A Study to Assess the Effectiveness of Hypertonic Saline Nebulized Suctioning on Airway Clearance Among Patients Connected to Mechanical Ventilator in Apollo Loga Hospital, Karur

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Abstract: *Care of the airway is an essential part of the management of patients receiving mechanical ventilation. If the airway is not properly managed, an endotracheal airway can result in retained secretions, airway obstructions, and infections. These complications may prolong mechanical ventilation duration and length of hospital stay and may increase the cost of affordability. Hypertonic saline nebulized suctioning is a technique used to lessen the duration of mechanical air flow and enhance airway clearance, which helps patients on mechanical ventilation breathe easier.* **Objectives** *of the study were, To assess the airway clearance among patients connected with Mechanical ventilator. To assess the effectiveness of 3%Hypertonic Saline Nebulization Suctioning on airway clearance among patients connected with Mechanical ventilator. To find out the association between post test score on 3% Hypertonic Saline Nebulization Suctioning on airway clearance among patients connected with mechanical ventilator with their selected demographic variables and clinical variables. The research approach adopted for this study was Quantitative Evaluative approach. The research design selected for the study was pre experimental one group pre and post-test design. The study was conducted in Apollo Loga Hospital, Karur. Non-probability convenient sampling technique was used to select the sample. The samples consisted of 30 mechanical ventilator patients. The tool used for data collection was semi structured interview schedule. It consists of three sections.*

Section A: Consists of interview schedule for collecting socio-Demographic Variables.

Section B: Consist interview schedule for collecting Clinical variables.

Section C: Consist of by using the modified bio- physiological parameters with arterial blood gas analysis scale. The purpose of the study was to evaluate the effectiveness of 3% hypertonic saline nebulized suctioning among patient connected to mechanical ventilator the study purpose was explained to participants and get obtained consent. The baseline characteristics like demographic variables were collected from the participants. The Modified bio physiological parameters with arterial blood gas analysis scale used to assess the level of airway clearance in pre-test and after administration of 3% hypertonic saline nebulized suctioning that is post-test. The study shows that over all Pre and post-test level of airway clearance among patients connected to mechanical ventilator. during the pre-test mean value was 7.96 and standard deviation was 3.34, In post-test mean value was 2.74 and standard deviation was 2.93. The calculated value of paired t test was 8.46 which greater than table value, the study identified that there was a highly significant between pre and post test score, which indicating the impact on effectiveness of 3% hypertonic saline nebulisation on airway clearance among the patients connected with mechanical ventilator before and after administration. The study shows that presents

substantive summary of chi-square analysis which was used to bring out the relationship between the post-test level of airway clearance with selected demographic and clinical variables.

I. INTRODUCTION

"The prevention of disease today is one of the most important factors in line of human endeavor" – Charles Mayo. Mechanical ventilation is a life-saving intervention that supports or replaces spontaneous breathing in critically ill patients. It improves pulmonary gas exchange, relieves respiratory distress, and allows lung healing, but its use is often associated with complications that increase morbidity, mortality, and healthcare costs (Colice, 2016; Talmor, 2020). Endotracheal intubation, though essential, interferes with natural airway defences, leading to secretion retention and higher infection risk (Hess, 2011). Thus, suctioning and airway clearance techniques such as humidification, nebulization, percussion, and chest physiotherapy are vital to maintain airway patency and optimize ventilation (Donaldson, 2015). The primary purpose of this study is to highlight the importance of safe and effective airway management in mechanically ventilated patients, focusing on suctioning and clearance techniques that minimize complications and enhance weaning outcomes. Given the risks associated with prolonged ventilation, current research emphasizes readiness assessment, safe weaning protocols, and evidence-based strategies to improve survival and quality of care in intensive care units (Vesalius, 2016; Rose & Nelson).

OBJECTIVES OF THE STUDY

1. To assess the airway clearance among patients connected with mechanical ventilator.
2. To assess the effectiveness of 3%hypertonic saline nebulization suctioning on airway clearance among patients connected with mechanical ventilator.
3. To find out the association between post test score on 3% hypertonic saline nebulization suctioning on airway clearance among patients connected with mechanical ventilator with their selected socio demographic variables and clinical variables.

II. RESEARCH HYPOTHESIS

H1: There is a significant difference between the effects on 3% hypertonic saline nebulized suctioning among patients connected with mechanical ventilator.

H2: There is a significant association between the post tests score of 3% hypertonic saline nebulized suctioning on airway clearance with their selected socio demographic variables and clinical variables.

