Respiratory and Hemodynamic Responses to Mobilization of Critically Ill Obese Patients

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ABSTRACT

Purpose: The aim of this study was to investigate the effects of mobilization on respiratory and hemodynamic parameters in critically ill obese patients. Methods: Critically ill obese patients (n=31) were included in this retrospective study. Data were collected from patients’ files and physiotherapy records of mobilization sessions. Heart rate (HR), systolic/diastolic/mean blood pressure, respiratory rate (RR), and percutaneous oxygen saturation (SpO2) were recorded. Cardiorespiratory parameters were collected just prior to the mobilization, just after the completion of the mobilization and after 5 minutes recovery period. Respiratory reserve was calculated before and after the mobilization. Results: A total of 37 mobilization sessions in 31 obese patients (mean age: 63.3 years, mean BMI: 32.2 kg/m²) who received physiotherapy were analyzed. Respiratory rate increased significantly after the completion of the mobilization compared to initial values (p < 0.05). SpO2 significantly increased (p < 0.05) and all other parameters remained similar (p > 0.05) compared to initial values after the recovery period. Mobilization resulted in a significant increase in respiratory reserve (p < 0.05). Conclusion: Early mobilization in intensive care unit promotes respiratory reserve in obese patients. We found that mobilization can be performed safely in critically ill obese patients if cardiorespiratory parameters are continuously monitored.

Key Words: obesity, mobilization, critically ill patients, physiotherapy

INTRODUCTION AND PURPOSE

Obesity is among the most serious public health problems1,2 that affects many people and often requires multidisciplinary treatment.3 There is overwhelming evidence that the prevalence of obesity, defined as having a body mass index (BMI) of ≥ 30 kg/m²,4 is increasing worldwide.5,6 Obesity is associated with increased risk of chronic diseases, secondary medical complications, and reduced health related quality of life.6 Approximately one-third of patients admitted to intensive care units (ICU) are obese and nearly 7% are morbidly obese.7,8 The term morbid obesity refers to adults with BMI greater than or equal to 40 kg/m².2 Several studies have investigated the effect of obesity on outcome in ICU setting.9,14 Many of these studies have shown increased morbidity and mortality.12-14 Data on outcomes of critically ill patients indicated that obese patients were more likely to have complications including acute respiratory distress syndrome (ARDS),10,12 septic shock,14 acute renal failure,10,12 and acquired infection.12,14 Besides these severe events, obesity is associated with increased risk of ARDS11 and increased length of ICU stay.11-14 As patients survive chronic illness, immobilization complications such as muscle weakness and atrophy, contractures, decreased cardiac reserve, venous thromboembolism, and orthostatic hypotension are more apparent.15 For these reasons, physiotherapy interventions should be initiated as early as possible after the acutely ill patient is admitted to the ICU.16 Many studies showed that mobilization of critically ill patients in the earliest days of critical care can result in improved patient outcomes.17-20 Recently, there has been an interest in early mobilization of ICU patients. Although many authors agree that mobilization of acutely ill patients is feasible and safe;20-22 to our knowledge, there are no studies that were specifically implemented in critically ill obese patients.

The aim of this retrospective study was to investigate the effects of mobilization on respiratory and hemodynamic parameters in critically ill obese patients. We focused on whether patients’ responses to mobilization were within the normal ranges.

METHODS

Design

The study was retrospective. Data were collected from patients’ files and physiotherapy evaluation forms.

Patient and settings

Critically ill obese patients who received mobilization sessions in their physiotherapy program during the ICU stay in the 18-bed Anesthesiology and Reanimation Intensive Care Unit of the university hospital between January 2007 and January 2010 were included in the study. This study was approved by the Institutional Review Board at Dokuz Eylul University.

Patients were classified as obese according to the definitions of the World Health Organization criteria4 based on
BMI formula: BMI = body weight (kg)/height² (m²). Obese patients were defined as having BMI of ≥ 30.00 kg/m².

Inclusion criteria for receiving mobilization sessions consisted of stable conscious state and able to understand and follow commands appropriately, hemodynamically stable (not requiring inotropes), body temperature < 38°C, hemoglobin levels stable and > 7 g/dL, percutaneous oxygen saturation (SpO₂) > 90%, mean blood pressure (MBP) > 60 mmHg, no orthopedic and neurological contraindications.

Mobilization protocol

The standard mobilization protocol is that mobilization is begun as soon as patients’ cardiorespiratory system is stable (as defined above). Per hospital standard protocol, mobilization was begun as soon as the patients’ cardiorespiratory system was stable (as defined above). Hemodynamic and respiratory parameters were continuously recorded at all stages of mobilization sessions. The mobilization progression was based on the patients’ general clinical status, ability, and willingness.

Physiological responses were monitored continuously as the patient progressed through the mobilization protocol in order to prevent adverse effects of mobilization.

The following criteria were chosen as intolerance findings:
1. ≥ 20 mmHg increase or decrease in systolic blood pressure (SBP)/diastolic blood pressure (DBP),
2. ≥ 20 beats/minute increase or decrease in heart rate (HR),
3. SpO₂ < 90%, and
4. paradoxical breathing, dizziness, perspiration, and faintness.

Intolerance findings were recorded by the physical therapists to evaluate the safety of patients and patients’ abnormal responses to mobilization.

Data collection and outcome measure

One physiotherapist specialized in intensive care collected the information retrospectively from the obese patients’ files (see Table 1). Data were collected in 3 categories: patients’ demographics (age, gender, height, body weight, BMI), patients’ medical information, and physiotherapy records of mobilization sessions during their ICU stay.

