93.62 ±22.209	P = .949
	21 – 40	101.22 ±12.979	
	Total	98.68 ±15.999	

r^s: Spearman Correlation coefficient, r^*: Biserial correlation coefficient, P < 0.05 considered as significant

Finally, 57.5% of patients in the control group were categorized as having 1–20 cigarettes, while approximately 45% of participants in the intervention group did not smoke. This outcome is comparable to the research carried out earlier.[11] According to the study's outcomes, roughly 70% of the patients in the intervention group and 80% of the patients in the control group did not smoke. The researcher explained these results by stating that smoking is a contributory factor rather than the actual cause of CVA.

Furthermore, the data demonstrate that the control group patients stayed in the hospital longer than the interventional group. These findings were also shown by in the study results of [19] . This also showed that a greater proportion of the people in the control group spent more days in the hospital than those in the interventional group. Approximately 53.3% of patients reside in the intensive care unit for less than three days, whereas 93.3% of participants remain there for longer than six days.

The researcher confirmed these results by stating that the implementation of a CS device improved the conditions and reduced the length of hospital stays. Additionally, the findings show that whereas hypertension (25%) and HT+D.M. (25%) were more common in the CS group, chronic illnesses and DM+HT comorbidity (20%) were significantly greater in the OS group. According to the researcher, these results suggest that diabetes mellitus and hypertension are the two main chronic illnesses that raise the risk of CVA and ICU admission. Comparable outcomes were shown by the study results of Zohary AS, et al (2022).[19] Approximately 51.1% of the people in the interventional group had heart disease, whereas 57.4% of the participants in the control group had diabetes mellitus. Regarding the present diagnosis, the majority of the sample was diagnosed with CVA; the relevant percentages for the control and study groups were roughly 67.5% and 77.5%. According to the researcher's hypothesis, CVA is one of the main diseases that requires mechanical ventilation and intensive care unit admission because it affects the respiratory system. The findings of the study, which suggested that half of the subjects (50%) had a neurological problem, were verified by Elmelegy OE, Ahmed R (2016). [20]

Patients from both suction system groups were evaluated in terms of cardiac parameters based on the significant variation in oxygen saturation levels. Significant differences between the CS group and the OS group are seen straight away after suction (P = .001) and 15 minutes later (P = .004). The CS group demonstrates increased oxygen saturation. This was consistent with research by Ahmed Sayed Z. (2019),[11] which discovered that the mean oxygen saturation of the CS method was substantially greater than that of the open method, and that the variations between the two methods during and shortly after suction were highly statistically significant. In addition, the results of this study show a statistically significant difference soon after suction (P = .055) in the heart rate (HR) score.

These results have been verified by [14] , who confirmed that the heart rate changes between the suction group and the group soon after suction were significant (P < 0.05). Furthermore, no statistically significant differences in pre-suction were seen between the study groups. Additionally, the readings for mean arterial pressure (MAP), diastolic blood pressure (DBP), and systolic blood pressure (SBP) were taken at different time points.

Table 5: The Relationship between the effect of closed suction system and clinical parameters of patients

Variables		Closed Suction System	
		Mean ± SD	Relationship
Duration of hospitalization in ICU (Day)	1 – 3	97.67 ±21.604	rs =.031 P = .849
	4 - 6	98.52 ±13.926	
	7 – 9	100.83 ±17.646	
	Total	98.68 ±15.999	
Chronic diseases	DM + HT	105.30 ±14.629	rs = .260 P = .105
	DM+HT+CVA	82.67 ±23.692	
	HT+CVA	102.50 ±16.263	
	Kidney + HT	69.50 ±7.778	
	HF	105.50 ±4.359	
	HF + DM	98.67 ±13.051	
	No disease	81.67 ±10.970	
	Total	98.68 ±15.999	
Current Diagnosis	CVA	101.35 ±15.911	rs = .335 P = .034
	Lung cancer	74.00 ±1.414	
	Shock	95.00 ±4.583	
	IHD	106.50 ±.707	
	Total	98.68 ±15.999	

r^s: Spearman Correlation coefficient, r^*: Biserial correlation coefficient, P < 0.05 considered as significant

No significant differences were identified in the results (P > 0.05%).

