Novelty Journals

ISSN 2394-7330

International Journal of Novel Research in Healthcare and Nursing
Vol. 4, Issue 2, pp: (200-209), Month: May - August 2017, Available at: www.noveltyjournals.com

Effectiveness of Backrest Elevation on Oxygenation and Hemodynamic Status among Mechanically Ventilated Patient after Coronary Artery Bypass Graft Surgery

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Abstract: **Backrest elevation is one of the most frequently performed nursing activities in the critical care, often providing an essential focus for planning other nursing activities. Aim of the study was to examine the effect of backrest elevation on oxygenation and hemodynamic status among mechanically ventilated critically ill patients after Coronary artery bypass graft surgery. Setting: The study was conducted at the open heart surgery, Intensive Care Unit (ICU) at Menoufia University Hospital. Sample: A convenient sample of fifty critically ill patients who were admitted to the open heart surgery ICU. Design: A quasi- experimental design was utilized. Tools: A Semi Structured Demographic Questionnaire, Cardiorespiratory Parameters Questionnaire, and Acute Physiology and Chronic Health Evaluation II (APACHE II) scale. The results: there was a highly statistically significant improvement in oxygenation (PaO2, SaO2, and ScvO2), and hemodynamic parameters (PR, RR, MAP and CVP) after 10 minutes of the 30° backrest elevation position comparing with the 20° and 45° backrest elevation position, P <0.001. Also there was a highly statistically significant improvement in oxygenation (PH, PaO2, SaO2, and ScvO2) and hemodynamic parameters (PR, RR, MAP and CVP) after 30 minutes of 30°backrest elevation position comparing with the 20° and 45° backrest elevation position. Conclusion: The 30°backrest elevation position had improved Oxygenation and hemodynamic status among postoperative mechanically ventilated patients after CABG surgery. Recommendation: Backrest elevation is a simple and cost effective nursing intervention for optimizing oxygenation and hemodynamic status among CABG patients. Initiate the development of training programs for critical care nurses about the importance of 30 degree backrest elevation to improve oxygenation and hemodynamic status among mechanically ventilated patients post CABG surgery.**

Keywords: **Backrest Elevation, Oxygenation, Hemodynamic Status, Coronary Artery Bypass Graft Surgery.**

1. INTRODUCTION

Coronary Artery Bypass Grafting (CABG) surgery is considered to be the “gold standard” in treating patients with multi-vessel disease and remains the treatment of choice for patients with severe Coronary Artery Disease (CAD), including three-vessel or left main coronary artery disease. There were 94 CABG per 100 000 in 2014 [1]. Patients undergoing CABG surgery are admitted to an intensive care unit (ICU) and connect to mechanical ventilation for at least 6-8 hours. Imperfect gas exchange, including mainly hypoxia is one of the most common problems of patients after CABG surgery in critical care unit [2]. These patients are always vulnerable to hypoxia, metabolic acidosis and decreased cardiac output due to muscle relaxant drugs, Anesthesia drugs, chest surgery, and changes in breathing patterns [3].

ISSN 2394-7330

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In the postoperative period of CABG surgery, there are factors that may predispose the patient to the change in lung function such as general anesthesia, Cardiopulmonary Bypass (CPB), ischemic time, intensity of the surgical manipulation, internal mammary artery dissection, number of pleural drains and the use of topical cooling for myocardial protection[4]. Post CABG surgery, there is reduction of Residual Volume (RV), Total Lung Capacity (TLC), Vital Capacity (VC) and Functional Residual Capacity (FRC), leading to the formation of atelectasis, with changes in the ventilation-perfusion ratio (V/Q), the Partial pressure of Carbon dioxide in arterial blood (PaCO2) and Partial pressure of Oxygen in arterial blood (PaO2). Also the median sternotomy, promotes significant changes in pulmonary function by the consequent instability of the upper chest [5].

The pulmonary dysfunction developed after cardiac surgery is influenced by two main factors. One is the mechanical stress and biotrauma induced by the mechanical ventilation and the use of an inadequate ventilator strategy with high volumes and low Positive End Expiratory Pressure (PEEP) levels that stimulate atelectasis. Second is the exaggerated systemic inflammatory response to the cardiac surgery and its associated factors, like the effects of general anesthesia, sternotomy incision, topical cooling, and extracorporeal circulation [6].

