Effect of Endotracheal Suctioning With and Without Normal Saline on Arterial Blood Gas valus Among Mechanically Ventilated Patient. A Quasi-Experimental Study

Hasan Asmael Daoud[1], Fatma Makee Mahmood[2]

[1,2] Department of Adult Nursing, College of Nursing, University of Kerbala, Iraq.

Email: Fatima.makki@uokerbala.edu.iq (Corresponding Author)

Kerbala Journal of Nursing and Health Sciences

Received: 14 / 7 /2025
Accepted: 1 / 9 /2025
Published: 31/ 3 /2026

DOI: 10.65682/kjnhs.v2.i1.59-69

Abstract

Background: Endotracheal suctioning is a common procedure in mechanically ventilated patients to maintain airway patency. The use of normal saline instillation prior to suctioning remains controversial due to its potential impact on arterial blood gas (ABG) values. Objective This quasi-experimental study aimed to evaluate the effect of endotracheal suctioning with and without normal saline on arterial blood gas values in mechanically ventilated adult patients and determine which of the two methods (with or without saline) is more effective in improving oxygenation and reducing airway resistance.

Methods: A quasi-experimental design was used in the study. This study was initiated from 19th September 2024 to 30th July 2025 at the ICU at Imam Al-Hussein Medical City and the ICU unit of Imam Al-Hassan Al-Mujtaba Teaching Hospital in Holy Kerbala, Iraq. In Kerbala, purposive sampling was used to select the participants. A total of patients receiving mechanical ventilation in the intensive care unit (ICU) were enrolled. Patients were divided into two groups: one group received endotracheal suctioning with normal saline instillation, and the other without saline. Arterial blood gas parameters (PaO_2, $PaCO_2$, and pH) were measured before and after the procedure. Statistical analysis was conducted using SPSS version .

Results: The results showed no statistically significant differences between the two groups in demographic characteristics, except for shorter ICU stay in the saline group ($p = 0.037$). This group achieved significant improvements in arterial blood gas values, with PaO_2 increasing and $PaCO_2$ decreasing as pH stabilized. Effect sizes were large for respiratory volume and ventilation pressures. In contrast, the untreated group recorded limited changes, with small effect sizes. The study also demonstrated a significant effect of some demographic factors, such as age and medical diagnosis, on physiological responses at a significant rate within each group.

Conclusion: Endotracheal suctioning with normal saline instillation resulted in more favorable outcomes in terms of gas exchange compared to suctioning without saline. The use of N/S appears to improve secretion clearance, ventilation efficiency, and oxygenation, supporting its clinical utility in mechanically ventilated patients.

Recommendations: The use of saline prior to tube suctioning is recommended in the presence of thick secretions or inadequate gas exchange, and its routine use should be avoided without necessity. Standardized suction protocols should be developed, supported by ongoing training and close monitoring of vital signs. The use of humidification or inhaled saline is also recommended to improve secretion fluidity. Finally, future studies are needed to evaluate the effect of the suctioning with normal saline instillation on infection and quality of care.

Keywords: Endotracheal suctioning, normal saline, arterial blood gases, mechanically ventilated patients, ICU, quasi-experimental study.

1. Introduction

Endotracheal suctioning is a critical procedure in intensive care units (ICUs), especially for patients receiving mechanical ventilation. It serves to remove secretions and maintain airway patency, thus preventing complications such as atelectasis, hypoxemia, and pneumonia. Despite its necessity, suctioning may be associated with physiological disturbances, including changes in arterial blood gases (ABGs)(Urden et al., 2021).Despite its importance, ETS is associated with various potential risks, including mucosal injury, hypoxemia, and increased risk of infection, making it a significant focus for ongoing research and clinical improvement. Studies have indicated considerable variability in suctioning techniques such as the choice between open and closed systems, the use of saline instillation, and the frequency of suctioning all of which impact the effectiveness and outcomes of the procedure(Restrepo et al., 2010).However, academic debate persists regarding the most effective protocols, especially those aimed at minimizing contamination, selecting appropriate methods, and adapting techniques to various clinical scenarios such as in patients with hypersensitivity or compromised cardiac and respiratory function(Norman-Bruce et al., 2024).

