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RESEARCH

A COMPARISION OF EFFECT OF SEMI FOWLER'S VS SIDE LYING POSITION ON TIDAL VOLUME & PULSE OXYMETRY IN ICU PATIENTS

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ABSTRACT

Aim of study: To find out Comparision of side lying versus semi Fowler's position in mechanically ventilated ARDS (Acute Respiratory Distress Syndrome) patients on tidal volume and pulse oxymetry in ICU. **Study Design**: Cross sectional observational comparative study. **Study Group**: 30 patients admitted to ICU of government hospital fulfilling criteria for a diagnosis of ARDS. **Inclusion Criteria:** Mechanically ventilated patients, Age between 20 to 60 yrs, Sex: male female both and patient with ARDS. **Exclusion Criteria:** Aged less than 20 years, Evidence of cerebral edema and neurosurgery, Chest X-ray showed pleural effusion, pneumothorax or atelectasis, thoraco abdominal surgery or severe hemodynamic instability, Shock refractory to vasoactive drugs and volume therapy. **Outcome Measures:** Tidal Volume, Pulse Oxymetry, PaO2, PaCO2. **Result:** suggest that there is extremely significant difference in tidal volume after giving semi Fowler's position. There is no significant difference in tidal volume after giving right and left side lying position. **Conclusion:** Comparing semi Fowler's position to each of these side lying positions, semi Fowler's positioning found to be better in improving tidal volume and oxygenation in mechanically ventilated ARDS patients in ICU. These findings may be helpful in reducing FiO2, hence side effects related to oxygen toxicity in mechanically ventilated ARDS patients in ICU.

INTRODUCTION

Therapeutic body positioning which is prescribed to optimize cardiopulmonary function and oxygen transport is different from routine body positioning. Body position that stimulate normal physiological effect of gravity and position change on oxygen transport are priority that is being upright and moving .This is very important in bed ridden ICU patients. The distribution of ventilation and perfusion and ventilation perfusion matching in the lungs are primarily influenced by gravity and therefore by body position. Manipulating body position however alters both intraregional and interregional determinants ventilation perfusion and their matching. A variant of upright position is Fowler`s position in which head of the bed is elevated between 45 to 60 degrees. In semi Fowler's position, the head end of the bed is elevated between 30 to 45 degrees. [2], [3]

Side lying with the affected lung uppermost to improve VA/Q matching for patients with unilateral lung disease; side lying with the affected lung uppermost to improve ventilation (via distending forces on the uppermost lung) and clearance of airway secretions for patients with acute lobar atelectasis. Patients with uniformly distributed bilateral lung disease may derive greater benefit when right lung is lowermost. [1]

ARDS is characterized by:[4],[6] Acute onset, Bilateral infiltrates on chest radiograph sparing costophrenic angles, Pulmonary artery wedge pressure < 18 mmHg (obtained by pulmonary artery catheterization), if this information is available; if unavailable, then lack of clinical evidence of left ventricularlar failure suffices, If PaO2:FiO2 < 300 mmHg (40 k Pa) acute lung injury (ALI) is considered to be present and If PaO2:FiO2 < 200 mmHg (26.7 k Pa) acute respiratory distress syndrome (ARDS) is considered to be present.

Previous Studies have shown that pulmonary function and outcome are better in patients that lost weight

or pulmonary wedge pressure was lowered by diuresis, corticosteroids or fluid restriction. [7] Several studies are done regarding effect of prone position in mechanically ventilated ARDS patients. But comparatively few studies are done about comparision of side lying versus semi Fowler's position in mechanically ventilated ARDS patients in ICU.

So aim of this study was to find out Comparision of side lying versus semi Fowler's position in mechanically ventilated ARDS patients on tidal volume and pulse oxymetry in ICU.

MATERIALS & METHODS

PARAMETERS

Pulse oxymetry provides a very similar measure to the direct measurement of oxygen saturation. The infrared sensor of a pulse oxymeter worn on the finger ,ear lobe ,or other body part senses amount of oxygen saturating hemoglobin by interpreting the density of the blood flow through the particular body part with the probe. The oxygen saturation is then calculated automatically via regression equations within the pulse oxymeter. Heart rate is also measured as oxymeter evaluates each arterial pulse. .Accuracy of Pulse oxymetry is less than the direct measurement of oxygen saturation via arterial blood gases. Oxygen saturation is related to PaO2 via oxy hemoglobin curve. [4]

Tidal volume is amount of air which is inspired or expired during each breath .The initial tidal volume is usually set between 10 to 12 ml/kg of ideal body weight. The lower end of acceptable tidal volume range (about 10 ml/kg) may be appropriate for certain patients. [5]

PROCEDURE

Thus semi Fowler and lateral positions are both effective in bed ridden patients .But very few evidences are available regarding their effect in acute respiratory distress syndrome patients. Also to avoid inhomogenisity in study group, only ARDS patients were included.

