Original Research article

Is There a Relationship between Changing Patients' Position in Bed and Intra-Abdominal Pressure and Mean Arterial Pressure among Mechanically Ventilated Patients in ICU?

Abstract

Background: The prevalence of intra-abdominal hypertension in ICU patients is about 50% and can be affected by changing the position of the patients. This study aimed to investigate the relationship between changing patient positions in bed with intra-abdominal pressure and mean arterial pressure among mechanically ventilated patients in ICU.

Methods: This study was a clinical trial conducted on 68 patients admitted in intensive care units of Imam Khomeini hospital of Urmia city, Iran. The patients were selected through convenience sampling based on the inclusion criteria. In this study, the effects of changes in five positions (0, 15, 30, 45, left and right lateral position with 30 degrees) on the mean arterial pressure was evaluated. Statistical tests such as chi square and repeated measures ANOVA were used as well. All analyzes were performed using SPSS 21.

Results: In this study, there were 24 men (35.3%) and 44 women (64.7%). The mean age, weight and height of patients were 70.35±16.98 years, 75.76±9.77 kg and 168.82±8.14 cm, respectively. There was no significant difference regarding intra-abdominal pressure by gender ($p<0.05$). There was a significant difference regarding intra-abdominal pressure between first, second, fourth and fifth measurements ($p<0.001$). There was a significant difference regarding mean arterial pressure between first, second, third, fourth and fifth measurements ($p<0.001$). Significant differences were observed between the fifth and fourth mean arterial pressure measurements as well ($p<0.001$).

Conclusion: According to the results of this study, the changing of patient's body position from supine to higher positions lead to the increase of intra-abdominal pressure.

Keywords: Position, Intra-Abdominal Pressure, Mean arterial pressure, ICU

Introduction

Monitoring and measuring of the vital signs and hemodynamic parameters is one of the most important tasks of intensive care unit nurses (1). In this regard, intra-abdominal pressure is one of these parameters that can affect other measurements as well. Ignoring it may cause errors in calculating and recording unrealistic hemodynamic values (2). Intra-abdominal pressure is the sustained pressure that lies within the abdominal cavity and the diaphragm movements, body posture, weight, and abdominal muscle tension are factors that affect its value (3-6).

The normal range of intra-abdominal pressure in normal individuals is zero to 7 mmHg, but is also considered normal in patients admitted to intensive care units due to disease conditions up to 12 mmHg (7). However, exposure to intra-abdominal pressure in the range of 12 to 25 mmHg is called intra-abdominal hypertension, which without diagnose and above 25 mmHg will cause the abdominal compartment syndrome (8, 9). The prevalence of intra-abdominal hypertension in ICU patients is about 50% and is considered to be an independent predictor of mortality due to this high prevalence and in case of abdominal compartment syndrome; it can lead to death and will have a mortality rate of 40% to 100% (10, 11).

Given the importance of the intra-abdominal pressure monitoring in critically ill patients admitted to intensive care units undergoing mechanical ventilation (12), therefore ICU nurses should monitor intra-abdominal pressure in addition to monitoring and measuring other vital signs of the patient (13). Patients undergoing mechanical ventilation are usually immobilized for a long time, and this immobility can cause numerous problems in various body systems including the cardiovascular system, the respiratory system, the musculoskeletal system as well as the skin (14). Common nursing practice in the intensive care unit in the care of immobilized patients undergoing mechanical ventilation is to change their body position every two hours to prevent the effects of immobility and improving the drainage of respiratory secretions. However, this change in position can be in a sitting position or rotating the patient to the right or left (15, 16).

In addition, in most patients undergoing mechanical ventilation, the head of the bed is kept at a height of 30 degrees or more to prevent ventilator-associated pneumonia as well as to reduce the risk of pressure ulcers (17, 18), The question that arises is how much of the changes in these patients affect their intra-abdominal pressure and what is the most appropriate position to measure intra-abdominal pressure in these patients.

Considering the contradictory results and the lack of studies (2, 17, 19) and in accordance with the recommendation of the World Association of Abdominal Compartment Syndrome to carry out research in this field (20), the research group decided to conduct a study to investigate the relationship between bed position and patient intra-abdominal pressure and mean arterial pressure in patients undergoing mechanical ventilation in intensive care units.