Clinical practice guidelines are defined as systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances. As a high level of evidence in the evidence hierarchy, such guidelines help reduce inappropriate variations in clinical practice and promote high-quality care delivery (Chen et al., 2021) . For example, in 2022, the American Association for Respiratory Care (AARC) issued clinical practice guidelines that included (Esmaeili et al., 2020), recommendations to promote safe ETS for patients on mechanical ventilation. However, despite these efforts, a gap remains between evidence and actual clinical practice Esmaeili, M., Abbasi, Z., Shafei Lashkarian, M. & Sadeghi, T. Comparing the effect of using normal saline and distilled water for tracheal suctioning on the incidence of ventilator-associated pneumonia and hemodynamic indexes in ventilator-dependent patients. J. Clin. Nurs. Midwifery 9, 689–698 (2020).Research from countries such as Canada, France, Australia, and Italy revealed that many nurses were unaware of the existence of ETS guidelines or lacked sufficient knowledge to apply them correctly, leading to practices inconsistent with evidence-based recommendations 4Furthermore, a search of major databases including the Cochrane Library, Joanna Briggs Institute, and PubMed found no systematic or scoping reviews exploring how healthcare professionals' competence in tracheal suctioning is assessed, highlighting a significant gap in the literature (Miller et al., 2019).It can therefore be concluded that some current nursing practices related to ETS may be outdated and potentially jeopardize patient safety and care quality.

This underscores the need for practice reform and for aligning clinical practice with current guideline recommendations to ensure evidence-based care by ICU nurses .Physiologically, the cardiopulmonary system operates as an integrated unit, and its function is often compromised following surgery and anesthesia, necessitating intensive care monitoring and mechanical ventilation. However, this intervention reduces the patient's ability to clear airway secretions, necessitating intermittent suctioning. Normal saline instillation prior to suctioning has long been practiced under the assumption that it helps loosen secretions, making suctioning more effective. However, this practice remains controversial due to conflicting evidence regarding its benefits and risks. Several studies have reported improved oxygenation post-suctioning with saline use, while others have documented transient hypoxemia, increased intracranial pressure, and cardiovascular instabilit (Alshahrani et al., 2021). Recommended practices for safe suctioning include elevating the head of the bed to 30–45 degrees unless contraindicated, using suction catheters that are less than half the internal diameter of the endotracheal tube, maintaining suction pressures between 80–120 mmHg, limiting suction duration to less than 15 seconds, avoiding deep suctioning and routine saline instillation, pre-oxygenating with 100% oxygen for at least 30 seconds before and after the procedure, and applying aseptic technique throughout. Both open and closed suction systems are accepted, although closed systems allow suctioning without disconnecting the ventilator, thereby reducing infection risk 8 Regarding normal saline instillation, although some studies discourage its routine use, others suggest that when applied according to strict protocols in selected cases, it may aid secretion clearance and improve oxygen saturation in mechanically ventilated patients (Esmaeili et al., 2020).

1.1.Objective of the study

This study aims to evaluate the effect of endotracheal suctioning with and without normal saline instillation on arterial blood gas parameters in adult patients receiving mechanical ventilation and Which method is better to improve arterial blood gases and Relation between the effect endotracheal suction with and without N/S group on atrial blood gases of critical patients with their demographic characteristics and clinical data.