A total 30 patients with diagnosis of ARDS were included in study. Out of this 30 patients, 10 patients were given Semi Fowler's position (group 1), 10 patients Right side lying (group2) and 10 patients were given Left side lying position (group3). Patients were maintained in their respected position for 30 minutes. All the parameters were recorded before giving any position. For recording tidal volume average of 6 readings were taken.

The patients were initially placed in a supine position and then were turned to the right side lying position. The patients were returned to the supine position for at least 2 hours before being turned in side lying. In order to obtain a standard side lying position, an imaginary line was drawn from the head of the humerus at an angle to the horizontal to obtain a 90 degree angle. The head was supported by a pillow, both arms were fixed anteriorly and a pillow was inserted between both knees to prevent pressure compression. Change of position was performed manually by four attendants.

For achieving semi Fowler position head end of the bed was elevated to 45 degrees. The ventilator settings were not changed during the study period. Measurements were obtained in the supine position and after 30 minutes after changing the position. Arterial blood gases, respiratory mechanics, hemodynamic parameters and complications due to changing position were recorded. Arterial blood gas analysis was taken as an additional outcome measure because it is routinely done procedure in ICU by anesthetists.

RESULTS

A total 30 patients were included in this study. Out of these 30 patients, 24 patients were responders while 6 patients were non responders in terms of oxygenation and tidal volume improvement. In responder group of patients, 1. There was significant improvement in Tidal volume, PaO_2, PaCO2 after giving semi Fowler's position.. There was no significant change in pulse rate and SpO_2. 2. There was significant improvement in PaO2 after giving right and left side lying position. There was no significant improvement in SpO2, PaCO2, tidal volume and Pulse rate after giving right and left side lying position 3. Comparing semi Fowler's position to each of these side lying positions, semi Fowler's positioning found to be better in improving oxygenation in mechanically ventilated ARDS patients.

TABLE I: TIDAL VOLUME FOR RESPONDERS

Position	*Pre Mean ± SD*	*Post Mean ± SD*	*t value*	*p Value*	*Result*
Semi Fowler's	417.1 ± 29.68	440 ± 26.97	6.225	<0.0004	Extremely significant
Right side lying	422.8 ± 41.19	427.9 ± 35.67	2.078	0.0673	Not significant
Left side lying	404.6 ± 31.74	406.1 ± 31.22	1.477	0.1832	Not significant

Figure 1: Comparision of mean values of pre positioning and post positioning tidal volume

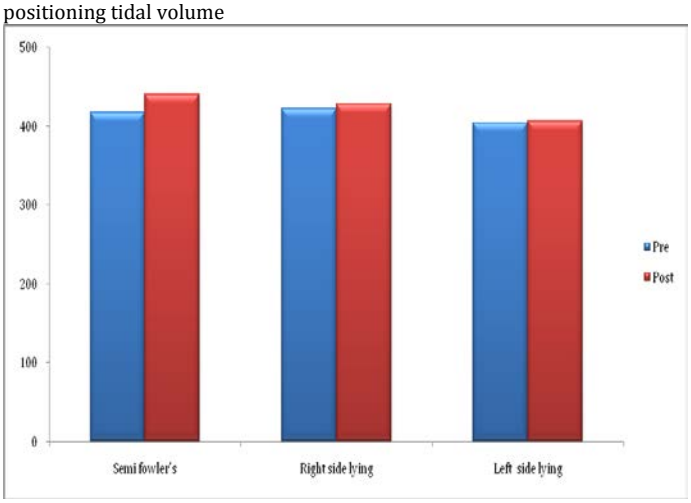

TABLE II: SpO2 FOR RESPONDERS

Position	*Pre Mean ± SD*	*Post Mean ± SD*	*t Value*	*p Value*	*Results*
Semi Fowler	95.5 ± 2.390	97.75 ± 2.55	2.346	0.0514	Not significant
Right side lying	96.25 ± 2.493	98 ± 2.138	2.198	0.0639	Not significant
Left side lying	96.63 ± 3.204	98.25 ± 1.669	1.976	0.088	Not significant

