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Effect of Nebulization With 3% Hypertonic Saline for Airway Clearance on Mechanically Ventilated Patients Admitted in ICUs of Pt. B.D. Sharma, PGIMS, Rohtak

Pratibha Rani Nanda[1,*], Rajpati Amrawat[2], Shaveta[3]

Abstract

Background of the Study: *The ability to breathe artificially prolongs life in many situations. Patients requiring mechanical breathing in the intensive care unit are more likely to have complications and even death due to a variety of interconnected causes. As a result, it became critical to rapidly ventilate in the safest and most efficient manner available. Intubated patients have benefited from nebulized suctioning, as it improves lung clearance and decreases the risk of infection.* ***Objectives:*** *To evaluate the effect of nebulization with 3% hypertonic saline for airway clearance on mechanically ventilated patients admitted to ICUs by Pt. B. D. Sharma, PGIMS, Rohtak.* ***Methodology:*** *For this study, a quasi-experimental research design was selected, and the samples for the study were selected from the ICUs of PGIMS Rohtak, Haryana. Samples were chosen using a convenience sampling approach, with a total sample size of 40. Data collection was done with the structured tool, which consisted of socio-demographic variables, clinical variables, and bio-physiological parameters. The collected data was subjected to analysis utilizing both descriptive and inferential statistical methods.* ***Results:*** *During the pre-test, among the samples in the experimental group, the post-test mean and standard deviation were 3.40±2.30. The control group exhibited a post-test mean and standard deviation score of 10.50±2.60, with a mean difference score of 7.1. The independent 't' test value, computed with degrees of freedom, was –9.130. This reached statistical significance at a p value of <.005.* ***Conclusion:*** *Maintaining airway patency in mechanically ventilated patients using hypertonic saline nebulization has been demonstrated to be a straightforward, low-cost, and successful therapy method.*

Keywords: Hypertonic saline nebulized suctioning, mechanical ventilation, airway clearance

***Author for Correspondence**
Pratibha Rani Nanda
E-mail: Pratibhadeep2012@gmail.com

[1]M. Sc (N) Scholar, College of Nursing, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India
[2]Senior Lecturer, College of Nursing, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India
[3]Assistant Professor, Department of Medicine, Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India

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INTRODUCTION

Mechanical ventilation is essential to current lifesaving technology. Several interconnected factors affect the morbidity and mortality rates of mechanically ventilated ICU patients. Therefore, the safest and most effective ventilation system had to be used for the shortest time. Saline hypertonic Nebulized suctioning improves lung clearance and reduces infection risk in intubated patients [1].

Mechanical ventilation is a frequently employed strategy within the intensive care unit setting. This intervention is employed to provide assistance to the patient throughout the resolution of their primary issue. In cases where a patient's respiratory function is compromised as a result of their condition, the provision of mechanical support becomes

necessary. This support is typically provided through the utilisation of a medical device commonly referred to as a ventilator or respirator. The utilisation of an endotracheal tube, a pliable plastic tube that is introduced through the oral cavity of the patient and subsequently positioned within the trachea, serves the purpose of establishing a linkage between the patient and the mechanical ventilator [2].

Ventilator-associated pneumonia (VAP), a prevalent ICU infection, causes significant morbidity, death, and healthcare expenditures. VAP risk factors include complex host features and widespread infections, requiring many prevention measures. Prevention should focus on reducing bacterial colonisation, aspiration, antibiotic exposure, and invasive device use. Empirical prevention guidelines are numerous, often ignored, and not implemented. New insights about preventative initiative barriers have emerged. This article reviews recent VAP prevention guidelines and publications and examines their implementation challenges. Prioritise risk reduction and patient outcomes through cost-effective prevention and execution. A multidisciplinary prevention team lead by a "champion" should create priorities, assess targets, analyse data, and plant risk reduction seeds [3].