The majority of these complications were found to be resolved by body poisoning in the early postoperative period [7]. It is considered an important area of the collaborative management for patients after CABG surgery. Body positioning is a primary intensive care unit (ICU) intervention, because it has direct and potent effect on oxygenation and hemodynamic [8]. Different degree of backrest elevation (20°, 30°and 45°) have effect on hemodynamic such as Heart Rate (HR), Central Venous Pressure (CVP), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Mean Arterial Pressure (MAP) and oxygenation parameters such as Respiratory Rate (RR), pH, Arterial Partial Pressure of Oxygen (PaO2), Arterial Partial Pressure Carbon Dioxide (PaCO2), Arterial Blood Oxygen Saturation (SaO2) and Central Venous Oxygen Saturation (ScvO2) [8].

Backrest elevation is an important component of the semi recumbent position that must be considered for CABG patients to optimize ventilation and perfusion, promote effective pulmonary gas exchange, and promote lung expansion maneuvers that increases functional residual capacity, enhances quality of respiration, improves alveolar ventilation, decreases work of breathing and establishes diaphragmatic excursion. In addition, it improves cardiac output, myocardial contractility, resting heart rate, improves venous return and strengthens cardiac muscle [7]. Backrest elevation can create different physiological effects on hemodynamic and oxygenation. The level of Backrest elevation determine the gravitational gradient that act on the cardiovascular and cardiopulmonary systems, from moment to moment, and affects distribution of optimal blood flow and pulmonary venous and arterial system. Also changes in diaphragm movement due to pressure from abdominal viscera, causing respiratory effects in different backrest elevation [9].

A Prospective observational study investigated the effect of head of bed elevation on hemodynamic and oxygenation among Twenty Mechanically Ventilated patients [7]. Patients were positioned at different degree of head of bed elevation (20°, and 30°) then heart rate, MAP and arterial blood gases parameters were measured at baseline, 10 and 20 minutes after each position change. The study finding revealed that the 30° head of bed elevation position was more effective in improving oxygenation and hemodynamic compared with the 20° head of bed elevation position. The findings of the study showed that there was improvement in the oxygenation parameters in the 30° head of bed elevation position while there was a reduction in the oxygenation parameters in the 20° head of bed elevation position.

Critical care nurse play a vital role in caring of CABG patient through their knowledge and understanding about the effect of different degree of backrest elevation. Because of problematic positioning may result in an imbalance in the oxygen supply and demand relationship and also distribution of blood flow. Positioning patient is a well-accepted nursing activity and the critical care nurse are responsible for monitoring and assessing the cardiovascular and respiratory status to create an effective care plan and practice guidelines to provide comfort, safety, and prevent complications which will ultimately reduce the incidence of morbidity and mortality and shorten the length of stay in ICU and in the hospital [7]. The finding of the present study will enable critical care nurses to choose the most appropriate therapeutic position for these patients post CABG because appropriate position of the mechanically ventilated patient can dramatically improve oxygenation and hemodynamic, resulting in a shorter stay in the intensive care unit and an improved recovery outcomes[10, 11]. Therefore, the aim of the current study was to examine the effectiveness of backrest elevation on hemodynamic and oxygenation among mechanically ventilated patients after Coronary artery bypass graft surgery.

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Research Hypotheses:

The following research hypotheses are formulated to achieve the aim of the study:

1- There will be a change in patients' oxygenation status after receiving backrest elevation intervention after CABG surgery.

2- There will be a change in patients' hemodynamic parameters after receiving backrest elevation intervention after CABG surgery.

2. METHODS

Research Design: A quasi-expermental (repeated measure) study design was utilized to examine the effect of backrest elevation of 20, 30, 45 degree on oxygenation and hemodynamic status among mechanically ventilated patients after Coronary Artery Bypass Graft Surgery (CABG).

Settings: The study was conducted at the Intensive Care Unit (ICU) of open heart surgery at Menoufia University Hospital, Shebin El-Kom city, Egypt.

