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A Study To Assess The Effectiveness Of Hypertonic Saline Nebulized Suctioning On Airway Clearance Among Patients Connected To Mechanical Ventilator In A Selected Hospital, Namakkal District, Tamilnadu

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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 Swamy Vivekanandha Medical College Hospital & Research Institute Namakkal District, Tamilnadu. 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.

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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.

Keywords: *Mechanical Ventilation, Airway Clearance, Hypertonic Saline Nebulization, Endotracheal Suctioning, Arterial Blood Gas Analysis, Pre-experimental Study*

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, 2006; Talmor, 2010). Endotracheal intubation, though essential, interferes with natural airway defenses, 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 ssess 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.

RESEARCH HYPOTHESIS

H_1: There is a significant difference between the effects on 3% hypertonic saline nebulized suctioning among patients connected with mechanical ventilator.

H_2: 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.

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 Swamy Vivekanandha Medical College Hospital & Research Institute, Namakkal, Tamil Nadu. 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 analyzed 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 institutional

ethics committee, and 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.

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

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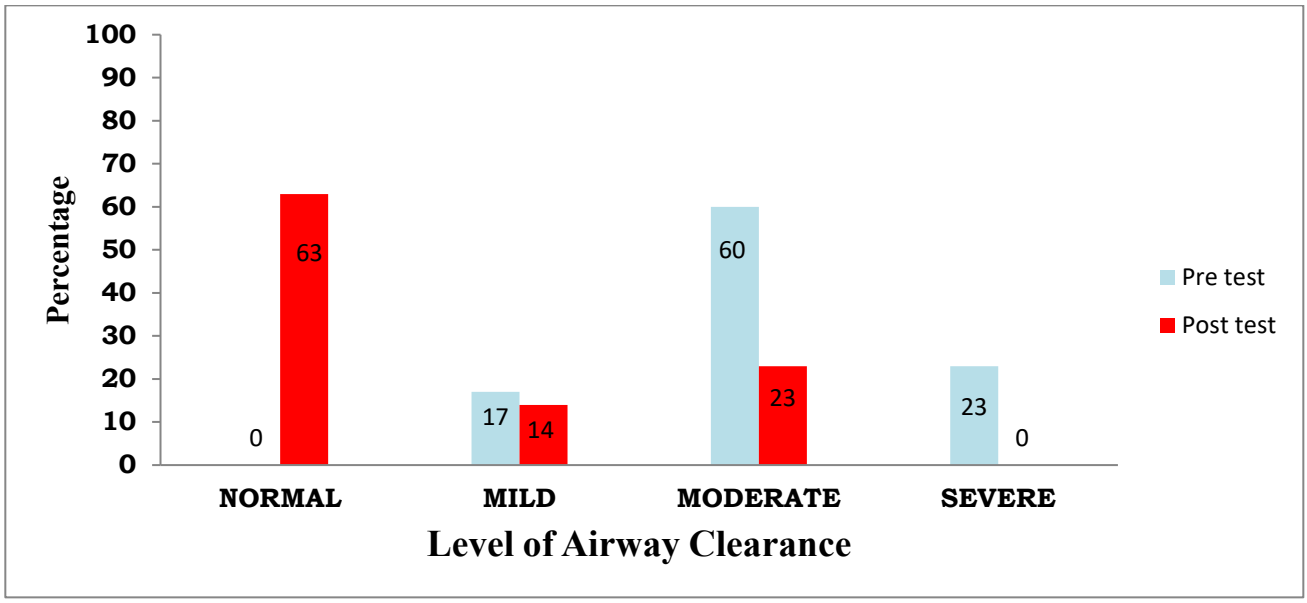
Table 1- Comparison of pre and post level according to air way clearance among the patients connected to mechanical ventilator (n=40)

S.NO	LEVEL OF AIRWAY INTERPRETATION	PRETEST		POSTTEST	
		FREQUENCY	PERCENTAGE(%)	FREQUENCY	PERCENTAGE(%)
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

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
1	PreTest	7.96	3.34	8.46 TV=1.96
2	PostTest	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 VARIABLES	N	Level of airway Interpretation			Chi Square
			Normal	Mild	Moderate	
1	**Age**					
	a) 21 - 30 years	4	2	1	1	6.11
	b) 31 - 40 years	8	4	2	2	Df = 6, NS
	c) 41 - 50 years	10	9	1	-	
	d) 51 – 60 years	8	1	-	4	
2	**Gender**					6.46
	a) Male	17	8	2	7	Df = 2, NS
	b) Female	13	11	2	-	
3	**Educational Qualification**					
	a)No formal education	5	3	1	1	
	b) Primary education	16	9	3	4	3.42
	c) Secondary education	3	2	-	-	Df = 6, NS
	d)Graduate	6	5	-	-	
4	**Occupational Status**					
	a) Business	5	4	1	-	
	b) Daily Wages	8	3	2	3	8.56
	c)Unemployed	6	3	1	2	Df = 6, NS
	d) Private	8	6	-	2	
	e) Government	3	3	-	-	
5	**Religion**					9.43
	a)Hindu	18	10	4	4	Df = 6, NS
	b)Christian	5	4	-	1	
	c) Muslim	7	5	-	2	
	d) Others	-	-	-	-	
6	**Income**					
	a) Rs.< 1000	-	-	-	-	
	b) Rs.1000 – Rs.3999	2	1	1	-	
	c) Rs.4000 – Rs.6999	8	6	2	-	6.53
	d) Rs.7000 – Rs.9999	12	6	1	5	Df = 8, NS
	a) Rs.>10000	8	6	-	2	
7	**Marital Status**					