In short-term clinical trials, inhaling hypertonic saline increased mucociliary clearance and improved lung function in cystic fibrosis patients. We assessed the safety and effectiveness of breathed hypertonic saline in a long-term investigation. Over a duration of 48 weeks, 164 patients diagnosed with stable cystic fibrosis, aged 6 years and above, were randomly assigned to inhale either 4 ml of 0.9% saline (control) or 7.5% hypertonic saline twice daily. To mask the flavour, quinine sulphate (0.25 mg/ml) was added. Bronchodilators were given before each dose throughout the experiment, and other conventional therapy were continued. Throughout the 48-week treatment period, no notable disparity was observed in the rate of change (slope) in lung function, assessed through forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and forced expiratory flow at 25 to 75% of FVC (FEF25-75). The p-value was 0.79, indicating a lack of statistical significance. When the total variation in lung function throughout all post-randomization visits over the course of the 48-week treatment period was taken into account, it was shown to be statistically significant (P=0.03). In contrast to the control group, the hypertonic-saline group demonstrated comparable FEF25-75 values but notably higher FVC (increase of 82 ml; 95% confidence interval, 12 to 153) and FEV1 (increase of 68 ml; 95% confidence interval, 3 to 132) values. Additionally, there was a substantial reduction in pulmonary exacerbations (56% relative reduction; P=0.02) and a significantly higher proportion of patients in the hypertonic-saline group (76 versus 62% in the control group; P=0.03) who remained free of exacerbations. Hypertonic saline did not correlate with an increase in inflammation or bacterial infection [4].

Several studies have been done to see if hypertonic saline nebulization can help cystic fibrosis people clear out their mucociliary system better. Using 6% hypertonic saline instead of isotonic saline showed a 15% increase in FEV1 from the start of the study. Some researchers did a study that lasted 48 weeks. They discovered that 7% hypertonic saline raised FEV1 by 68 ml and FVC by 82 ml. Isotonic saline raised FEV1 by 0.3 ml and FVC by 0.5 ml. The number of patients in the hypertonic saline group who did not have an episode was also significantly higher [5].

STATEMENT OF THE PROBLEM

A Study to Evaluate the Effect of Nebulization with 3% Hypertonic Saline for Airway Clearance on Mechanically Ventilated Patients Admitted in ICUs of Pt. B. D. Sharma, PGIMS, Rohtak.

OBJECTIVES

- To assess the Pre and Post-test score of biophysiological parameters of mechanically ventilated patients in ICUs of Pt. B. D. Sharma, PGIMS, Rohtak.
- To evaluate the effect of 3% hypertonic saline for airway clearance on mechanical ventilated patients in ICUs of Pt. B. D. Sharma, PGIMS, Rohtak.
- To find out the association between Pre-test score of biophysiological parameters with clinical variables.

Hypotheses

- *H_0:* There will be no significant difference in selected biophysiological parameters based on the 3% hypertonic saline nebulization at 0.05 level of significance.
- *H_1:* There will be significant difference in selected biophysiological parameters based on the 3% hypertonic saline nebulization at 0.05 level of significance.
- *H_2:* There is expected to be a correlation between the pre-test biophysiological parameters and the chosen clinical variables.
- H3: No correlation is anticipated between the pre-test biophysiological parameters and their selected clinical variables.