Methods and materials

Design and patients

This study was a clinical trial with registration code (IRCT20181105041560N1), in which conducted on 68 patients admitted in intensive care units of Imam Khomeini hospital of Urmia city, Iran. The patients were selected through convenience sampling. In this study, the effects of changes in five positions (0, 15, 30, 45, left and right lateral position with 30 degrees) on the mean arterial pressure was evaluated. . Indeed, the mean arterial pressure indicates tissue blood pressure and is calculated based on diastolic and systolic blood pressure using the following formula (21, 22):

MAP= (SBP + 2DBP)/3 or MAP= DBP + 1/3(SBP – DBP)

Inclusion criteria

Age > 18 years old, mechanically ventilated patient, having indwelling urine catheter in place, length of ICU stays ≥ 48 hours

Exclusion criteria

Unable to change position, neurogenic bladder, bladder rupture, hematuria, heart failure and pulmonary edema, pregnancy, morbid obesity, acute abdominal patients, probability of survival less than 24 hour

Data collection

The demographic questionnaire included units age, gender, height and weight, which was completed by the medical records. Predetermined checklist including the abdominal pressure in different positions and mean arterial pressure were recorded via a monitor attached to the patients. In this study, the measurement of intra-abdominal pressure was measured indirectly by intra-bladder pressure measurement as the gold standard for intra-abdominal pressure measurement, using a water manometer (used to measure central venous pressure) (23).

Ethical approval

The study protocol was approved by the Ethics Committee of Urmia University of Medical Sciences, Urmia, Iran. (Approval ID: UMS IR.UMSU.REC.1397.358). The current study was performed according to the Institutional Committee for the Protection of Human Subjects, which was adopted by the 18th World Medical Assembly, Helsinki, Finland and its later amendments (Declaration of Helsinki). Written informed consents were obtained from all patients.

Statistical analysis

For description of the quantitative variables, mean and standard deviation were used, and for qualitative variables, frequency and percentage were used. Statistical tests such as chi square and repeated measures ANOVA were used as well. All analyzes were performed using SPSS 21.

Results

In this study, there were 24 men (35.3%) and 44 women (64.7%). The mean age, weight and height of patients were 70.35±16.98 years, 75.76±9.77 kg and 168.82±8.14 cm, respectively. There was no significant difference regarding intra-abdominal pressure by gender ($p < 0.05$) (**Table 1**). There was a significant difference regarding intra-abdominal pressure between first, second, fourth and fifth measurements ($p < 0.001$) (**Table 2**). The trend of intra-abdominal pressure in different positions was significantly different and increasing (**Figure 1**). There was a significant difference regarding mean arterial pressure between first, second, third, fourth and fifth measurements ($p < 0.001$) (**Table 3**). There was a significant difference in intra-group comparisons between first and second as well as between first and fourth mean arterial pressure measurements ($p<0.05$). There was a significant difference between the mean arterial pressure of the second and third mean arterial pressure ($p < 0.05$). There was a significant difference between the third and fourth mean arterial pressure measurements ($p < 0.001$). Significant differences were observed between the fifth and fourth mean arterial pressure measurements as well ($p < 0.001$) (Figure 2).

Table 1: Frequency distribution of intra-abdominal pressure in different positions by gender of patients

Variable		N	Intra-abdominal pressure N (%)				X^2	P value
			0-12	12-15	15-20	>20		
Zero degree	Male	24	15 (32.6)	4 (36.4)	2 (40)	3 (50)	0.767	0.857
	Female	44	13 (83.1)	7 (36.6)	3 (60)	3 (50)		
15 degree	Male	24	13 (13.3)	5 (29.4)	3 (50)	3 (50)	1.460	0.692
	Female	44	13 (83.1)	12 (70.6)	3 (50)	3 (50)		
30 degree	Male	24	13 (34.2)	3 (18.8)	4 (57.1)	4 (57.1)	4.865	0.182
	Female	44	13 (83.1)	13 (83.1)	3 (42.9)	6 (42.9)		
45 degree	Male	24	13 (35.1)	5 (26.3)	6 (50)	-	1.807	0.405
	Female	44	24 (64.9)	14 (73.7)	6 (50)	-		
Left lateral with 30 degree	Male	24	11 (34.4)	3 (25)	6 (35.3)	4 (57.1)	2.032	0.566
	Female	44	21 (65.6)	9 (75)	11 (65.7)	3 (42.9)		
Right lateral with 30 degree	Male	24	13 (34.2)	3 (18.8)	4 (57.1)	4 (57.1)	4.864	0.182
	Female	44	25 (65.8)	13 (83.1)	3 (42.9)	3 (42.9)		

Table 2: The mean and standard deviation of intra-abdominal pressure in five positions