Sample: A convenient sample of 50 adult patients were recrutted. Patients who met the following study inclusion criteria were included: a) Adult patients (19 -65 years); b) Postoperative CABG patient after Two hours from admission to ICU; c) Patients on mechanical ventilation; and d) Hemodynamically stable (ie, mean arterial pressure > 60 mm Hg, and blood loss < 100 mL in the last 30 minutes). Patients were excluded if they had any of the following Exclusion Criteria: a) Continuous air leak from cardiac drains because this will lead to tension pneumothorax and impaired gas exchange; b) Fever (temperature > 38°C) because fever will affect patient heart rate; c) Patients with open chests not surgically anastomosed; and d) Patients with an intra-aortic balloon pump. All patients in whom the supine position is contraindicated (for example patients with traumatic brain injury), or those who were immobilized due to spinal injuries or unstable pelvic fractures were also excluded.

Sample Size Calculation: sample size for this study was calculated using Power Analysis. A significance level of 0.05, a statistical power of 0.80 and a small effect size as calculated from previous studies [7, 12].

Data Collection Tools:

I- A Semi Structured Demographic Questionnaire: was used to collect data including: age, gender, educational level, marital status, occupation, smoking habit, medical history and medication. Data was extracted from the patient's medical records by the investigator.

II- Cardiorespiratory Parameters Questionnaire: was developed by Holzheimer (2001) [13]to assess oxygenation parameters which including respiratory rate, pH, arterial partial pressure of oxygen (PaO2), arterial partial pressure carbon dioxide (PaCO2), arterial blood oxygen saturation (SaO2) and central venous oxygen saturation (ScvO2). Arterial blood sample was drown from patient and was analyzed via blood gas analyzer (RAPIDPoint® 500**)** which equipped with fully automated calibration mechanism. Also venous blood sample was taken via jugular or subclavian central line for assessment of central venous oxygen saturation and was analyzed via the same blood gas analyzer. The reliability of RapidPoint 500(®) was reported in a sample of One hundred sixty five adult hospitalized patients in ICU. The Intra-and inter- assay coefficients was higher than 0.91[14]. The validity of RapidPoint 500(®) was assessed through two types of evaluation. The first was an analysis of paired- sample measurements on a 114 randomly selected patient blood samples using the RapidPoint 500(®) and standard analyzer. The second analysis consisted of using standard reference material to assess reproducibility (precision) of the analyzer over a 20 day period. In the paired-sample analysis, the correlation coefficients for the values determined by the two systems showed a significant relationship (r = 0.962 for pH, r = 0.9955 for PaCO2), and r = 0.9829 for PaO2). RapidPoint 500(®) has adequate accuracy and precision for use in the clinical arena [15**]**.

Hemodynamic parameters included central venous pressure (CVP), heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and Mean Arterial Pressure (MAP). These parameters were obtained from bed side monitor (NIHON KOHDEN, life scope, BSM 3000 series, Tokyo, Japan). The blood pressure was measured via arterial catheter placed either in the radial or femoral artery. The correct position of an arterial pressure transducer was adjusted after each backrest elevation. CVP was measured manually. The reliability of bed side monitor (NIHON KOHDEN, life scope, BSM 3000 series) was tested by Cronbach's Co efficiency Alpha (a=.0.87) .

The validity of bed side monitor (NIHON KOHDEN, life scope, BSM 3000 series) had an Respiratory Rate accuracy of 93.1% and an Heart Rate accuracy of 94.4% among ICU patients [16].