METHODOLOGY

This study utilized a quantitative research methodology. Given the inherent characteristics of the issue being investigated and in order to achieve the study's goals, a quasi-experimental design consisting of a one-group pre-test-post-test was implemented in this research. The research was conducted in Intensive Care Units (ICUs) at PGIMS Rohtak, which have received accreditation from the National Accreditation Board for Hospitals and Healthcare Providers (NABH). The samples for this research consisted of ICU-admitted patients who were mechanically ventilated and met the predetermined selection criteria. For the current investigation, the investigator employed a non-probability sampling approach, specifically utilising a convenient sampling procedure to select samples from the target population. The data collection instrument utilised in this research comprises three distinct sections. Section A comprises socio-demographic variables, while Section B comprises clinical variables. Section C comprises modified biophysiological parameters. The investigation received ethical approval from an institutional ethics committee and does not cause any damage to living organisms. The formal authorization was acquired from the PHIMS-Rohtak hospital authorities. A formal introduction was extended to the patients' relatives, and they subsequently provided their formal written consent. Ensuring the privacy of the participants and their responses was a primary concern. The research committee, the College of Nursing, Pt. B.D. Sharma, PGIMS, and Rohtak all validated the instrument. In order to ascertain the content validity of the instrument pertaining to the evaluation of airway clearance, it was submitted to five nursing specialists for review; their evaluations were acknowledged and integrated. Prior to data collection, formal written consent was obtained from the medical superintendent of PGIMS Rohtak and permission was obtained from the principal of the College of Nursing, Pt. B.D. Sharma, PGIMS Rohtak. Written consent was obtained from the relatives of the patients prior to data collection through an explanation of the study's objectives and subsequent consent collection. Furthermore, they were guaranteed the preservation of their confidentiality. Consent was obtained from both the college of nursing at PGIMS, Rohtak and the director and M.S. of PGIMS, Rohtak. Patients who met the inclusion criteria and were undergoing mechanical ventilation were selected for participation in this study. Consent having been obtained from patients or their next of kin. The allocation of patients to the comparison and intervention groups was conducted using a practical sampling technique. In-depth interviews were conducted to gather demographic information and medical history, which were obtained from medical records. Observation and recording of biophysiological parameters were utilised to acquire pre-test data from mechanically ventilated patients admitted to the intensive care unit of PGIMS Rohtak. Mechanically ventilated patients received nebulization with 3% normal saline followed by suctioning three times daily for four consecutive days, while the control group received standard care. Three times per day following the intervention, biophysiological parameters of mechanically ventilated patients in both groups were evaluated using post-test assessments. A standard intervention was administered to the control group. Following the organisation of all collected data, statistical analysis was conducted. The data analysis was conducted utilising descriptive and inferential statistics in conjunction with IBM SPSS Software Version 25.0.

RESULTS

Table 1 depicts the frequency and percentage distribution of subjects in experimental and in control group.

Table 1. Frequency and Percentage distribution of demographic variables of the samples in experimental and control group (n=20).

S.N.	Socio-Demographic Variables		Experimental Group		Control Group	
			Frequency	*Percentage*	*Frequency*	*Percentage*
1	Age (years)	18–35	10	50.0	6	30.0
		36–55	6	30.0	7	35.0
		56–75	4	20.0	5	25.0
		More than 75	0	0.0	2	10.0
2	Gender	Male	16	80.0	12	60.0
		Female	4	20.0	8	40.0
3	Education	Illiterate	9	45.0	10	50.0
		Graduate	11	55.0	8	40.0
4	Occupation	Labor	11	55.0	2	10.0
		Govt Employee	1	5.0	2	10.0
		Private Job	2	10.0	2	10.0
		Business	3	15.0	2	10.0
		Unemployed	3	15.0	3	15.0
5	Income	Rs. 10,000 to 20,000	15	75.0	11	55.0
		Rs. 21,000 to 30,000	1	5.0	3	15.0
		Rs. 31,000 to 50,000	1	5.0	2	10.0
		Nil	3	15.0	1	5.0
6	Type of Family	Nuclear	19	95.0	10	50.0
		Joint	1	5.0	10	50.0
7	Dietary Pattern	Vegetarian	16	80.0	17	85.0
		Non-Vegetarian	4	20.0	3	15.0
8	Personal Habits	Alcohol	3	15.0	4	20.0
		Smoking	7	35.0	5	25.0
		No bad habits	9	45.0	11	55.0
		Any other	1	5.0	0	0.0