Variable	Mean	SD	F	P value
Intra-abdominal pressure at 15 degree	11.17	4.86	50.38	<0.001
Intra-abdominal pressure at 30 degree	12.14	4.92		
Intra-abdominal pressure at 45 degree	11.67	3.64		
Intra-abdominal pressure at Left lateral with 30 degree	13.36	4.65		
Intra-abdominal pressure at Right lateral with 30 degree	12.25	4.89		

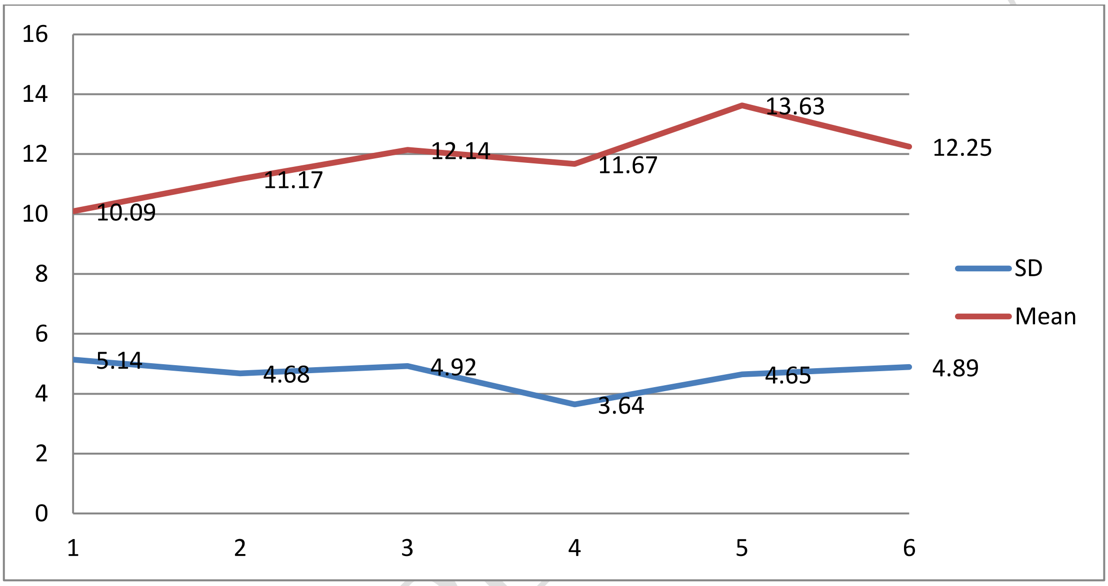

Figure 1: The mean and standard deviation of intra-abdominal pressure in different positions

Table 3: The mean and standard deviation of mean atrial pressure in five positions

Variable	Mean	SD	F	P value
Mean arterial pressure at 15 degree	80.95	15.32	9.50	<0.001
Mean arterial pressure at 30 degree	78.27	14.34		
Mean arterial pressure at 45 degree	80.57	13.86		
Mean arterial pressure at Left lateral with 30 degree	76.38	14.94		
Mean arterial pressure at Right lateral with 30 degree	80.30	13.99		