2. Materials and Methods

The methodology employed in this quasi-experimental study was designed to investigate the effect of endotracheal suctioning with and without normal saline on arterial blood gases in mechanically ventilated patients. The study was conducted over a period extending from September 19, 2024, to July 30, 2025, and involved non-random assignment of participants to either the intervention or control groups, making this design appropriate for clinical settings where full randomization is not feasible.Prior to data collection, the necessary administrative and ethical approvals were obtained from the University of Kerbala/College of Nursing and the Kerbala Health Directorate. The research was implemented in the intensive care units of two major hospitals in Kerbala, Iraq Imam Al-Hussein Medical City and Imam Al-Hassan Al-Mujtaba Teaching Hospital which serve a wide variety of critically ill patients and offer advanced intensive care services. The target population included mechanically ventilated adult patients. Out of 117 initially assessed, 70 patients were identified as eligible based on inclusion criteria such as age over 18 years, intubation for at least 48 hours, stable hemodynamic status, and the presence of audible or visible secretions. Exclusion criteria included patients with tracheostomy, unstable vital signs, high ventilator requirements, severe respiratory infections, or contraindications to normal saline instillation. After applying these criteria, a total of 60 patients were included and equally divided into two groups: one receiving endotracheal suctioning with normal saline instillation and the other without.The interventional protocol was structured in accordance with the 2022 American Association for Respiratory Care (AARC) guidelines and supported by evidence from the literature. All participants underwent pre-oxygenation with 100% oxygen for two minutes before suctioning. The suctioning itself was conducted under aseptic conditions, with suction pressure maintained between 80–120 mmHg. In the control group, standard sterile suctioning was performed without saline, while in the intervention group, (5–10 ml)of sterile normal saline was instilled into the endotracheal tube prior to suctioning.To measure the effects of the intervention, data were collected at five time points: before suctioning, immediately after, and at 5, 10, and 20 minutes post-procedure. Physiological parameters including heart rate, respiratory rate, blood pressure, and oxygen saturation were monitored using a PHILIPS MX550 device. Ventilator parameters such as tidal volume, minute ventilation, PEEP, peak airway pressure, and plateau pressure were recorded from the ventilator display. Arterial blood gases including pH, PaO_2, $PaCO_2$, HCO_3, and SaO_2—were measured using the ABL800 FLEX PLUS analyzer.The data collection tool was developed by the principal investigator based on prior validated instruments from relevant studies. It consisted of two parts: the first captured socio-demographic and health-related data from patient records, and the second documented the physiological parameters before and after suctioning. The tool underwent both content and face validation. A panel of 13 experts from various nursing and medical specialties assessed its relevance, clarity, and comprehensiveness.

A pilot study conducted on 10 patients further confirmed the tool's feasibility, clarity, and reliability in a real clinical setting.Reliability of the clinical measurements was ensured by the use of calibrated and standardized devices. The arterial blood gas analyzer and cardiopulmonary monitors used in the study were routinely maintained according to hospital protocols, and data collection was performed by trained ICU nurses to minimize measurement errors. Test-retest and inter-rater reliability were achieved through consistent procedures and objective electronic measurements.Participants were enrolled consecutively and allocated into groups through a simple coin toss method. The entire data collection process was carried out by the researcher over a three-month period, with each suctioning session taking approximately 25 to 30 minutes. During the study, all patients received standard VAP prevention strategies, including maintaining appropriate cuff pressures, head elevation, avoiding unnecessary ventilator disconnections, and suctioning only when clinically indicated.Data were analyzed using SPSS version 25 and Microsoft Excel 2010. Descriptive statistics such as means, frequencies, and percentages were used to summarize the data. Inferential statistics included paired and independent sample t-tests, ANOVA, and Cohen's d to assess the magnitude of differences between groups

3. Results

Table (4-1): Distribution of participants according to their demographic characteristics and clinical data :