III. METHODOLOGY

A quantitative evaluative approach with a pre-experimental one-group pre-test and post-test design was adopted to assess the effectiveness of 3% hypertonic saline nebulized suctioning on airway clearance. The study was conducted at Apollo Loga Hospital, Karur. The target population consisted of patients receiving nebulization while on mechanical ventilation, and the accessible population included patients who met the inclusive criteria. A total of 30 mechanically ventilated patients were selected through a non-probability convenient sampling technique. The intervention involved administration of 3% hypertonic saline nebulized suctioning in patients connected to a mechanical ventilator, followed by evaluation of airway clearance. Data collection was performed using a semi structured interview schedule to capture socio-demographic and clinical variables, along with modified bio physiological parameters measured using arterial blood gas (ABG) analysis. The independent variable was hypertonic saline nebulized suctioning, the dependent variable was airway clearance, and attributed variables included socio demographic and clinical characteristics such as age, gender, and education. Data were analysed using, descriptive statistics (frequency, percentage, mean, median, and

standard deviation) were used to summarize the data, while inferential statistics (chi-square test) were applied to determine associations between variables, with the level of significance set at $p < 0.05$. Ethical clearance was obtained from the ethics committee and Unit Head informed consent was secured from the participants' legal guardians prior to data collection. The results were presented in tables, figures, and narratives, followed by a summary, conclusion, and recommendations for clinical practice.

IV. DATA ANALYSIS AND INTERPRETATION

SECTION – A DISTRIBUTION OF SOCIO DEMOGRAPHIC VARIABLES AND CLINICAL VARIABLES AMONG PATIENTS CONNECTED TO MECHANICAL VENTILATOR

In the view distribution of patients according to age, among the patients 4(13%) of them age were between 21-30 years, 8(27%) of them age were between 31-40 years, 10(33%) of them age were between 41-50 years and 8(27%) of them age were between 51-60 years. The study shows that distribution of patients according to gender, among the patients 17(57%) of them were male and 13(43%) of them were female. In accordance with that distribution of patients according to education status, among the patients 5(17%) of them had no formal education, 16(53%) of them had primary education, 3(10%) of them had secondary education and 6(20%) of them were graduates. It viewed that distribution of patients according to occupational status, among the patients 5(17%) of them were doing business, 8(26%) of them were daily wages, 6(20%) of them were unemployed, 8(27%) of them were private employee and 3(10%) of them were government employee. The distribution of patients according to religion, among the patients 18(60%) of them were Hindu, 5(17%) of them were Christian, 7(23%) of them were Muslim and none of them in others. It implicit that distribution of patients according to income, among the patients 2(6%) of them were earning 1000-3999, 8(27%) of them were earning 4000-6999, 12(40%) of them were earning 7000-9999 and 8 (27%) of them were earning above 10000.The distribution of patients according to marital status, among the patients 2(6%) of them were unmarried, 24(80%) of them were married, 3(10%) of them were widow/widower, 1(3%) of them was separated and none of them in divorced. It implicit that distribution of patients according to type of family, among the patients 12(40%) of them were belongs to nuclear family, 10(33%) of them were belongs to joint family and 8(27%) of them were belongs to extended family. The study shows that distribution of patients according to dietary pattern, among the patients 16(53%) of them were vegetarian and 14(47%) of them were non vegetarian. In narrating that distribution of patients according to personal habits, 2(6%) of them had alcohol, 10(34%) of them were smokers, 18(60%) of then don't had the bad habits and none of them in tobacco chewing. The study shows that distribution of patients according to history chronic illness, 16(53%) of them had history of chronic disease and 14(47%) of them don't had the history of chronic disease The distribution of patients according to Reason for mechanical ventilation, among the patients 6(20%) of them had CNS disorder 8(27%) of them had Cardiac disorder, 14(46%) of them had renal disorder,2(7%) of them had metabolic disorder and none of them in others. It is verified that according to frequency of suctioning, among the patients 13(43%) of them were suctioning every 2 hours, 8(27%) of them were suctioning every 4 hours and 9(20%) of them were suctioning every 6 hours. In the view distribution of patients according to duration of mechanical ventilation, among the patients 19(63%) of them were in mechanical ventilation in less than 21 days and 11(37%) of them were in mechanical ventilation in more than 21 days. The distribution of patients according to patient position during suctioning, among the patients 18(60%) of them were in supine position and 12(40%) of them were in semi fowler's position. The study shows that distribution of patients according to frequency of nebulisation, among the patients 15(50%) of them were had nebulisation once a day, 6(20%) of them were had nebulisation two times per day, 9(30%) of them were had nebulisation three times per day and none of them in four time per day.