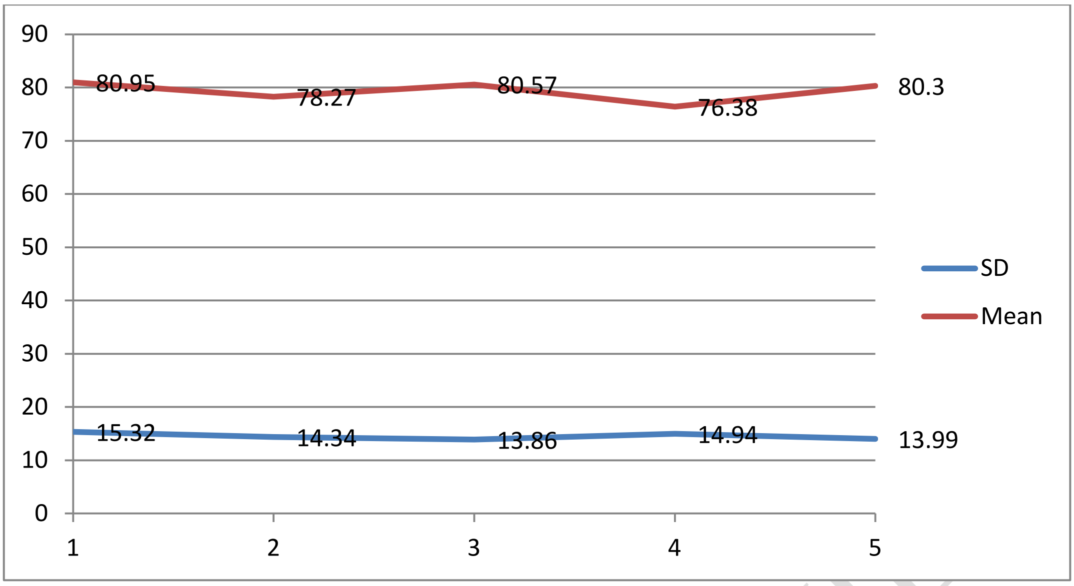

Figure 2: The mean and standard deviation of mean arterial pressure in different positions

Discussion

Intra-abdominal pressure measurement is one of the most important hemodynamic monitoring that should be performed in intensive care units to identify patients at risk for intra-abdominal hypertension and subsequent abdominal compartment syndrome (3). The intra-abdominal pressure clearly varies with different body positions as well as bed head height (24). This study aimed to investigate the relationship between bed position change and patient's intra-abdominal pressure and mean arterial pressure in patients undergoing mechanical ventilation in intensive care units. In our study, there was a significant difference between abdominal pressure measurements between groups.

Consistent with the present study, Cheatham et al in 2009 conducted a prospective study to determine the effect of bed head height on intra-abdominal pressure. The intra-abdominal pressure was measured through the bladder after 4 cc normal saline injections into the bladder using the Ab Viser set at 0, 15, and 30 degrees for four hours. A zero point was used to measure the mid-axillary line in the iliac spine. All measurements were performed at the end of expiration and when the patient was completely calm (25).

The results of this study showed that there was a significant difference between the intra-abdominal pressure at 15 and 30 degrees compared to the zero degree, and raising the head increased the intra-abdominal pressure compared to the zero degree position, and In order to make the right clinical decision about the patient, the patient's condition must be constant from one measurement to the next. The results of this study also showed that raising the bed head to prevent pneumonia may cause intra-abdominal pressure to be lower than the actual level (24). These results were consistent with the present study because with increasing bed degree to 30 degrees, the frequency of high abdominal pressure (15-20 and > 20) increased to 7 in each group. That is, an increase in the degree of bed has increased abdominal pressure. Also in another prospective study, Ejike et al. conducted a study to test the hypothesis that "increasing the angle of bed causes increased intra-abdominal pressure" and to measure intra-abdominal pressure, a urinary catheter was used. Pediatric intra-abdominal pressure measurements were connected and the transducer zero point was leveled with the pubic symphysis level in each patient. Measurement of intra-abdominal pressure was recorded at 0 and 30 degrees every 2 hours over a period of 6 hours or by extubation of tracheal tube. The results of this study showed that intra-abdominal pressure in critically ill children increased significantly with increasing bed height from 0 to 30 degrees (21). In the present study, the change of position from zero to 30 degree led to increased intra-abdominal pressure.

In this regard, non-randomized, prospective study of Mahran et al., to investigate the effect of lateral position on intra-abdominal pressure compared to supine position in patients undergoing mechanical ventilation. This study showed that when the patient's body position changes from supine to lateral, the mean intra-abdominal pressure increases (26), which was consistent with the results of our study.

In a study by Vasquez et al., the effect of semi-fowler position on abdominal pressure measured from the bladder was investigated on trauma patients admitted to the surgical intensive care unit underwent intra-abdominal pressure measurement through the bladder at 0, 15, 30, and 45 degrees with a reverse Trendelenberg of 15 degrees. These measurements were performed using a counterbalanced fashion method with the help of built-in angle indicators near the bed. Patients were connected to intra-abdominal pressure monitoring by a Foley catheter. Significant differences were observed between all these degrees regarding intra-abdominal pressure. Increasing bed height increased abdominal pressure (27). These results were consistent with the results of the present study and indicate the effect of patient position on intra-abdominal pressure changes.

In this regard, Samimian et al. conducted a cross-sectional descriptive-analytic study to determine intra-abdominal pressure and its related factors in the human patient in particular centers. The results of this study showed that there was a significant relationship between the frequency of intra-abdominal pressure and the mean arterial pressure has the greatest effect on intra-abdominal pressure, so consideration of this variable as well as its influencing factors should be considered (28).

Conclusion

According to the results of this study, the patient's body position changing from supine to higher positions lead to the increase of intra-abdominal pressure.

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