Half of the experimental group's samples (50.0%) are 18–35 years old. The majority of control group samples (73.5%) were 36–55 years old. Males (80%) dominated the experimental group. Males (12 (60.0%)) dominated the control group. Over half of the experimental group's (11) samples were graduates. The majority of (10 (50.0%)) control group samples were illiterate. Most of the (11 (55.0%)) experimental samples were workers. Most of (11 (55.0%)) control group samples were unemployed. In the experimental group, 15 samples (75.0%) had incomes ranging from Rs. 10,000 to 20,000. Similarly, the control group included 14 samples (70.0%) with incomes falling within the Rs. 10,000 to 20,000 range. The experimental group had 16 (80.0%) vegetarians and 4 (20.0%) non-vegetarians. The control group's diet was mostly vegetarian (85%) with only three non-vegetarians (15.0%). Most of the (19 (95.0%)) experimental group members are nuclear families. Most experimental group samples (45.0%) exhibited no negative habits. Most of the (11 (55.0%)) control group samples exhibited no harmful habits.

Table 2 shows clinical variable-based sample frequency and percentages in experimental and control groups. Most experimental group samples (10%) had neurological problems. Most control group samples (45.0%) had neurological problems. Most of 19 (95.0%) of the experimental group samples were suctioned every 6 h, and 1 (5.0%) every 4 h. All 20 samples (100.0%) in the control group underwent suctioning every 6 h. Before suctioning, all experimental group samples were positioned. Before suctioning, all control group samples were positioned. All 20 (100.0%) experimental samples were suctioned three times a day for nebulization. Most of (19 (95.0%)) control group samples

nebulized three times a day before suctioning. All 20 samples (100.0%) in the experimental group had thick mucous discharges. Most samples in control group (13 (65.0%)) had thick mucous membranes. The bulk of (12 (60.0%)) experimental samples were ventilated for 7 days. Most of the 15 control group samples (75.0%) had ventilation for 7 days. Most of (13 (65.0%)) experimental group samples were ventilated due to CNS problems. Most of (11 (55.0%)) control group samples were ventilated due to CNS diseases.

During the pre-test, majority of the samples (13 (65.0%)) had moderate level of airway clearance. Severe disturbance was seen among 5 (25.0%). Mild disturbance was seen among 2 (10.0%). At the time of post-test, mild disturbance was seen from 14 (70.0%) of the samples. Those who were normal were 5 (25.0%) (Figure 1).

During pre-test, majority of the samples (15 (75.0%)) had moderate level of airway clearance. Severe disturbance was seen among 3 (15.0%). Mild disturbance was seen among 2 (10.0%).

At the time of post-test, moderate disturbance was seen from 15 (75.0%) of the samples. Mild disturbance was seen among 2 (10.0%) of the samples. Severe disturbance was seen from 1 (5.0%) (Figure 2).

Table 3 shows the Mean, Mean Difference, Standard deviation and Independent 't' test values of samples airway level of clearance in Experimental and Control Group.

Table 2. Frequency and percentage distribution of samples according to clinical variables in experimental and group (n = 20).

S.N.	Clinical Variables		Experimental Group		Control Group	
			Frequency	*Percentage*	*Frequency*	*Percentage*
1	Diagnosis	Cardiac Disease	2	10.0	4	20.0
		Renal Disease	12	60.0	1	5.0
		Neurological Disease	2	10.0	9	45.0
		Respiratory Disease	4	20.0	2	10.0
		Other Diseases	1	5.0	4	20.0
2	Frequency of Suctioning	Every 4-hourly	19	95.0	0	0.0
		Every 6-hourly	20	100.0	20	100.0
3	Patient Positioning	Yes	0	0.0	20	100.0
		No	0	0.0	0	0.0
4	Frequency of Nebulization	Two times a day before suctioning	20	100.0	0	0.0
		Three times a day before suctioning	0	0.0	19	95.0
		Four times a day before suctioning	20	100.0	1	5.0
5	Types of Mucous Secretions	Thick	0	0.0	13	65.0
		Mild	0	0.0	3	15.0
		Clear	0	0.0	3	15.0
		Tenacious	12	60.0	1	5.0
6	Duration of Ventilation	7 days	7	35.0	15	75.0
		8–15 days	1	5.0	3	15.0
		16–20 days	13	65.0	2	10.0
7	Reason for Ventilation	CNS Disorder	13	65.0	11	55.0
		Cardiac Disorder	0	0.0	2	10.0
		Respiratory Disorder	3	15.0	3	15.0
		Renal Disorder	1	5.0	2	10.0
		Any Other	3	15.0	2	10.0