Figure 2: Comparision of mean values of pre positioning and post positioning SpO2

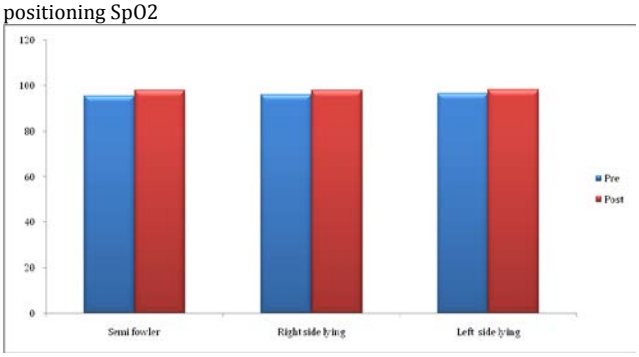

TABLE III: PULSE RATE FOR RESPONDERS

Position	*Pre* *Mean ± SD*	*Post* *Mean ± SD*	*t* *value*	*p* *Value*	*Result*
Semi Fowler	104.6 ± 7.981	111.3±13.17	1.91	0.0978	Not significant
Right side lying	104.6 ±8.684	110.6±10.18	1.789	0.1168	Not significant
Left side lying	115.3 ± 11.42	109.9 ± 9.583	2.292	0.0556	Not significant

Figure 3: Comparision of mean values of pre positioning and post positioning pulse rate

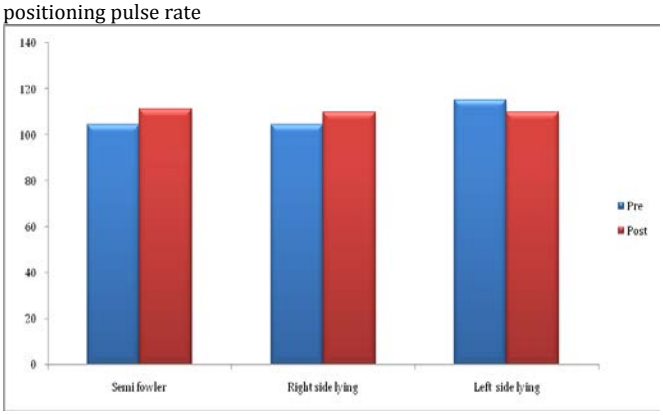

TABLE IV: DIFFERENCE PaO2 FOR RESPONDERS

Position	*Pre* *Mean ± SD*	*Post* *Mean ± SD*	*t* *value*	*p* *Value*	*Result*
Semi Fowler	87.63 ± 5.476	127.6 ± 7.652	15.69	<0.0001	Extremely significant
Right side lying	87.5 ± 4.928	104.1 ± 12.38	3.934	0.0056	Very significant
Left side lying	88.88 ± 8.323	100.9 ± 13.01	2.426	0.0457	Significant

Figure 4: Comparision of mean values of pre positioning and post positioning PaO2

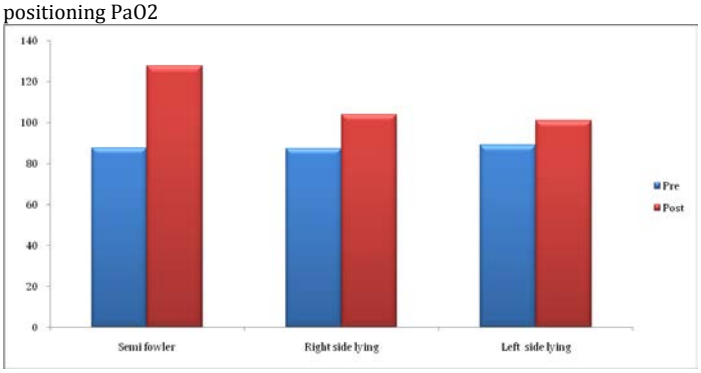

TABLE VIII: PaCO2 FOR RESPONDERS

Position	*Pre* *Mean ± SD*	*Post* *Mean ± SD*	*t* *value*	*p* *Value*	*Result*
Semi Fowler	53.5 ± 3.505	42.75 ± 5.036	5.177	0.0013	Significant
Right side lying	49.75 ± 3.412	46 ± 3.703	2.106	0.0732	Not significant
Left side lying	48.5 ± 6.325	46.5 ± 5.071	1.427	0.1966	Not significant