SECTION – B a) COMPARISION OF PRE AND POST TEST LEVEL ACCORDING TO AIR WAY CLEARANCE AMONG THE PATIENTS CONNECTED TO MECHANICAL VENTILATOR

Table 1- Comparison of pre and post level according to air way clearance among the patients connected to mechanical ventilator (n=40)

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S.NO	Level of Airway	Pertest Frequency	Pertest %	Post-test Frequency	Post-test %
1	Normal	–	–	19	63%
2	Mild	5	17%	4	14%
3	Moderate	18	60%	7	23%
4	Severe	7	23%	–	–

Figure: 1. Bar diagram quotes distribution of subjects according to their level of depression among elderly

SECTION-C

a) COMPARISION OF PRE AND POST TEST LEVEL OF AIRWAY CLEARANCE WITH MEAN, STANDARD DEVIATION AMONG THE PATIENTS CONNECTED TO MECHANICAL VENTILATOR
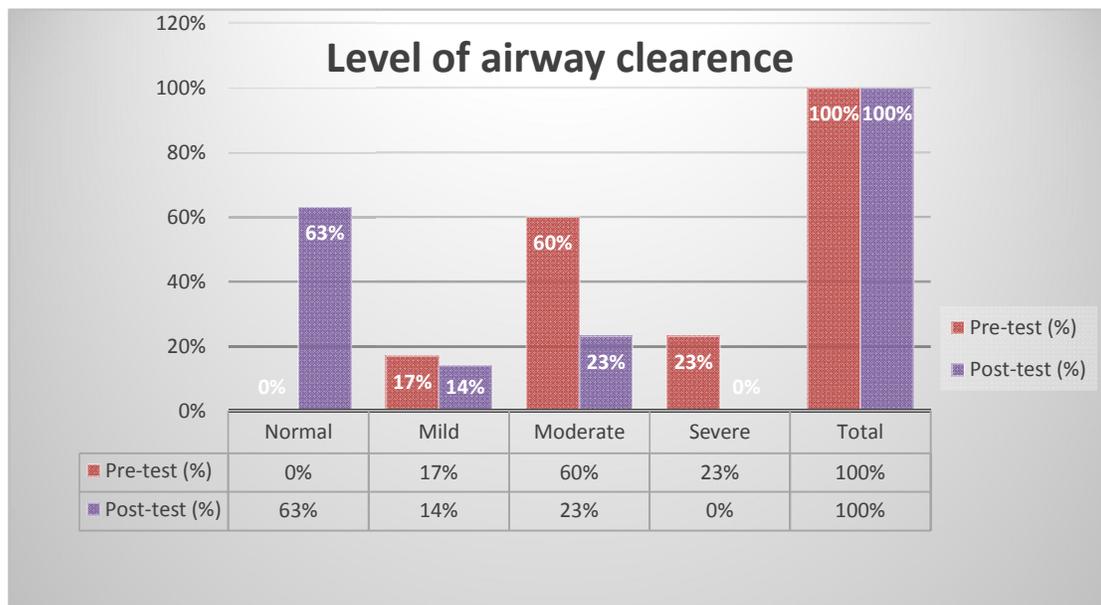

Level of airway clearence

	Normal	Mild	Moderate	Severe	Total
Pre-test (%)	0%	17%	60%	23%	100%
Post-test (%)	63%	14%	23%	0%	100%

Table 2- Mean and standard deviation with pre and post-test level of airway clearance among the patients connected to mechanical ventilator

S.No	Test	Mean	SD	t-value	Table Value (TV)
1	Pre-test	7.96	3.34	8.46	1.96
2	Post-test	2.74	2.93	–	–

The study shows the Mean and standard deviation with pre and post-test level of airway clearance. Among the patients, during the pre-test mean value was 7.96 and standard deviation was 3.34, In post-test mean value was 2.74 and standard deviation was 2.93. The calculated value of t was 8.46 which greater than table value, it is noted that there was a highly significant between pre and post test score so there is effectiveness of 3% hypertonic saline nebulisation on airway clearance Among the patients connected with mechanical ventilator. H1: There will be a significant difference to assess the effectiveness of 3%hypertonic saline nebulized suctioning among patients connected to mechanical ventilator was accepted.