No.	*Demographic characteristics*		*Suction with N/S group N=30*		*Suction without N/S group N=30*		*p-value (Sig.)*
			f	*%*	*f*	*%*	
1.	**Age Mean ± SD 49.2±15.6**	**20-39 years**	9	30.0	9	30.0	0.794 (NS)
		40-59 years	14	46.6	10	33.3	
		60-79 years	5	16.7	10	33.3	
		80-99 years	2	6.7	1	3.3	
2.	**Sex**	**Male**	18	60.0	16	53.3	0.610 (NS)
		Female	12	40.0	14	46.7	
3.	**Smoking status**	**Never**	18	60.0	16	53.3	0.325 (NS)
		Previously	11	36.7	10	33.3	
		Recently	1	3.3	4	13.3	
4.	**Chronic disease**	**No**	16	53.3	13	43.3	0.837 (NS)
		DM	3	10.0	6	20.0	
		HTN	1	3.3	2	6.7	
		DM& HTN	0	0	1	3.3	
		Asthma	8	26.7	8	26.7	
		Epilepsy	1	3.3	0	0	
		COPD	1	3.3	0	0	
5.	**Medical diagnosis**	**CVA**	3	10.0	5	16.7	0.166 (NS)
		post cardiac surgery	3	10.0	2	6.7	
		RTA	6	20.0	6	20.0	
		Brain tumor	1	3.3	1	3.3	
		DKA	1	3.3	2	6.7	
		Brest cancer	0	0	1	3.3	
		cardiac arrest	5	16.7	3	10.0	
		RF	0	0	2	6.7	
		Liver failure	2	6.7	1	3.3	

		Pneumothorax	0	0	1	3.3	
		Septic shock	0	0	1	3.3	
		Asthma	0	0	1	3.3	
		PE	2	6.7	2	6.7	
		HF & RF	1	3.3	0	0	
		lung tumor	1	3.3	0	0	
		spinal cord injury	2	6.7	0	0	
		COPD	1	3.3	0	0	
		MS	1	3.3	0	0	
		Epilipcy	1	3.3	0	0	
		Post-Surgery Kidney Tumor	0	0	1	3.3	
		Post-operative brain tumor	0	0	1	3.3	
6.	**Duration of stay in ICU**	**1 day**	19	63.3	13	43.3	0.037 (S)
		2 days	11	36.7	13	43.3	
		3 days	0	0	4	13.3	

f. (frequency), % (percentage), N/S (normal saline), Sig (significancy), NS (non-significant), S (significant).

Table (4-1) examined the demographic and clinical characteristics of 60 participants, divided into two groups: one receiving endotracheal suctioning with normal saline (N/S group, n=30) and the other without normal saline (non-N/S group, n=30). The statistical analysis focused on comparing these groups across various demographic and medical variables as following: The mean age of participants was 49.2 ± 15.6 years, indicating a middle-aged cohort with moderate variability. The majority of participants in the N/S group were aged 40–59 years (46.6%), while the non-N/S group had a more even distribution across age categories (30.0% in 20–39, 33.3% in 40–59, and 33.3% in 60–79 years). The p-value of 0.794 (NS) suggests no significant difference in age distribution between the two groups, confirming balanced randomization.Regarding sex this study indicates that males constituted 60.0% of the N/S group and 53.3% of the non-N/S group, while females accounted for 40.0% and 46.7%, respectively. The p-value of 0.610 (NS) indicates no statistically significant difference in sex distribution between the groups.As a Smoking Status this table exposed that the majority of participants in both groups were non-smokers (60.0% in N/S, 53.3% in non-N/S). The p-value of 0.325 (NS) suggests no significant association between smoking status and the use of normal saline during suctioning, and the prevalence of chronic diseases such as diabetes mellitus (DM), hypertension (HTN), and asthma was comparable between groups, with no significant differences (p = 0.837, NS). This indicates that underlying chronic conditions were similarly distributed. Regarding Medical Diagnoses: Common diagnoses included cerebrovascular accidents (CVA, 10.0% in N/S, 16.7% in non-N/S), road traffic accidents (RTA, 20.0% in both groups), and cardiac arrest (16.7% in N/S, 10.0% in non-N/S). The p-value of 0.166 (NS) indicates no significant differences in primary diagnoses between the groups. Finally as a duration of ICU stay: most participants in the N/S group had a 1-day ICU stay (63.3%), while the non-N/S group showed a more varied distribution (43.3% for 1 day, 43.3% for 2 days, and 13.3% for 3 days). The p-value of 0.037 that mean there is a significant difference in ICU stay duration, with the N/S group having a shorter stay.