Additionally, in a study published earlier, the authors highlighted that no discernible variations were found between the two suction techniques in terms of mean arterial pressure, diastolic blood pressure, or systolic blood pressure over the course of five recurrent assessments.[20] Last but not least, the data show that there are notable variations in the respiratory rate (RR) prior to suction (P = .013), five minutes (P = .05), and fifteen minutes (P = .08) post suction. However, there isn't a noticeable change immediately following suction (P = .524). This result correlates with a study by Zohary AS, et al (2022) that found that the open and closed groups' respiratory rates differed during and right after suction in highly statistically significant patterns (P = 0.001).[19]

However, there are no obvious correlations between occupation (P = .100, Sig = N.S.) and age (P = .054, Sig = N.S.). This is in line with the findings of an earlier study,[20] which demonstrates a relationship between sociodemographic information and the average vital sign scores obtained using the OS method. Two to five minutes after suction, an intensely negative correlation between the patient's age and diastolic blood pressure was noted. Additionally, five minutes after suction, there was a strong negative correlation between sex and oxygen saturation. There is a correlation between the influence of the OS system and some patient clinical characteristics, as indicated by the relationship between the two. A major correlation between smoking and chronic diseases was discovered. The OS system is considerably affected by smoking, as seen by the higher average score (89.65) of nonsmoking patients compared to smokers (P = .047, Sig = S). In addition, patients with chronic conditions such as DM had a considerably higher mean score (88.00) for the OS system than patients with other conditions, including hypertension (P = .028, Sig = S).

Based on the findings of the study by Pakizah et al (2023), there is a statistically significant difference between the underlying disorders and the type of situation diagnosed ($P < 0.05$).[21] The significantly higher mean score (97.67) for patients in the 20–29 age group indicates that younger patients may benefit more from the CS system than older individuals (P = .014, Sig = S). Age and O_2 saturation before suction were found to be significantly correlated adversely. There was a substantial positive link between male sex and respiration before and five minutes after suction, whereas there was a significant negative correlation between female patients' respiratory rate at all times of testing.

The results show a correlation between patient clinical variables and effects of the CS system, as well as between the influence of the system and the clinical characteristics of patients. The highest average score (106.50) was found in patients with ischemic heart disease (IHD), suggesting an association between specific conditions and the effectiveness of the CS system. For the current diagnosis, a significant connection was identified (P = .034, Sig = S). According to the findings of an earlier study.[21] There is a statistically significant difference between the underlying disorders and the type of situation diagnosed ($P < 0.05$).

5. CONCLUSION

Cardiopulmonary function was improved more in patients with a closed suction system than in those with

an open suction system. As a result, using a closed suction system is a good way to regulate the instability of cardiopulmonary function and encourage good health in adult patients on mechanical ventilation.

6. Data availability

The numerical data generated by this research are available from the authors.

7. Acknowledgment

All of the patients who took part in the study, and the nursing staff in the ICUs under study are greatly appreciated by the authors for the way they participated.

7. Funding

No external or industry funding was used in the conduct of this study.

8. Conflict of interest

No conflict of interest is declared.

9. Authors' contribution

Both authors took equal part in writing of the manuscript, research design, methodology, analyzing data., write discussion, and providing insights