III- Acute Physiology and Chronic Health Evaluation II (APACHE II) Scale: developed by Knaus et al., (1985) [17]. **APACHE II** was designed to measure the severity of disease for adult patients admitted to ICU. It is applied within 48 hours of patient admission to the ICU. An integer score from 0 to 71 was computed based on several measurements such as patient's age and 12 routine physiological measurements including PaO2 (depending on FiO2), Temperature, MAP, arterial pH, HR, RR, serum Sodium, serum Potassium, Creatinine, Hematocrit, White blood cells count, Glasgow Coma Scale. The scoring system of the scale interpreted as: 5 to 9 had 8% mortality risk, 10 to 14 had 15% mortality risk, 15 to 19 had 25% mortality risk, 20 to 24 had 40% mortality risk, 25 to 29 had 55% mortality risk, 30 to 34 had 75% mortality risk and >34 had 85% mortality risk. The reliability of the APACHE II scale was assessed in a study of two hundred adult ICU patients. The Internal consistency was evaluated using Cronbach's alpha and was 0.95 for the total scale [18]. In the present study, the reliability of the APACHE II scale was tested by Crombach`Coeffeciency alpha and was 0.95. The Validity of the APACHE II scale was conducted using Pearson Product Moment Correlations. Based on the significant value obtained by the Sig (2-tailed) <0.05 and the internal consistency (r = 0.41- p-value = <0.05) which indicated that the items of the APACHE II scale were valid.

Ethical Consideration:

The permission for conducting the study was obtained from the Research and Ethics Committee at the Faculty of Nursing and an official permission was obtained from Menoufia University Hospital director to carry out the study. A written / oral consent was obtained from eligible participants relatives. At the initial interview, participants' relatives were informed about the purpose, nature of the study, data collection procedure, and the expected benefits from participating in the study. The researcher explained to the relatives that participation in the study is voluntary and they can withdraw from the study at any time without penalty. Relatives were assured that patients' confidentiality and anonymity were guaranteed through coding all data and placeing all paper in a secured blocked cabinet. Questionnaires were fulfilled by the investigator here self and the nature of the questionnaires didn't cause any physical or emotional harm to participants.

Data Collection Procedure (Intervention):

Each participant received backreast elevation after 2hours from returning to the ICU from the operating theater for 30 minutes once a day. Participant was placed in different degree of backrest elevation (20°, 30°, and 45°) consectevely. Before each degree of backrest elevation, participant was placed in a supine position for 10 minutes to allow for hemodynamic stability to collect base line data. oxygenation and hemodynamic paramters were measured using Cardiorespiratory qestionnaire after 10, 20, 30 minutes of each degree of backrest elevation postion. Oxygenation and hemodynamic were measured for 4 consecutive times during the study. Comparison was done between differant degree of backrest elevation to examine the effectiveness of different angles of backrest elevation (20°, 30°, and 45°) on oxygenation and hemodynamic among mechanically ventilated patient after CABG surgery.

Statistical Analysis:

Data was coded and transformed into specially designed form to be suitable for computer entry process. Data was statistically analyzed using Statistical Package for Social Science (SPSS) Version 16 for windows. The findings were collected, tabulated, and statistically analyzed by two types of statistics that were: Descriptive statistics (Frequency, Arithmetic Mean (X), Stander Deviation (SD), and Analytic Statistics (Student t-test, Paired t –test, Multivariate analysis of variance (MANOVA).

3. RESULTS

Characteristices of the Studied Sample:

A total sample of 50 adult critically ill mechanically ventilated patients were undergoing a postoperative period after Coronary Artery Bypass Graft surgery included in the study, of whom 64% were male, 54% were married, 80% were educated and 74% were smokers. The mean age of the studied participants was 54.08 ±5.57. See table (1).

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Table (1) Sociodemographic Characteristics of the Studied Sample

Socio-demographic	No	%
Age		
X ± SD	54.08 ±5.57	
Range	45.00 - 63.00	
Gender		
Male	32	64.0%
Female	18	36.0%
Educational .level		
Educated	40	80.0%
Non educated	10	20.0%
Marital status		
Single	23	46.0%
Married	27	54.0%
Smoking		
Yes	37	74.0%
no	13	26.0%
Occupation		
Working	31	62.0%
Not working	19	38.0%

Effect of the 20° Backrest Elevation Position on Hemodynamic Parameters:

There was a highly statistically significant increase in MAP after 10, 20, and 30 minutes of the 20° backrest elevation position comparing with10 and 20 minutes, however there were no statistically significant differences in HR, RR, and CVP in all measurement points. See table (2).