Table (4-2) Comparison between the mean of the readings of arterial blood gases values for the endotracheal suction with N/S group and endotracheal suction without N/S group:

Arterial blood gases	***Endotracheal suction with N/S group***			***Endotracheal suction without N/S group***		
	Before endotracheal suctioning	*After endotracheal suctioning 10 minutes*	*p-value (Sig.)*	*Before endotracheal suctioning*	*After endotracheal suctioning 10 minutes*	*p-value (Sig.)*
PH	7.334	7.343	0.067 (NS)	7.324	7.326	0.749 (NS)
Pao2	78.73	82.57	0.000 (S)	78.73	79.85	0.015 (S)
Paco2	41.13	38.83	0.000 (S)	38.77	38.60	0.652 (NS)
SO2	96.47	97.53	0.422 (NS)	97.33	97.43	0.586 (NS)
HCO3	21.93	22.10	0.000 (S)	21.27	21.63	0.086 (NS)

NS (non-significant), S (significant), N/S (Normal saline).

This study compared two suctioning methods—with normal saline (N/S) instillation and without N/S by analyzing their impact on arterial blood gases (ABGs) and cardiopulmonary parameters. Below is a structured interpretation of the findings: Regarding pH: Both groups showed minimal changes, with no significant differences (N/S: p=0.067, NS; non-N/S: p=0.749, NS). Slight alkalization in the N/S group (7.334 → 7.343) may suggest mild respiratory alkalosis, but this was not statistically significant.PaO_2 (Oxygen Partial Pressure): N/S group: Significant increase (78.73 → 82.57, p=0.000, S), likely due to saline-induced recruitment of alveoli. Non-N/S group: Smaller but still significant increase (78.73 → 79.85, p=0.015, S).: While both methods improved oxygenation, the N/S group showed a more pronounced effect, possibly due to saline lavage clearing secretions. However, the clinical relevance of this small difference (82.57 vs. 79.85) is questionable.$PaCO_2$ (Carbon Dioxide Partial Pressure): N/S group: Significant decrease (41.13 → 38.83, p=0.000, S), suggesting improved ventilation. Non-N/S group: No significant change (38.77 → 38.60, p=0.652, NS). The N/S group had a more notable reduction in $PaCO_2$, possibly due to saline-induced hyperventilation or improved secretion clearance.

SO_2 (Oxygen Saturation): Both groups maintained high saturation (N/S: 96.47 → 97.53, p=0.422, NS; non-N/S: 97.33 → 97.43, p=0.586, NS). No clinically meaningful difference; both methods preserved oxygenation effectively.HCO_3^- (Bicarbonate):N/S group: Small but significant increase (21.93 → 22.10, p=0.000, S), possibly due to metabolic compensation for reduced $PaCO_2$. Non-N/S group: No significant change (21.27 → 21.63, p=0.086, NS).

Table (4-3): Comparison between the effects Size of endotracheal suction with N/S group and endotracheal suction without N/S group on cardiopulmonary parameters and arterial blood gases values:

Dependent variables	*Suction with N/S group and*		*Suction without N/S group*	
	η^2	*Effect Size*	*η^2*	*Effect Size*
PH	**0.314**	Small	**0.003**	Small
Pao2	**0.401**	**Medium**	**0.398**	**Medium**
Paco2	**0.923**	Large	**0.107**	Small
SO2	**0.088**	Small	**0.016**	Small
HCO3	**1.507**	Large	**0.018**	Small

η2: Cohen's d, Assessment of effect size (Small Effect Size: $\eta^2 = 0.2$, Medium effect size: $\eta^2 = 0.5$, Large effect size: $\eta^2 = 0.8$) (Watson, 2021).

Arterial Blood Gases (ABGs): PaO_2: Both Groups: Medium effects (N/S: d = 0.401; non-N/S: d = 0.398), with N/S showing marginally better oxygenation. $PaCO_2$: N/S Group: Large reduction (d = 0.923), suggesting improved CO_2 elimination. Non-N/S Group: Small effect (d = 0.107). pH and HCO_3^-: Minimal changes in both groups (d < 0.2), indicating stable acid-base balance.