SECTION-D

Table – 3 :- ASSOCIATION BETWEEN POST TEST LEVEL OF AIRWAY CLEARANCE WITH SELECTED DEMOGRAPHIC VARIABLES AND CLINICAL VARIABLES AMONG PATIENTS CONNECTED TO MECHANICAL VENTILATOR

S.No	Demographic Variable	Categories	N	Normal	Mild	Moderate	Chi-Square	Df	Significance
1	Age	21–30, 31–40, 41–50, 51–60	4, 8, 10, 8	2, 4, 9, 1	1, 2, 1, –	1, 2, –, 4	6.11	6	NS
2	Gender	Male, Female	17, 13	8, 11	2, 2	7, –	6.46	2	NS
3	Education	No formal, Primary, Secondary, Graduate	5, 16, 3, 6	3, 9, 2, 5	1, 3, –, –	1, 4, –, –	3.42	6	NS
4	Occupation	Business, Daily wages, Unemployed, Private, Govt.	5, 8, 6, 8, 3	4, 3, 3, 6, 3	1, 2, 1, –, –	–, 3, 2, 2, –	8.56	6	NS
5	Religion	Hindu, Christian, Muslim, Others	18, 5, 7, –	10, 4, 5, –	4, –, –, –	4, 1, 2, –	9.43	6	NS
6	Income	a) Rs.< 1000 b) Rs.1000 – Rs.3999 c) Rs.4000 – Rs.6999 d) Rs.7000 – Rs.9999 e) Rs.>10000	–, 2, 8, 12, 8	–, 1, 6, 6, 6	–, 1, 2, 1, –	–, –, –, 5, 2	6.53	8	NS
7	Marital Status	Unmarried, Married, Widow, Separated, Divorced	2, 24, 3, 1, –	1, 18, –, –, –	1, 2, 1, –, –	4, 2, 1, –, –	11.46	8	NS
8	Family Type	Nuclear, Joint, Extended	12, 10, 8	6, 5, 8	1, 3, –	5, 2, –	6.74	4	NS
9	Diet	Vegetarian,	16,	10, 9	4, –	2, 5	6.78	4	NS

S.No	Demographic Variable	Categories	N	Normal	Mild	Moderate	Chi-Square	Df	Significance
		Non-vegetarian	14						
10	Habits	Alcohol, Smoking, Tobacco, None	2, 10, –, 18	1, 5, –, 13	–, 3, –, 1	1, 2, –, 4	8.43	8	NS
11	Chronic Disease	Yes, No	16, 14	11, 8	3, 1	2, 5	3.45	2	NS
12	Type of Disease	Arthritis, Asthma, Cancer, COPD, Others, None	3, 5, 2, 3, –, 14	2, 3, 1, 3, –, 8	2, 1, –, –, –, –	1, 1, –, –, –, 5	6.79	6	NS
13	Reason for Ventilation	CNS, Cardiac, Renal, Metabolic, Others	6, 8, 14, 2, –	3, 5, 11, –, –	1, 2, –, 1, –	2, 1, 3, 1, –	6.53	8	NS
14	Suctioning Frequency	2nd hr, 4th hr, 6th hr	13, 8, 9	8, 5, 6	3, 1, –	2, 2, 3	4.56	4	NS
15	Ventilation Duration	1 week, 1 month, >1 month	3, 22, 5	2, 16, 1	1, 2, 1	–, 4, 3	3.14	2	NS
16	Position	Supine, Semi-Fowler	18, 12	11, 8	3, 1	4, 3	6.57	2	NS
17	Nebulisation Frequency	Once, Twice, Thrice, Four times	15, 6, 9, –	10, 3, 6, –	2, 1, 1, –	3, 2, 2, –	8.53	6	NS
18	Oxygen Episodes	2, 3, 4, s>5	6, 19, 5, –	2, 13, 4, –	1, 2, 1, –	3, 4, –, –	11.46	6	NS
19	Airway Clearance Method	Exam, Cough, Nebulisation, Physio, Others	4, 12, 8, 6, –	1, 8, 5, 5, –	1, 3, –, –, –	2, –, 1, 3, 1	11.53	12	NS
20	Mucous Type	Thick, Mild, Clear	14, 13, 3	12, 7, –	2, 1, 1	–, 5, 2	8.74	6	NS

S.No	Demographic Variable	Categories	N	Normal	Mild	Moderate	Chi-Square	Df	Significance
21	Mucous Odour	Yellow, White, Green, Chunky/Foul	8, 6, 12, 4	3, 4, 9, 3	2, 1, 1, –	3, 1, 2, 1	9.36	9	NS

Table - 3:- The study shows the association between level of airway clearance with selected demographic and clinical variables, for considering the variables age, education qualification, occupation status religion, income marital status type of family, dietary pattern, personal habits, history of chronic disease, If any history of chronic disease reason for mechanical ventilation, frequency of suctioning, duration of mechanical ventilation, frequency of nebulization, Episode of lower oxygen saturation, how to check airway clearance, Type of mucous secretion, Odour of mucous secretion had no association between level of airway clearance & gender dietary pattern, patient position during suctioning association with level of air way clearance. H2: There is a significant association between the post-tests score of 3% hypertonic saline nebulized suctioning on airway clearance with their selected socio demographic variables and clinical variables.