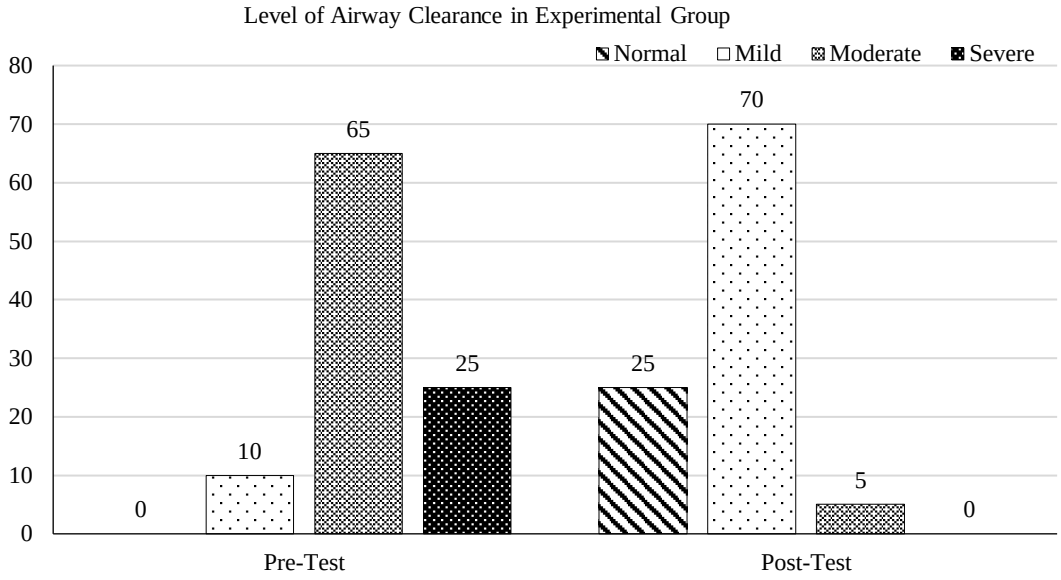

Figure 1. Percentage distribution of subjects according to level of airway clearance in experimental group.

In the pre-test phase, the experimental group exhibited a post-test mean and standard deviation of 3.40+2.30, while the control group showed a post-test mean and standard deviation of 10.50+2.60. The mean difference score was 7.1. The independent 't' test value was –9.130 with 38 degrees of freedom, indicating statistical significance at a p-value <0.005. Hence, we shall reject null hypothesis and accept alternate hypothesis.