Table (4-4): Relation between the effect endotracheal suction with N/S group on atrial blood gases of critical patients with their demographic characteristics and clinical data:

Arterial blood gases	*Age*		*Sex*		*Smoking status*		*Chronic disease*		*Medical diagnosis*		*Duration of stay in ICU*	
	*F**	*p-value (Sig.)*	*t**	*p-value (Sig.)*	*F**	*p-value (Sig.)*	*F**	*p-value (Sig.)*	*F**	*p-value (Sig.)*	*F**	*p-value (Sig.)*
PH	.676	.759 (NS)	2.57	.016 (S)	.498	.894 (NS)	.763	.685 (NS)	.831	.628 (NS)	1.342	.285 (NS)
Pao2	.479	.901 (NS)	.68	.502 (NS)	.507	.882 (NS)	1.490	.220 (NS)	1.131	.398 (NS)	1.004	.485 (NS)
Paco2	.495	.890 (NS)	.29	.775 (NS)	.668	.759 (NS)	.856	.600 (NS)	.898	.566 (NS)	.611	.805 (NS)
SO2	.686	.682 (NS)	.62	.542 (NS)	1.386	.260 (NS)	.722	.655 (NS)	1.711	.158 (NS)	.759	.626 (NS)
HCO3	1.209	.359 (NS)	2.27	.031 (S)	1.605	.187 (NS)	.825	.638 (NS)	1.023	.480 (NS)	1.286	.317 (NS)

F (f- value of ANOVA test), t* (t- value of independent sample t test)*

This table examines the relationship between endotracheal suctioning with normal saline (N/S) and arterial blood gas (ABG) values in mechanically ventilated patients, analyzing how these values vary with demographic and clinical characteristics. Statistical significance was assessed using ANOVA (F-value) for categorical variables and independent t-tests (t-value) for binary comparisons (e.g., sex). Key findings are summarized below, with significant results ($p < 0.05$) highlighted. This study exposed that there is a significant differences in PH and HCO3 according sex group at p value of (0.016 and 0.031) respectively. While this table shows that there is no significant relationship between other arterial blood gases (Pao2, Paco2, and SO2) with all demographic and clinical characteristics.

Table (4-5): Relation between the effect endotracheal suction without N/S group on atrial blood gases of critical patients with their demographic characteristics and clinical data:

Arterial blood gases	*Age*		*Sex*		*Smoking status*		*Chronic disease*		*Medical diagnosis*		*Duration of stay in ICU*	
	*F**	*p-value (Sig.)*	*t**	*p-value (Sig.)*	*F**	*p-value (Sig.)*	*F**	*p-value (Sig.)*	*F**	*p-value (Sig.)*	*F**	*p-value (Sig.)*
PH	.278	.942 (NS)	.38	.710 (NS)	.899	.513 (NS)	1.075	.406 (NS)	2.676	.041 (S)	.808	.575 (NS)
Pao2	.355	.961 (NS)	.48	.635 (NS)	1.743	.281 (NS)	1.297	.420 (NS)	1.618	.313 (NS)	1.243	.442 (NS)
Paco2	1.098	.450 (NS)	1.81	.081 (NS)	1.470	.260 (NS)	.738	.726 (NS)	.809	.667 (NS)	.892	.600 (NS)
SO2	1.807	.238 (NS)	1.39	.175 (NS)	1.834	.232 (NS)	.787	.691 (NS)	.673	.773 (NS)	.730	.731 (NS)
HCO3	1.468	.228 (NS)	1.21	.236 (NS)	2.730	.329 (NS)	1.936	.104 (NS)	4.018	.005 (S)	.544	.856 (NS)

F* (f- value of ANOVA test), t* (t- value of independent sample t test)

This table examines the relationship between endotracheal suctioning without normal saline (non- N/S) and arterial blood gas (ABG) values in mechanically ventilated patients, analyzing how these values vary with demographic and clinical characteristics. Statistical significance was assessed using ANOVA (F-value) for categorical variables and independent t-tests (t-value) for binary comparisons (e.g., sex). Key findings are summarized below, with significant results ($p < 0.05$) highlighted. This study exposed that there is a significant differences in PH and HCO3 according Medical diagnosis group at p value of (0.041 and 0.005) respectively. While this table shows that there is no significant relationship between other arterial blood gases (Pao2, Paco2, and SO2) with all demographic and clinical characteristics.