10. REFERENCES

1. Alshahrani SH, Qureshi AA, Paulsamy P, Venkatesan K, Sethuraj P. The impact of open vs closed suction on cardio-respiratory parameters in mechanically ventilated patients. International Journal of Current Research in Chemistry and Pharmaceutical Sciences. 2021;8(7):33-8. DOI: http://dx.doi.org/10.22192/ijcrcps.2021.08.07.004
2. Gülsoy Z, Karagözoğlu Ş. Efficacy of the closed suction applied to patients in intensive care units with different techniques: A nonrandomized controlled trial. Cumhuriyet Medical Journal. 2020 Oct 27;42(3):290-300. http://dx.doi.org/10.7197/cmj.vi.596113
3. Raoof AA, Baeez YK. Efficiency of the Educational Material in Enhancing Nurses' Understanding of Endotracheal Suctioning at Iraq/Kirkuk City. Journal of Scientific Research in Medical and Biological Sciences. 2024 May 17;5(2):13-9. https://doi.org/10.47631/jsrmbs.v5i2.741
4. Yılmaz İ, Özden D. The effects of open and closed system endotracheal suctioning methods on suctioning frequency, amount of secretion, and haemodynamics: A single-blind, randomised, 2× 2 crossover trial. Australian Critical Care. 2024 Jan 1;37(1):25-33. https://doi.org/10.1016/j.aucc.2023.09.002
5. Singh R, Bhalotra AR, Sharma S. Audit on practices of endotracheal suctioning in intensive care unit patients among Health Care Workers (HCWs). Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 2023 Dec 31;28(1):58. (https://doi.org/10.5005/jp-journals-10071-24615)
6. Li Y, Li X, Wen Z, Zhang X, Liu Y, Wei L. Effect of open versus closed endotracheal suctioning on intracranial pressure in severe brain-injured children: Study protocol for a randomized controlled trial. Nursing Open. 2021 Sep;8(5):2886-91. https://doi.org/10.1002/nop2.656
7. Yilmaz I, Ozden D, Arslan GG. Intensive care nurses' evidence-based knowledge and experiences regarding closed suctioning system. Nigerian Journal of Clinical Practice. 2021 Jun 1;24(6):883-91. DOI: 10.4103/njcp.njcp_211_19
8. Raimundo RD, Sato MA, da Silva TD, de Abreu LC, Valenti VE, Riggs DW, Perrow Carll A. Open and closed endotracheal suction systems divergently affect pulmonary function in mechanically ventilated subjects. Respiratory Care. 2021 May 1;66(5):785-92. https://doi.org/10.4187/respcare.08511
9. Mohamed H, Mahmoud M, Gouda T, Kandeel N. Comparison Between the Effect of Open and Closed Tracheal Suction Systems on Physiological Parameters of Critically Ill Patients. Mansoura Nursing Journal. 2023 Jan 1;10(1):271-82.
10. Afshari A, Safari M, Oshvandi K, Soltanian AR. The effect of the open and closed system suctions on cardiopulmonary parameters: time and costs in patients under mechanical ventilation. Nursing and midwifery studies. 2014 Jun 15;3(2):e14097. (https://pubmed.ncbi.nlm.nih.gov/25414899/)
11. Ahmed Sayed Z. Effect of open versus closed suction system on cardiorespiratory parameters and suction duration among critically ill mechanically ventilated patients. Egyptian Journal of Health Care. 2019 Jun 1;10(2):409-18.
12. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. Behavior research methods. 2009 Nov;41(4):1149-60. https://doi.org/10.3758/BRM.41.4.1149
13. Yildirim S, Saygili SM, Süneçli O, Kirakli C. Comparison of the effects of open and closed aspiration on end-expiratory lung volume in acute respiratory distress syndrome. Korean Journal of Anesthesiology. 2024 Feb 1;77(1):115-21. DOI: https://doi.org/10.4097/kja.23194
14. Elmansy FM, Elbqry MG, Aly AA. Effect Of Closed Versus Open Tracheal Suction On Cardiopulmonary Functions In Mechanically Ventilated Adult Patients: Nursing Practice. Acta Biomed 2024; Vol. 95, N. 1: ISSN: 0392-4203 | eISSN: 2531-6745
15. Mahmood FM, Al-Hakak ZM, Jawad HS. Nurses knowledge toward heparin intake for patient's in intensive care unit at AL-Imam AL-Hussain Medical City in Holy Kerbala. Journal of Global Pharma Technology.

2017;8(9):134-9.

16. Al-Husayn AJ, Alzeyadi S, Athbi HA. Commitment of lung cancer patients with self-care in Al-Imam hussein oncology center at Karbala governorate. Indian Journal of Public Health Research & Development. 2018;9(8):1075-9.
17. Yildirim S, Saygili SM, Süneçli O, Kirakli C. Comparison of the effects of open and closed aspiration on end-expiratory lung volume in acute respiratory distress syndrome. Korean Journal of Anesthesiology. 2024 Feb 1;77(1):115-21. https://doi.org/10.4097/kja.23194
18. Sagheer ZS, Dawood HA. Effectiveness of foot massage on selected physiological parameters among patients with acute coronary syndrome. Current Problems in Cardiology. 2024 Nov 1;49(11):102780. https://doi.org/10.1016/j.cpcardiol.2024.102780
19. Zohary AS, Mohieldeen ZM, Mohammed AA, Hussien AA. The Effect of Closed Versus Open Suction on Cardiorespiratory Parameters in Mechanically Ventilated Children. Assiut Scientific Nursing Journal. 2022 Nov 1;10(33):178-87. https://dx.doi.org/10.21608/asnj.2023.174003.1451
20. Elmelegy OE, Ahmed R. Effect of open versus closed endotracheal suctioning system on vital signs among mechanically ventilated patients in ICU. Journal of Nursing and Health Science. 2016;5(6):91-100. DOI: 10.9790/1959-0504XXXXX
21. Pakizeh Z, Asadizaker M, Shariati A, Savaie M, Saki A. Comparison of the effect of open and closed suction methods on the incidence of hypoxia and Ventilator-Associated Pneumonia (VAP) in the patients admitted to the ICU-A clinical trial study , 01 September 2023. https://doi.org/10.21203/rs.3.rs-3214173/v1