Figure 5: Comparision of mean values of pre positioning and post positioning PaCO2

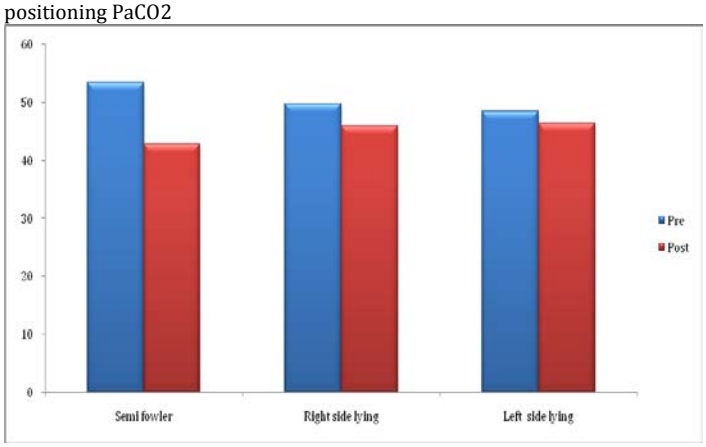

TABLE V: SEMI FOWLER'S VS RIGHT SIDE LYING

	t	*p*	*Results*
Pre	0.0479	0.9624	Not significant
Post	4.567	0.0004	Extremely Significant

TABLE VI: SEMI FOWLER'S VS LEFT SIDE LYING

	t	*p*	*Results*
Pre	0.3549	0.7280	Not significant
Post	5.013	0.0002	Extremely Significant

TABLE VII: RIGHT SIDE LYING VS LEFT SIDE LYING

	t	*p*	*Results*
Pre	0.4021	0.6937	Not significant
Post	0.5118	0.6167	Not significant

DISCUSSION

So, probable mechanisms behind getting above findings may be as follows: An infectious or inflammatory insult to the lungs, damages alveolar capillary membrane allowing fluid to enter alveolar spaces, impairing gas exchange in ARDS. Surfactant function is reduced, altering ventilation perfusion matching and encouraging local inflammatory esponse that further deteriorates gas exchange resulting in profound hypoxemia.

Although the processs appears quite diffuse on chest x ray, the use of computed Although the process appears quite diffuse on chest radiograph, the use of computed tomography has shown that the process is not so

homogenous; there are dependent zones which are collapsed, zones that are "recruitable" and zones which are well ventilated. [8] So treatment of ARDS must focus on maintaining tissue perfusion and oxygen delivery and eliminating the cause.

In the upright position FRC and tidal volume increase due to lowering of diaphragm and alveolar expansion due to lung's own weight The upright position maximizes lung volumes and capacities except closing volume which is decresed.. The higher volumes observed in responders in semi Fowler's position could result either from alveolar recruitment, i.e., more volume at the same pressure, or by an increase inrespiratory system compliance. So overall it can increase tidal volume and oxygenation, and reduced PaCO2. [10], [11]

In the side lying (lateral position) the distribution of the blood flow and ventilation is similar to that of upright position, but turned by 90 degree blood flow and ventilation is significantly greater to the dependent lung than to nondependent lung. Good V_A/Q matching at the dependent lungs results in the adequate oxygenation in the awake patient who is breathing spontaneously. There are 2 important concepts in this situation. 1. Because the perfusion is gravity dependent the vertical hydrostatic gradient is smaller in the lateral than in upright position. Therefore Zone 1 is usually less extended. 2. In regard to ventilation; the dependent diaphragm is pushed higher into the chest by abdominal contents compared with the nondependent lung diaphragm thus side lying can be used to enhance the efficiency of gas exchange and thereby to minimize or avoid the use of supplemental oxygen. Arterial blood gases have been reported to favourably in all patients, when the good lung is down. [11]

Prolonged side lying has been shown to mobilize lung water in patients with pulmonary odema and to a lesser extent in patients with pulmonary inflammation. Physical therapy interventions that entail gravitational challenges therefore can have a direct effect on lung water distribution and compartmentalization that in turn may affect pulmonary compliance and gas exchange [11]. All of above mentioned physiological changes occurring in side lying can result in increased oxygenation.

The FRC in side lying falls between that in upright and supine position. Compared with supine in side lying, compliance is increased, resistance is reduced, and the work of breathing is reduced, whereas these measures are reversed when side lying is compared to upright position. [11] That's why semi Fowler's position proved to be more effective than side lying.