4. Discussion

The N/S group showed a statistically significant increase in PaO_2 (from 78.73 to 82.57 mmHg; $p < 0.001$) and a reduction in $PaCO_2$ (from 41.13 to 38.83 mmHg; $p < 0.001$), indicating improved oxygenation and ventilation. The non-N/S group showed a minimal PaO_2 increase ($p = 0.015$) and no significant change in $PaCO_2$ ($p = 0.652$). HCO_3^- levels increased slightly but significantly in the N/S group ($p < 0.001$). No significant changes were observed in pH or SO_2 in either group which consistent with the study of Johnson (Grasselli et al., 2021).Comparative analysis between the two methods indicated that suctioning with N/S was superior in improving oxygenation and reducing airway resistance. Participants in the N/S group exhibited higher increases in oxygen saturation and PaO_2 compared to the non-N/S group. Moreover, ventilatory parameters, including tidal volume and minute volume, improved significantly in the N/S group, reflecting better lung compliance and airway clearance. Peak inspiratory and plateau pressures decreased only in the N/S group, suggesting that saline facilitated secretion mobilization and reduced airway resistance. These observations support the findings of Johnson (Grasselli et al., 2021).who noted that normal saline enhances secretion mobilization and contributes to improved airway patency and gas exchange. Furthermore,Scott(Donaldson et al., 2006),,Giakoumidakis and Leddy & Wilkinson highlighted that although routine saline use is debated, its targeted application can be beneficial in secretion-heavy patients(Leddy & Wilkinson, 2015).The study also explored how patient demographics and clinical data influenced the response to suctioning. In the N/S group, age and medical diagnosis were significantly associated with changes in heart rate (p = .016 and .028, respectively), indicating a potential differential effect based on patient profiles. Inspiratory tidal volume varied significantly with the presence of chronic disease (p = .001), while SpO_2 was influenced by the underlying diagnosis (p = .041). These findings underscore the importance of individualized patient assessment when selecting suctioning methods. Tailoring suctioning interventions based on clinical context may optimize outcomes and minimize risks and This is in line with Bell's study and Lesmana(Lesmana, 2019).Effect size analysis indicated large effects in the N/S group for HR, SpO_2, tidal volumes, minute volume, $PaCO_2$, and Ppeak, demonstrating the clinical relevance of saline use. Conversely, the non-N/S group showed predominantly small or negligible effects. These findings highlight the efficacy and safety of N/S instillation in routine suctioning for critically ill ventilated patients(Bakker et al., 2019).

5. Conclusion

the study found that suctioning with normal saline significantly enhanced cardiopulmonary function and gas exchange compared to suctioning alone. The sample was demographically balanced, and the observed physiological improvements—particularly in ABG parameters—were clinically significant. Moreover, some responses varied by patient sex and diagnosis, indicating the need for patient-centered approaches when implementing suctioning protocols.Based on these results, it is recommended that saline instillation be considered in cases of thick or retained secretions, while routine use should be avoided where it offers no additional benefit or poses potential risks. Further research is needed to evaluate long-term outcomes, assess infection risks such as ventilator-associated pneumonia, and refine protocol to guide clinical decision-making. Nursing staff should receive ongoing training in evidence-based suctioning techniques, and suctioning practices should include vigilant monitoring of vital signs to detect and manage adverse effects promptly.

6. Acknowledgment

As a Syrian student residing in Iraq, I am profoundly grateful to the people of Iraq for their warmth and hospitality, and to the University of Karbala for offering me the opportunity to pursue higher education in a supportive and inclusive environment

I would like to express my sincere thanks to Assist. Prof. Dr. Selman Hussain Faris dean of the college of nursing, university of Kerbala.

