A COMPARISON 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 comparison 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 ventricular 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 comparison of side lying versus semi
Fowler’s position in mechanically ventilated ARDS patients
in ICU.

So aim of this study was to find out Comparison 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
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Tidal volume is amount of air which is inspired or expired
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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 inhomogeniety 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
(group 2) and 10 patients were given Left side lying position
(group 3). 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, PaO2, PaCO2 after giving semi Fowler’s
position. There was no significant change in pulse rate
and SpO2. 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

<table>
<thead>
<tr>
<th>Position</th>
<th>Pre Mean ± SD</th>
<th>Post Mean ± SD</th>
<th>t value</th>
<th>p Value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi Fowler’s</td>
<td>417.1 ± 29.68</td>
<td>440 ± 26.97</td>
<td>6.225</td>
<td>&lt;0.0004</td>
<td>Extremely significant</td>
</tr>
<tr>
<td>Right side lying</td>
<td>422.8 ± 41.19</td>
<td>427.9 ± 35.67</td>
<td>2.078</td>
<td>0.0673</td>
<td>Not significant</td>
</tr>
<tr>
<td>Left side lying</td>
<td>404.6 ± 31.74</td>
<td>406.1 ± 31.22</td>
<td>1.477</td>
<td>0.1832</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

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

TABLE II: SpO2 FOR RESPONDERS

<table>
<thead>
<tr>
<th>Position</th>
<th>Pre Mean ± SD</th>
<th>Post Mean ± SD</th>
<th>t value</th>
<th>p Value</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi Fowler’s</td>
<td>95.5 ± 2.390</td>
<td>97.75 ± 2.55</td>
<td>2.346</td>
<td>0.0514</td>
<td>Not significant</td>
</tr>
<tr>
<td>Right side lying</td>
<td>96.25 ± 2.493</td>
<td>98 ± 2.138</td>
<td>2.198</td>
<td>0.0639</td>
<td>Not significant</td>
</tr>
<tr>
<td>Left side lying</td>
<td>96.63 ± 3.204</td>
<td>98.25 ± 1.669</td>
<td>1.976</td>
<td>0.088</td>
<td>Not significant</td>
</tr>
</tbody>
</table>
TABLE III: PULSE RATE FOR RESPONDERS

<table>
<thead>
<tr>
<th>Position</th>
<th>Pre Mean ± SD</th>
<th>Post Mean ± SD</th>
<th>t value</th>
<th>p value</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi Fowler</td>
<td>104.6 ± 7.981</td>
<td>111.3 ± 13.17</td>
<td>1.91</td>
<td>0.0978</td>
<td>Not significant</td>
</tr>
<tr>
<td>Right side lying</td>
<td>104.6 ± 8.684</td>
<td>110.6 ± 10.18</td>
<td>1.789</td>
<td>0.1168</td>
<td>Not significant</td>
</tr>
<tr>
<td>Left side lying</td>
<td>115.3 ± 11.42</td>
<td>109.9 ± 9.583</td>
<td>2.292</td>
<td>0.0556</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

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 response that further deteriorates gas exchange resulting in profound hypoxemia. Although the process 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 decreased. 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 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 edema 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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