Table (2) Effect of the 20° Backrest Elevation Position on Hemodynamic Parameters after 10, 20 and 30 Minutes

Items	**After 10 min of position**	**After 20 min of position**	**After 30 min of position**	MANOVA	P –value
	X ± SD	**X ± SD**	**X ± SD**		
HR	89.64 ± 8.66	90.04 ± 8.83	90.92 ± 9.42	.266 NS	> 0.05
RR	28.08 ± 2.85	28.84 ± 2.66	29.16 ± 2.59	2.104 NS	> 0.05
MAP	92.80±1.03	99.44± 9.26	104.94 ± 8.59	**20.7****	<.001
CVP	6.82 ± 1.26	6.82 ±1.26	6.90 ± 1.29	.066ns	> 0.05

**= Highly Significance
*= Significance
NS= No Significance

Effect of the 30° Backrest Elevation Position on Hemodynamic Parameters:

There was a highly statistically significant decrease in MAP and CVP after 30 minutes of the 30° backrest elevation position comparing with10 and 20 minutes, but there was no statistically significant difference in HR, and RR. See table (3).

Table (3) Effect of 30° Backrest Elevation Position on Hemodynamic Parameters after 10, 20 and 30 Minutes

Items	**After 10 min of position**	**After 20 min of position**	**After 30 min of position**	MANOVA	P –value
	X ± SD	**X ± SD**	**X ± SD**		
HR	82.30 ± 7.97	80.94 ±6.00	80.14 ±5.59	1.37 NS	> 0.05
RR	22.30 ± 3.23	21.58 ± 2.58	21.02 ± 2.50	2.64 NS	> 0.05

MAP	90.52 ± 6.44	84.04 ± 6.93	79.74 ± 7.15	**31.3****	<.001
CVP	5.76 ±1.97	4.38 ± 1.10	4.30 ± 1.09	**16.0****	<.001

Effect of the 45° Backrest Elevation Position on Hemodynamic Parameters:

There was a highly statistically significant decrease in MAP after 30 minutes of the 45° backrest elevation position comparing with10 and 20 minutes, but HR, RR and CVP did not show any statistically significant change. See table (4).

Table (4) Effect of the 45° Backrest Elevation Position on Hemodynamic Parameters after 10, 20 and 30 Minutes

Items	After 10 min of position	After 20 min of position	After 30 min of position	MANOVA	P –value
	X ± SD	X ± SD	X ± SD		
HR	83.14±8.08	84.10±8.60	85.92±9.42	1.31NS	> 0.05
RR	21.90 ±1.58	22.06 ±1.78	21.98 ±1.66	.11NS	> 0.05
MAP	72.34 ± 7.16	68.30 ± 8.00	63.30 ± 7.33	**18.2****	<.001
CVP	2.46 ± .95	2.46± .95	2.46±.952	.000NS	> 0.05

Effect of the 20° Backrest Elevation Position on Oxygenation Status:

There was a statistically significant increase in SaO2 after 30 minutes of the 20° backrest elevation position comparing with10 and 20 minutes, but there were no statistically significant differences in pH, PaO2, PaCO2, and ScvO2. See table (5).

Table (5) Effect of the 20° Backrest Elevation Position on Oxygenation Status after 10, 20 and 30 minutes

Items	After 10 min of position	After 20 min of position	After 30 min of position	MANOVA	P –value
	X ± SD	X ± SD	X ± SD		
PH	7.38 ± .028	7.39 ± .027	7.39 ± .029	1.027 NS	> 0.05
PaO2	86.96 ± 5.49	86.24 ± 5.40	86.24 ± 4.88	.311 NS	> 0.05
PaCO2	39.06 ± 3.85	39.38 ± 3.70	39.68 ± 3.85	.332 NS	> 0.05
SaO2	91.24 ± 2.71	91.88 ± 3.22	92.74 ± 2.74	**3.36***	< 0.05
ScvO2	68.22 ± 1.64	68.22 ± 1.64	68.30 ± 1.27	.046 NS	> 0.05

Effect of the 30° Backrest Elevation Position on Oxygenation Status:

There was a highly statistically significant increase in the SaO2 and PaO2 after 30 minutes of the 30° backrest elevation position comparing with10 and 20 minutes, but there were no statistically significant differences in PaCO2 and ScvO2. See table (6).

