

Change in posture does not influence oxygenation and lung mechanics in critically ill ventilated patients

Introduction: Mechanically ventilated patients in the intensive care unit (ICU) are subjected to frequent and unavoidable changes in posture from the supine to semi-recumbent position as part of nursing procedures, the insertion of intravenous lines and intra-hospital transport. In addition, nursing of patients in the semirecumbent position (45°) is associated with lower rates of aspiration and ventilator-associated pneumonia (1). However, the actual influence of these changes in posture on oxygenation and lung mechanics has not been well described. The purpose of the present study was to investigate whether changes in posture have significant consequences for critically ill ventilated patients.

Materials and methods: Forty-two consecutive patients requiring mechanical ventilation were prospectively studied. Patients were studied at three levels of randomly assigned recumbency, i.e., supine, 30°, and 60°. Demographic data, diagnosis, Ramsay score, FiO₂, PEEP, mode of ventilation and APACHE II score, were recorded at entry into the study. After a 45-minute stabilization period in each position, the following parameters were noted: oxygenation (paO₂, paCO₂, paO₂/FiO₂ ratio), lung mechanics (dynamic compliance, resistance, tidal volume, peak and mean inspiratory pressures, respiratory rate), and hemodynamics (pulse rate, systolic blood pressure). No change in ventilatory status or administration of fluid boluses was allowed during the study period.

Statistical analysis: Results are shown as mean ± SD. Analysis of variance was performed with the Duncan multiple comparison option to analyze statistically significant differences in mean continuous parameters between the three groups according to posture. Student's t-test was performed to analyze statistically significant differences in mean continuous parameters between the two groups according to the severity of lung injury. A p value less than or equal to 0.05 was considered statistically significant.

Results: The mean age of the 42 patients was 62.9 ± 16.2 years; there were 21 males and 21 females. The most common diagnosis was bacterial pneumonia (33% of patients), followed by COPD (12%), cardiogenic pulmonary edema (12%) and ARDS (19.5%). Patients were most frequently (67%) ventilated with pressure support ventilation (PSV), with a mean level of 14 cmH₂O at onset of the study. All patients were receiving some form of sedation (mean Ramsay score 4.3 ± 1.1), usually in the form of a continuous infusion of midazolam; only one patient was paralyzed with vecuronium at the time of the study. The respiratory and hemodynamic parameters are shown in table 1.

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Table 1: Respiratory and hemodynamic parameters

Parameter	Supine	30° Elevation	60° Elevation	p Value
Oxygen saturation (%)	95.5±3.3	96.15±2.3	95.9±2.6	NS
pH	7.41±0.1	7.41±0.1	7.41±0.1	NS
PaO ₂ (mmHg)	99.3±36.2	103.3±35.9	104.6±40.9	NS
PaCO ₂ (mmHg)	43.6±11.1	43.6±10.6	43.3±12.2	NS
PaO ₂ /FiO ₂ ratio	236.4±99.5	245.4±99.9	246.5±114.0	NS
Dynamic compliance (ml/cmH ₂ O)	43.3±24.8	41.8±23.4	38.9±22.1	NS
Airway resistance (cm H ₂ O/L/sec)	22.6±7.1	21.9±7.9	23.3±7.8	NS
Averaged tidal volume (ml)	514.3±197.9	525.7±183.1	502.4±187.8	NS
Peak inspiratory pressure (cmH ₂ O)	24.5±6.5	24.0±6.2	25.3±7.6	NS
Mean airway pressure (cmH ₂ O)	11.9±4.2	11.1±3.7	12.4±4.2	NS
Respiratory rate (/min)	20.3±8.1	19.3±6.7	20.9±7.7	NS
Pulse rate (/min)	94.3±16.1	93.2±15.1	94.4±15.2	NS
Systolic blood pressure (mmHg)	123.4±23.3	128.8±24.0	134.9±26.7	NS

PaO₂ - partial pressure of oxygen in arterial blood; PaCO₂ - partial pressure of carbon dioxide in arterial blood; FiO₂ - fractional concentration of inspired oxygen.

Division of the patients by severity of lung injury, i.e., with or without ARDS (paO₂/FiO₂ ratio <200 or >200), yielded no significant differences for any of the three positions between the two groups.

Discussion

We found that changes in posture from the supine position to 60° head elevation do not significantly affect oxygenation or lung mechanics in critically ill ventilated patients.

In the one recent study examining the effect of a change in body posture in 16 acutely ill ventilated patients with acute lung injury (2) the authors found that oxygenation was not improved by the upright position and that static and dynamic compliance were in fact decreased. This could have important implications for treatment of critically ill patients.

We, too, were unable to show any improvement in oxygenation with change in posture. However, in contrast to the above study we noted no significant changes in lung mechanics, including dynamic compliance, with change in posture. The only real difference between the 2 studies is the mode of ventilation: synchronized intermittent mandatory ventilation (SIMV) in the earlier study and predominantly (67%) PSV in ours. A subanalysis of our results in the most severely compromised patients (paO₂/FiO₂ <200) also did not document any significant effect of posture.

The importance of this study is the documentation that changes in position of critically ill ventilated patients do not result in worsening of already compromised pulmonary function, even in patients suffering from ARDS.

References

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2. Bittner E, Chendrasekhar A, Pillai S, et al. Changes in oxygenation and compliance as related to body position in acute lung injury. *Am Surg* 1996;62:1038-1041