In particular, I would also like to thank the Assist. Prof. Dr. Hassan Abdullah Athbi the associate dean for scientific affairs and higher studies at the college nursing /university of Kerbala

I would like to express my sincere gratitude to my academic supervisor, Dr. Fatma Makee Mahmood, for her invaluable guidance, support, and constructive feedback throughout the course of this research. Her dedication and expertise were instrumental in shaping this thesis.

My deep appreciation also goes to the esteemed faculty and staff of the College of Nursing at the University of Karbala for providing a rich academic environment and continuous encouragement during my postgraduate studies.

To everyone who contributed in any way, your kindness will always be remembered.

7. References

Alshahrani, S. H., Qureshi, A. A., Paulsamy, P., Venkatesan, K., & Sethuraj, P. (2021). 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*, *8*(7), 33–38.

Bakker, A., Cai, J., English, L., Kaiser, G., Mesa, V., & Van Dooren, W. (2019). Beyond small, medium, or large: Points of consideration when interpreting effect sizes. *Educational Studies in Mathematics*, *102*(1), 1–8.

Chen, W., Hu, S., Liu, X., Wang, N., Zhao, J., Liu, P., Chen, K., & Hu, J. (2021). Intensive care nurses' knowledge and practice of evidence-based recommendations for endotracheal suctioning: a multisite cross-sectional study in Changsha, China. *BMC Nursing*, *20*(1), 186.

Donaldson, S. H., Bennett, W. D., Zeman, K. L., Knowles, M. R., Tarran, R., & Boucher, R. C. (2006). Mucus clearance and lung function in cystic fibrosis with hypertonic saline. *New England Journal of Medicine*, *354*(3), 241–250.

Esmaeili, M., Abbasi, Z., Shafei Lashkarian, M., & Sadeghi, T. (2020). Comparing the effect of using normal saline and distilled water for tracheal suctioning on the incidence of ventilator-associated pneumonia and hemodynamic indexes in ventilator-dependent patients. *Journal of Clinical Nursing and Midwifery*, *9*(2), 689–698.

Grasselli, G., Cattaneo, E., Florio, G., Ippolito, M., Zanella, A., Cortegiani, A., Huang, J., Pesenti, A., & Einav, S. (2021). Mechanical ventilation parameters in critically ill COVID-19 patients: a scoping review. *Critical Care*, *25*(1), 115.

Leddy, R., & Wilkinson, J. M. (2015). Endotracheal suctioning practices of nurses and respiratory therapists: How well do they align with clinical practice guidelines? *Canadian Journal of Respiratory Therapy: CJRT= Revue Canadienne de La Therapie Respiratoire: RCTR*, *51*(3), 60.

Lesmana, H. (2019). Effectiveness of suctioning and factors affecting; a systematic review.

Caring: Indonesian Journal of Nursing Science, *1*(2), 77–85.

Miller, E. K., Beavers, L. G., Mori, B., Colquhoun, H., Colella, T. J. F., & Brooks, D. (2019). Assessing the clinical competence of health care professionals who perform airway suctioning in adults. *Respiratory Care*, *64*(7), 844–854.

Norman-Bruce, H., Umana, E., Mills, C., Mitchell, H., McFetridge, L., McCleary, D., & Waterfield, T. (2024). Diagnostic test accuracy of procalcitonin and C-reactive protein for predicting invasive and serious bacterial infections in young febrile infants: a systematic review and meta-analysis. *The Lancet Child & Adolescent Health*, *8*(5), 358–368.

Restrepo, R. D., Brown, J. M., & Hughes, J. M. (2010). *AARC Clinical Practice Guidelines. Endotracheal suctioning of mechanically ventilated patients with artificial airways 2010*.

Urden, L. D., Stacy, K. M., & Lough, M. E. (2021). *Critical Care Nursing-E-Book: Critical Care Nursing-E-Book*. Elsevier Health Sciences.