Table (6) Effect of the 30° Backrest Elevation Position on Oxygenation Status after 10, 20 and 30 minutes

Items	After 10 min of position	After 20 min of position	After 30 min of position	MANOVA	P –value
	X ± SD	X ± SD	X ± SD		
pH	7.36± .048	7.38 ± .025	7.39 ± .026	**9.7****	<.001
PaO2	92.80 ± 3.09	94.54 ± 3.77	95.18 ±3.64	**6.17***	< 0.05
PaCO2	37.60 ± 3.54	37.30 ±3.46	37.08 ±3.43	.28NS	. > 0.05
SaO2	95.50 ± 1.42	96.76 ± 1.55	98.44 ± 1.09	**47.8****	<.001
ScvO2	68.98 ± 1.48	69.34 ± 1.12	69.34 ± 1.12	1.34ns	> 0.05

Effect of the 45° Backrest Elevation Position on Oxygenation Status:

There was a highly statistically significant increase in the SaO2 and the PaO2 after 10 minutes of the 45° backrest elevation position comparing with 30 and 20 minutes, but there were no statistically significant differences in the pH, PaCO2 and ScvO2. See table (7).

Table (7) Effect of 45° Backrest Elevation Position on Oxygenation Status after 10, 20 and 30 Minutes

pH	7.38 ± .027	7.38 ± .027	7.38 ± .028	.227 NS	> 0.05
PaO2	93.04 ± 3.60	91.520±4.23	90.92±3.76	**3.9***	< 0.05
PaCO2	38.98± 3.67	39.08±3.47	39.16±3.45	.033 NS	> 0.05
SaO2	96.38±1.39	95.50±1.79	95.04±1.48	**9.4****	<.001
ScvO2	67.52±1.97	67.20±1.77	66.74±1.66	2.35NS	> 0.05

Effect of the 20°, 30° and 45° Backrest Elevation on Oxygenation at the three Measurement Points:

There was a highly statistically significant improvement in the pH, PaO2, SaO2, PaCO2 and ScvO2 after 30 minutes of the 30° backrest elevation position comparing with the 20° and the 45° backrest elevation position which indicating that all the arterial blood gases parameters were improved after 30 minutes of the 30° backrest elevation position. Therefore, the study finding suggesting that positioning the patients at the 30° backrest elevation for 30 minutes duration is the most appropriate time to improve oxygenation status for mechanically ventilated patients post CABG surgery. See table (8).

Table (8) Comparing the Effect of the 20°, 30° and 45° Backrest Elevation on Oxygenation at the three Measurement Points.

Items	Position 20	Position 30	Position 45	MANOVA	P –value
	X ± SD	X ± SD	X ± SD		
pH	7.39 ± .029	7.38 ± .028	7.36± .048	10.4**	<.001
PaO2	86.24 ± 4.88	95.18 ±3.64	90.92±3.76	58.5**	<.001
PaCO2	39.68 ± 3.85	37.08 ±3.43	39.16±3.45	7.4*	< 0.05
SaO2	91.24 ± 2.71	98.44 ± 1.09	95.04±1.48	180.8**	<.001
ScvO2	68.30 ± 1.27	69.34 ± 1.12	66.74±1.66	45.7**	<.001

4. DISCUSSION

Cardiopulmonary dysfunctions are the most common problem after CABG surgery and contribute significantly to increase postoperative complications. Therefore, the improvement of cardiopulmonary status is a major objective for critical care nurses in the postoperative period. It has been proven that backrest elevation improves oxygenation and hemodynamic status, resulting in a shorter stay in the ICU and improves outcomes.

Effect of Backrest Elevation on Hemodynamic Status:

The current study hypothesized that there is a change in patients' hemodynamic parameters after receiving backrest elevation intervention of 20, 30, 45 degree after CABG surgery. The findings of the current study found that positioning the patients in the 45° Head of Bed Elevation reduces the MAP. These findings are similar to what was reported by Göcze et al., (2013), Thomas, Paratz, and Lipman, (2014) [7, 19] who examined the effect of head of bed elevation on hemodynamic among mechanically ventilated patients and found that 45° head of bed elevation position was associated with significant decreases in MAP in mechanically ventilated patients but the 30° head of bed elevation was associated with a significant improvement in MAP.