CONCLUSION

Comparing semi Fowler's position to each of these side lying positions , semi Fowler's positioning found to be better in improving tidal volume and oxygenation in mechanically ventilated ARDS patients in ICU. These findings may be helpful in reducing FiO2, hence side effects related to oxygen toxicity in mechanically ventilated ARDS patients in ICU.

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REFERENCES

[1] Donna L Frownfelter, Elizabeth Dean "Cardiovascular and pulmonary physiotherapy" 4th edition, published by Mosboy 1996, page no 267.

[2] Mark C Rogers "Textbook of Peadiatric Intensive Care", 5th edition.

[3] Ruth F Craver Constant, J Hirnie "Fundamentals of Nursing Humam Health and Function", 5th edition, Lippincot's and Wikin's Publications.

[4] William E.De Turek, Lawrence P. Cahalin,"Cardiovascular and pulmonary physical therapy- an evidence based approach" 3rd edition,Mc Grow Hill Publication;,Pg no 248.

[5] David W. Chang,"Clinical Application of Mechanical Ventilation" (2 nd edition); Georgia, page no 97-98.

[6] Irwin RS, Rippe JM (2003). "Irwin and Rippe's Intensive Care Medicine "(5th ed.). Lippincott Williams & Wilkins. ISBN 0-7817-3548-3.

[7] MacIntyre N "Mechanical ventilation strategies for lung protection". Semin Respir Crit Care Med 21 (3): 215–22. doi:10.1055/s-2000-9850. PMID 16088734(2000).

[8] Gattinoni L, Caironi P, Pelosi P, Goodman LR. What has computed tomography taught us about the acute respiratory distress syndrome? Am J Respir Crit Care Med 2001; 164: 1701–1711.\

[9] Respiratory Physiology, A Clinical Approach, Schwartzstein & Parker pp.23-28 & 95-105.

[10] Jean-Christophe M. Richard Salvatore. "Effects of vertical positioning on gas exchange and lung volumes in acute respiratory distress syndrome Intensive Care Medicine" Volume 32, Number 10, 1623-1626, DOI: 10.1007/s00134-006-0299-y.

[11] Donna L Frownfelter, Elizabeth Dean "Cardiovascular and pulmonary physiotherapy" 4th edition, published by Mosboy 1996, page no 315.

[12] Ashbaugh D, Bigelow D, Petty T, Levine B. "Acute respiratory distress in adults". Lancet 2(7511):319–23. Doi: 10.1016/S0140-6736(67)90168-7. PMID 4143721(1967).

[13] Bernard G, Artigas A, Brigham K, Carlet J, Falke K, Hudson L, Lamy M, Legall J, Morris A, Spragg R. "The American-European Consensus Conference on ARDS. Definitions, mechanisms, relevant outcomes, and clinical trial coordination". Am J Respir Crit Care Med 149 (3 Pt 1): 818–24. PMID 7509706(1994).

[14] Ware L, Matthay M"The acute respiratory distress syndrome". N Engl J Med 342 (18): 1334–49. Doi: 10.1056/NEJM200005043421806. PMID 10793167 (2000).

[15] Malhotra A "Low-tidal-volume ventilation in the acute respiratory distress syndrome". NEnglJMed 357 (11):111320. doi:10.1056/NEJMct074213. PMID 17855672(2007).

[16] Meduri G, Tolley E, Chrousos G, Stent "Prolonged methylprednisolone treatment suppresses systemic

inflammation in patients with unresolving acute respiratory distress syndrome: evidence for inadequate endogenous glucocorticoid secretion and inflammation-induced immune cell resistance to glucocorticoids". Am J Respir Crit Care Med 165 (7): 983–(2002).

[17] The Acute Respiratory Distress Syndrome Network. "Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome". N Engl J Med. May 4 2000; 342(18):1301-8. [Medline].

[18] Gattinoni L, Tognoni G, Pesenti "A. Effect of prone positioning on the survival of patients with acute respiratory failure." N Engl J Med. Aug 23 2001; 345(8):568-73.

[19] Wong W (1998) "Acute respiratory distress syndrome: pathophysiology, current management and implications for physiotherapy". Physiotherapy. 84, 9,439-450.

[20] Dirk Pappert, MD; Rolf Rossaint, MD; Klaus Slama, MD "Influence of Positioning on Ventilation-Perfusion Relationships inSevere Adult Respiratory DistressSyndrome", Chest 1994 ;106;1511-1516".