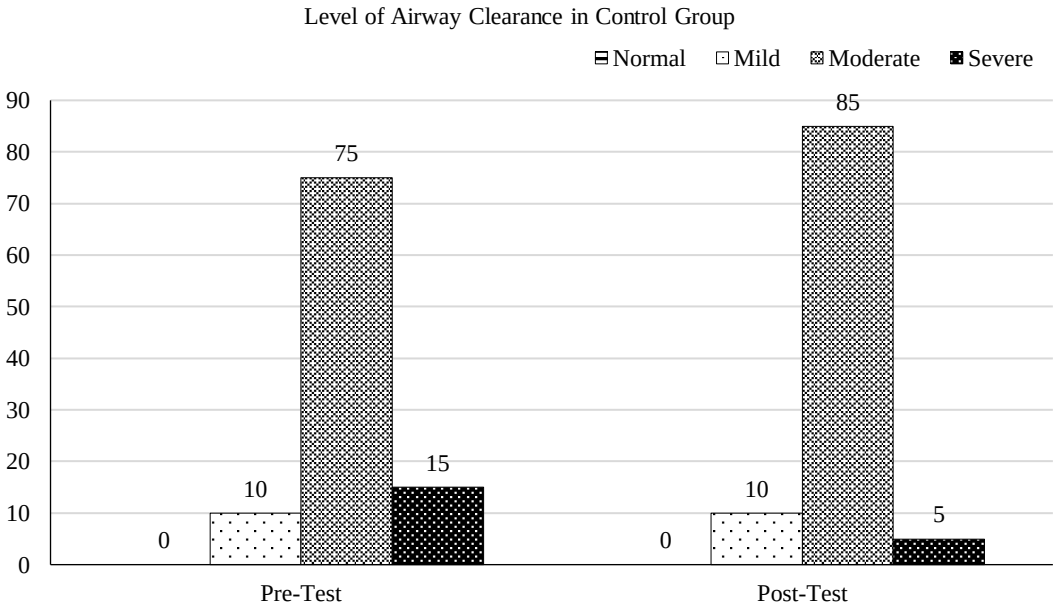

Figure 2. Percentage distribution of subjects according to level of airway clearance in control group.

Table 3. Mean, mean difference, standard deviation and independent ‘t’ test values of samples airway level of clearance in control group (n=20).

Groups	Post-Test Mean	Mean Difference	Standard Deviation	Independent ‘t’ test	p value
Experimental Group	3.40	7.1	2.30	–9.130	0.001* Significant
Control Group	10.50		2.60		

Among samples in the experimental group, the income of the samples was statistically significant with the pre-test level of airway clearance ($\chi 2=12.98$, df=0.04, $p<0.04$).

DISCUSSION

The outcomes are discussed as follows according to the objectives of the present study:

The First Objective of the Study was to Assess the Pre and Post-test Scores of Physiological Parameters of Mechanically Ventilated Patients in ICUs of Pt. B.D. Sharma, PGIMS, Rohtak

In the experimental group, the pre-test yielded a mean score of 11.55 with a standard deviation of 3.92. The mean and standard deviation score for the post-test was 3.40±2.30. The calculated mean difference score was 8.15. The paired t-test yielded a result of 13.79 for a degree of freedom of 19. The observed results demonstrated statistical significance, as shown by a p-value of less than 0.001.

In their study, Sobhy *et al.* sought to assess the efficacy of Hypertonic Saline 3% Nebulizer compared to Intravenous Hypertonic Saline 3% in mitigating the symptoms associated with acute respiratory distress syndrome [6]. The research findings indicated that the intravenous administration of hypertonic saline solution at a concentration of 3% exhibits a similar impact to the nebulized administration of hypertonic saline solution at the same concentration in mitigating the symptoms of acute respiratory distress syndrome (ARDS). Furthermore, in patients receiving mechanical ventilation, the intravenous administration of hypertonic saline solution at 3% concentration demonstrates higher efficacy in attenuating the manifestation of ARDS [6].

The present study's results align with those of a previous investigation conducted by Shein *et al*. [7]. In their investigation, it was noted that children who received hypertonic saline experienced a significantly longer duration of mechanical ventilation (208.1 {interquartile range 136.3–319.8} hours) compared to those who were given a placebo (129.5 {interquartile range 74.4–146.1} hours) (P=.03, determined through the Wilcoxon rank-sum test). The researchers also found that the prophylactic administration of nebulized hypertonic saline to mechanically ventilated children did not lead to any substantial improvement in clinically relevant outcomes, such as the duration of mechanical ventilation. The occurrence of wheezing following hypertonic saline therapy was infrequent [7].