Also, findings of the current study revealed that there was an improvement in hemodynamic parameters in the 20° head-up position comparing with the 45° head-up position, these findings are similar to what was reported by Wochenschrift, (2013), Martinez et al., (2015) [20, 21].

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However, findings of the current study are different from what was reported by Giuliano et al., (2013), Doering, (2010) [22, 23] who examined the effect of different degrees of backrest elevation on hemodynamic in 26 critically ill patients and found that there was no significant difference in the heart rate or mean arterial pressure values at the various backrest angle and measurement points. A possible explanation of the study findings may be due to the small sample size (26 patients) and the short duration of positioning the patients in each position (10 minutes).

Effect of Backrest Elevation on Oxygenation:

The current study hypothesized that there was a change in patients' oxygenation after receiving backrest elevation intervention of 20, 30, 45 degree after CABG surgery. The present study findings revealed that there was a highly statistically significant improvement in all ABG parameters (pH, PaO2, PaCO2, SaO2, and ScvO2 after 30 minutes of the 30° backrest elevation position comparing with the 20°and 45° backrest elevation position. These findings are similar to what was reported by Martinez, et al, (2015) [21] who examined the influence of different degrees of backrest elevation on oxygenation among mechanically ventilated patients and found that there was a statistically significant improvement in oxygenation (PaO2, SaO2, PaCO2) at the 30°and 20° backrest elevation position comparing with the 45° backrest elevation position.

The findings of the current study are similar to what was reported by Thomas, Paratz, and Lipman (2014), Spooner et al., (2014) [19, 7] who studied the effect of backrest elevation on gas exchange among 34 mechanically ventilated patient and reported that the 45° backrest elevation position was associated with significant reduction in PaO2, SaO2, PaCO2 and pH comparing with the 30° backrest elevation.

However, the findings of the current study are different from what was reported by Noll and Fountain (2012), Tidwell, (2009) [24, 25] who examined the effect of backrest position on central venous oxygen saturation (ScvO2) in mechanically ventilated patients after CABG surgery and found that there was no significant difference in ScvO2 in the three positions from baseline. A possible explanation of the study findings may be due to the small sample size (30 patients).

Limitation of the Study:

- The current study included patients two hours after CABG surgery, therefore, our findings can only be generalizable for patients in the early acute phase after admission to the ICU rather than long-term mechanically ventilated patients. Through this narrow period we could detected all acute hemodynamic changes associated with altering the angle of the backrest elevation, but cannot determine whether these changes would be maintained over time and what the longer-term consequences of these changes are.

- The findings of the study are limited in their generalizability because of the convenience sample, small sample size, and using a single setting for data collection.

5. CONCLUSION

Implementation of backrest elevation intervention had led to improve oxygenation and hemodynamic status among mechanically ventilated patients after CABG surgery.

6. RECOMMENDATIONS

- The findings of the current study indicated that all the arterial blood gases parameters were improved after 30 minutes of the 30° backrest elevation position. Therefore, the study finding suggesting that positioning the patients at the 30° backrest elevation for 30 minutes duration is the most appropriate time to improve oxygenation status for mechanically ventilated patients post CABG surgery.

- Initiate the development of practice guidelines for critical care nurses to position mechanically ventilated patients at 30 degree backrest elevation post CABG surgery to improve oxygenation and hemodynamic status.

- Replication of this study is recommended with several design changes such as, using large sample size, using of randomized selection.

Implications for Nursing Practice:

The 45° backrest elevation position causes decrease in MAP in mechanically ventilated patients, therefore, patients at risk may need positioning at 20° to 30° to overcome the negative effects of HBE, especially during the acute phase of ICU admission.

Implications for Future Research:

- Including patients passed the acute phase after CABG surgery so we can determine to what extent the effect of the HBE will remain.
- Future studies are needed to systematically examine the safety of the HBE and to identify the safest, most effective head of bed angle for mechanically ventilated patients after CABG surgery.

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