V. DISCUSSION

Objective 1. Assessment the level of airway clearance among the patient connected to mechanical ventilator in pre test. The study shows that Frequency and percentage distribution of patients connected to mechanical ventilator according to level of airway clearance in pre-test. The level of airway clearance, 5(17%) of the had mild level, 18(60%) of them had moderate level, 7(23%) of them had severe level and none of them in normal level. The study shows that Mean and standard deviation with pre level of airway clearance among the patients, during the pre test mean value was 7.96 and standard deviation was 3.34.

Objective 2. **Assessment the level of airway clearance among the patient connected to mechanical ventilator in post test.** The study shows that frequency and percentage distribution of patients connected to mechanical ventilator according to level of airway clearance in post test among the patients 19(63%) of them had normal level.4(14%) of them had mild level, 7(23%) of them had moderate level and none of them in severe level. In post test mean value was 2.74 and standard deviation was 2.93. The calculated value of t was 8.46 which greater than table value, it is noted that there was a highly significant between pre and post test score, so there is effectiveness of 3% hypertonic saline nebulization on airway clearance among the patients connected with mechanical ventilator.

Objective 3. To assess the effectiveness of 3% hypertonic saline nebulizer suctioning among patients with mechanical ventilator. H1: There will be a significant difference to assess the effectiveness of 3%hypertonic saline nebulized suctioning among patients connected to mechanical ventilator was accepted. The study shows that over all Pre and post test level of airway clearance among patients connected to mechanical ventilator, during the pre test mean value was 7.96 and standard deviation was 3.34. In post test mean value was 274 and standard deviation was 2.93. The calculated value of paired t test was 8.46which greater than table value the study identified that there was a highly significant between pre and post test score, which indicating the impact on effectiveness of 3% hypertonic saline nebulization on airway clearance among the patients connected with mechanical ventilator before and after administration.

4. To find out the association between post test score on 3% hypertonic saline nebulization suctioning on airway clearance among patients connected with mechanical ventilator with their selected socio demographic variables and clinical variables. H2: There is a significant association between the post tests score of 3% hypertonic saline

nebulized suctioning on airway clearance with their selected socio demographic variables and clinical variables. The study shows that presents substantive summary of chi-square analysis which was used to bring out the relationship between the post-test level of airway clearance with selected demographic and clinical variables, for considering the variables age, education qualification, occupation status, religion, income, marital status, type of family, dietary pattern, personal habits, history of chronic disease. The study shows that presents the relationship between the post-test level of airway clearance with clinical variables. There was association between reason for mechanical ventilation, frequency of suctioning, duration of mechanical ventilation, frequency of nebulization, Episode of lower oxygen saturation, how to check airway clearance. Type of mucous secretion, Odour of mucous secretion had no association between level of airway clearance & gender, dietary pattern, patient position during suctioning had association with level of air way clearance The findings of the present study are consistent with earlier research that emphasized the role of nebulized hypertonic saline (HS) in reducing the length of hospital stay and improving clinical outcomes in patients with respiratory illness. A study conducted in the United Arab Emirates (2016) demonstrated that mechanically ventilated patients who received 3% HS had a clinically significant 26% reduction in hospital stay compared with those treated with normal saline, and the therapy was well tolerated. Similarly, Wang JY et al. (2015) reported that adults with acute viral bronchiolitis who were administered nebulized 3% HS in combination with bronchodilators showed both shorter hospital stay and lower post-inhalation clinical scores within the initial days of treatment, also found that the addition of frequently nebulized 3% HS to standard therapy reduced the mean length of stay by one day compared with the normal saline group, with no adverse effects observed. Taken together, these studies reinforce the conclusion that nebulized 3% hypertonic saline is a safe, cost-effective, and clinically beneficial intervention that enhances airway clearance and facilitates earlier recovery among hospitalized patients. The consistency across diverse populations and settings highlights the reliability of HS as an adjunct therapy, aligning with the outcomes of the present study.

VI. CONCLUSION

The present study is used to assess the effectiveness of 3%hypertonic saline nebulization suctioning on airway clearance among patients connected with mechanical ventilator. The result revealed that, to find out the association between post test score on 3% hypertonic saline nebulization suctioning on airway clearance among patients connected with mechanical ventilator with their selected socio demographic variables and clinical variables. The study has shown that hypertonic saline nebulization is the cheapest, safe, effective and easiest way in maintaining the airway patency of patients connected to mechanical ventilator.

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