Assessing the impact of 3% hypertonic saline on airway clearance in mechanically ventilated patients in the intensive care units (ICUs) of Pt. B. D. Sharma, PGIMS, Rohtak, constituted the second aim of the research. The findings of the current research illustrate: In relation to the control group, the pre-test data revealed a mean of 11.15 and a standard deviation of 3.37. The mean score after the post-test was 2.60 and the standard deviation was 10.50. The average difference in points was 0.65. The value of the paired 't' test for the degree of freedom was 2.04. From a statistical perspective, this finding was deemed insignificant (p-value >0.085). The pre-test characteristics of the control group were similar to those of the experimental group; specifically, the mean and standard deviation of the experimental group's post-test samples were 3.40+2.30. For the control group, the post-test mean and standard deviation were 10.50 and 2.60, respectively. The average difference in points was 7.1. The value of the independent 't' test for the degree of freedom was 9.130. Statistical significance was established with a p-value of less than .005.

The efficiency of 3% hypertonic saline nebulized suctioning on airway clearance was examined in a study conducted by Metilda *et al*. using a quantitative evaluative technique with a one-group pretest-post-test design [8]. The results of this study offered confirmation for the hypothesis mentioned earlier. The study included both descriptive and inferential statistical methods to analyse the data pertaining to policies. The study demonstrates a significant difference in the mean values between the pre-test (M=7.96, SD=2.93) and post-test (M=2.74, SD=2.93). The calculated value for the paired 't' test was found to be 8.46, which was significantly greater than the corresponding table value. This indicates that there is a statistically significant efficiency of 3% hypertonic saline nebulization on airway clearance among patients who are attached to a mechanical ventilator [8].

CONCLUSION

The utilisation of hypertonic saline is increasingly prevalent in the therapeutic management of bronchiolitis and atelectasis. The study showed a higher efficacy in mitigating respiratory issues among individuals reliant on mechanical ventilation. The results of our study add to the current knowledge about the potential advantages of administering 3% hypertonic saline to uphold airway patency in individuals undergoing mechanical ventilation. The results suggested a notable enhancement in pulmonary function. The findings of this study demonstrate that daily administration of a 3% hypertonic saline (HS) solution via nebulization contributes to the stabilisation of fundamental biophysiological parameters associated with pulmonary well-being.

REFERENCES

1. Dorthy, *et al*. Fundamentals of Nursing Research. 2nd Edn. USA: Jones and Bartlet Publication; 1995.
2. Caruso Pedro, *et al*. Saline instillation before tracheal suctioning decreases the incidence of ventilator associated pneumonia. Crit Care Med. 2009; 37(1): 32–38.
3. Donald EC. Preventing Ventilator-Associated Pneumonia in Adults-Sowing Seeds of Change. Chest. 2006; 30(1): 251–260.
4. Riedler J, Reade T, Button B, Robertson CF. A pilot study of inhaled hypertonic saline to increase sputum production in adolescents with cystic fibrosis [abstract]. *Eur Respir J*. 1994; 7(Suppl 18): 430s. [CFGD Register: BD69c] [Google Scholar]
5. Alpern AN, Brumback LC, Ratjen F, Rosenfeld M, Davis SD, Quittner AL. Initial evaluation of the Parent Cystic Fibrosis Questionnaire--Revised (CFQ-R) in infants and young children. *Journal of Cystic Fibrosis: Official Journal of the European Cystic Fibrosis Society*. 2015; 14(3): 403–11.
6. Sobhy A, Hussiny A, Kamal M. Evaluation of the use of Hypertonic Saline 3% Nebulizer Intravenous Hypertonic Saline 3% to Attenuate the Manifestations of Acute Respiratory Distress Syndrome. Open Anesth J [Internet]. 2020 Sep 5; 14(1): 52–61. [cited 2023 Nov 24].
7. Shein SL, Gallagher JT, Deakins KM, Weinert DM. Prophylactic Use of Nebulized Hypertonic Saline in Mechanically Ventilated Children: A Randomized Blinded Pilot Study. Respir Care. 2016 May 1; 61(5): 586–92.
8. Metilda, Jaganath. Effect of Nebulized Suctioning with 3% Hypertonic Saline for Mechanically Ventilated Patient on Airway Clearance. Int J Innov Sci Res Technol. 2020; 5(9): 529–533. 10.38124/IJISRT20SEP404.