	a) Unmarried	2	1	1	-	
	b) Married	24	18	2	4	11.46
	c) Widow/Widower	3	-	1	2	Df = 8, NS
	d) Separated	1	-	-	1	
	e) Divorced	-	-	-	-	
8	**Type of Family**					
	a) Nuclear family	12	6	1	5	6.74
	b) Joint family	10	5	3	2	Df = 4, NS
	c)Extended family	8	8	-	-	
9	**Dietary Pattern**					6.78
	a) Vegetarian	16	10	4	2	Df = 4, NS
	b) Non Vegetarian	14	9	-	5	
10	**Personal Habits**					8.43
	a) Alcohol					Df = 8, NS
	b) Smoking	2	1	-	1	
	c) Tobacco Chewing	10	5	3	2	
	d) No bad Habits	-	-	-	-	
		18	13	1	4	
11	**History of Any Chronic Disease**					3.45
	a) Yes					Df = 2, NS
	b) No	16	11	3	2	
		14	8	1	5	
12	**If yes means _____(Chronic Disease)**					6.79
						Df = 6, NS
	a)Arthritis	3	2	1	-	
	b) Asthma	5	3	1	1	
	c) Cancer	2	1	-	1	
	d)Chronic Obstructive Pulmonary Disease	3	3	-	-	
	e) Others	2	2	1	-	
	f)No	14	8	1	5	
13	**Reason for mechanical ventilation**					
	a) CNS Disorder					
	b) Cardiac Disorder	6	3	1	2	
	c) Renal Disorder	8	5	2	1	6.53
	d) Metabolic disorder	14	11	-	3	Df = 8, NS
	e) Others	2	-	1	1	
		-	-	-	-	
14	**Frequency of suctioning**					
	a) Every 2nd hourly once	13	8	3	2	4.56
	b) Every 4th hourly once	8	5	1	2	Df = 4, NS
	c) Every 6th hourly once	9	6	-	3	
15	**Duration of mechanical ventilation**					

	a) One week b) One month **c)** More than one month	3 22 5	2 16 1	1 2 1	- 4 3	3.14 Df = 2, NS
16	**Position during suctioning** a) Supine Position b) Semi-Fowler's Position	18 12	11 8	3 1	4 3	6.57 Df = 2, NS
17	**Frequency of nebulisation** a) Once A Day b) Two Times A Day c) Three Times A Day d) Four Times A Day	15 6 9 -	10 3 6 -	2 1 1 -	3 2 2 -	8.53 Df = 6, NS
18	**Episode of Lower Oxygen Saturation** a) Two Episode b) Three Episode c) Four Episode d) More Than Five Episode	6 19 5 -	2 13 4 -	1 2 1 -	3 4 - -	11.46 Df = 6, NS
19	**How to Check Airway Clearance** a) Physical Examination b) Coughing And Huffing c) Nebulization And Suctioning d) Chest Physiotherapy **e)** Others	4 12 8 6 -	1 8 5 5 -	1 3 - - -	2 - 1 3 1 -	11.53 Df = 12, NS
20	**Type of mucous secretion** a) Thicking Secretion b) Mild Secretion c) Clear Secretion	14 13 3	12 7 -	2 1 1	- 5 2	8.74 Df = 6, NS
21	**Odour of mucous secretion** a) Yellow b) White c) Green d) Chunky In Consistency (or) Foul Smelling	8 6 12 4	3 4 9 3	2 1 1 -	3 1 2 1	9.36 Df = 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.

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,

indicating faster recovery. Supporting this evidence, Schulz et al. (2000) 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.

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.

REFERENCES

1. Caroline Wood. Effect of nebulized 3% hypertonic saline in the treatment of viral bronchiolitis. Pulmonary Research, 8(1), 2008, 149-158.
2. Caruso & Pedro. Saline instillation before tracheal suctioning decreases the incidence of ventilator-associated pneumonia. Critical Care Med, 37, 2009, 32-38.
3. Dolenska S, Dalal P & Taylor A. Essentials of airway management.(1sted). San Francisco: Mizpah publication, 2007.
4. Donald EC. Preventing Ventilator-Associated Pneumonia in Adults- Sowing Seeds of Change Chest journal, 30(1), 2006, 251-260.
5. Donaldson HS, William D, BennettZeman LK & Michael RK Mucus Clearance and Lung Function in Cystic Fibrosis with Hypertonic Saline. The New England Journal of Medicine, 354, 2006, 241-250.
6. Donaldson SH, Bennett WD, Zeman KL, Knowles MR, Tarran R, Boucher RC. Mucus clearance and lung function in cystic fibrosis with hypertonic saline. New England Journal of Medicine 2006;354(3):241e50.
7. Elkins MR & Peter TP. Inhaled hypertonic saline as a therapy for cystic fibrosis. Journal Pulmonary Medicine, 12(6), 2006, 445-452.
8. Elkins MR, et al. A controlled trial of long term inhaled hypertonic saline in patients with cystic fibrosis. The New England Journal of Medicine 2006;354(3):229e40.
9. Kellett F, et al. Evaluation of nebulised hypertonic saline (7%) as an adjunct to physiotherapy in patients with stable bronchiectasis. Respiratory Medicine 2005:99:27e31.
10. Robinson M, Hemming A, Regnis J, Wong A, Bailey D, Bautovich G, et al. Effect of increasing doses of hypertonic saline on mucociliary clearance in patients with cystic fibrosis. Thorax 1997; 52:900e3.

Net Reference :-

1. www.pubmed.com
2. www.Medline.com
3. www.Medscape.com
4. www.wikepedia.org.
5. www.popline.org
6. www.healthguidance.org
7. https://data.unicef.org
8. www.research gate.com
9. www.encyclopedia.com
10. www.medindia.com
11. www.emedicine.com