Hemoglobin levels, platelet counts, white cell counts, and blood glucose levels were collected from the most recent blood analyses and body temperature was recorded from the monitor (Draeger Medical Systems Inc, U.S.A) before mobilization.

The following hemodynamic and respiratory parameters were taken from the monitor: HR, SBP, DBP, MBP, respiratory rate (RR), and SpO₂. Measurements were collected in 3 stages: (1) just prior to the mobilization in supine position (preamobilization), (2) just after the completion of the mobilization when the patient had been returned to the supine position (postmobilization), and (3) after 5 minutes recovery period (5 minutes recovery).

The ratio of partial pressure of oxygen in arterial blood to the inspired fraction of oxygen (PaO₂/FiO₂) was calculated from the most recent arterial blood gas samples for assessing the respiratory reserve before and after the mobilization. Respiratory reserve reflects oxygenation.

Data analysis

The statistical package SPSS 15.0.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Level of significance was set at p < 0.05. All continuous variables were evaluated for normality using Kolmogorov-Smirnov test with Lilliefors Significance Correction. Continuous variables were expressed as mean ± standard deviation (if data were normally distributed) or as medians in combination with quartiles and percentiles (if data were not normally distributed). Mobilization data were analyzed with a one way repeated measure analysis of variance (ANOVA). Statistically significant changes were further analyzed with post-hoc Bonferroni t-test. To compare changes in respiratory reserve between before and after mobilization, paired sample t-test was performed.

RESULTS

Retrospective analysis of 31 patients’ files who received mobilization in their physiotherapy program during the ICU stay fulfilled all aspects of the study. A total of 31 obese patients received 37 mobilization sessions in ICU. Baseline characteristics of the patients are summarized in Table 1.

All mobilization sessions were performed after patients were extubated. Mobilization events included 26 (70.3%) sitting on the edge of the bed, 3 (8.1%) standing, 8 (21.6%) walking to the chair and sitting in the chair.

A total of 7 intolerance findings were recorded in 6 patients. One patient had 2 intolerance findings. Intolerance findings included 4 increase or decrease in SBP (20 mmHg or more), 3 increase or decrease in HR (20 beats/minute or more). Despite the intolerance findings, no deterioration in clinical status occurred during the mobilization sessions.

Effects of mobilization on hemodynamic parameters

The results showed that HR was significantly different when 3 mobilization stages were compared (F = 3.79, p = 0.049). Heart rate significantly decreased in the 5 minute recovery period when compared with postmobilization values (p < 0.05). There were no significant differences in other hemodynamic parameters (p > 0.05) (Table 2).

Effects of mobilization on respiratory parameters

Significant changes were seen in RR (F = 17.35, p = 0.00) with progression of mobilization. Respiratory rate significantly increased from premobilization to postmobilization. A significant RR reduction was seen in the 5 minute recovery period when compared with postmobilization values (p < 0.05).

Mobilization caused a significant change in SpO₂ (F = 4.11, p = 0.02). After a 5 minute recovery period, SpO₂ significantly increased compared with premobilization values (p < 0.05) (Table 2). Mobilization resulted in a significant increase in respiratory reserve when compared with premobilization values (t = -5.440 p = 0.00) (Table 2).
DISCUSSION

In this retrospective study, we investigated the hemodynamic and respiratory responses to early mobilization and effects of the mobilization on oxygenation in critically ill obese patients. Although mobilization resulted in significant increases in RR after mobilization, all parameters were similar in the 5 minute recovery period when compared with initial values, except for SpO₂. Increases in RR may be due to the patients’ efforts to compensate for the increased physical activity. It was an expected response to increased work of breathing. Nonsignificant HR, SBP, DBP, and MBP increases were seen during postmobilization period. This result showed that mobilization did not put excess hemodynamic stress on obese patients. Significant increase was observed in SpO₂ in the recovery period when the patient was taken back to supine position in bed. Additionally, we found that respiratory reserve significantly improved after mobilization. Although the 7 of 37 mobilization sessions had intolerance findings, mobilization did not result in deterioration in clinical status. On the two of 7 intolerance findings, the magnitude of SBP or HR increases were very small when compared to chosen intolerance findings (in one patient: 21 beats/minute increase in HR, in the other patient: 21 mmHg increase in SBP). No specific intervention was applied during mobilization to stabilize cardiorespiratory parameters. Patients’ hemodynamic and respiratory responses to mobilization were within the normal value.

The main finding of the present study is that mobilization can be performed safely in critically ill obese patients if cardiorespiratory parameters are continuously monitored. This finding is similar to other mobilization studies, which investigated the effects of mobilization in critically ill patients with other diagnosis.

There are several outcome studies investigating the effect of obesity in ICU. It is well known that obesity is related to increased morbidity and mortality. In the literature, it is shown that early mobilization improves functional outcomes in critically ill patients. Although mo-

| Table 1. Baseline Characteristics of the Patients |

| Age (years) | Mean ± SD 63.35±12.25 |
| Gender [n(%)] | Male 15 (48.4%) Female 16 (51.6%) |
| Body weight (kg) Mean ± SD 87.48±11.78 Range 70.00-120.00 |
| Height (cm) Mean ± SD 164.54±9.79 Range 145.00-184.00 |
| Body temperature (°C) Mean ± SD 36.97±0.38 Range 36.00-37.70 |
| Hemoglobin levels (g/dL) Mean ± SD 10.69±1.75 Range 7.10-13.70 |
| Platelet counts (cells/mm³) Mean ± SD 214.229±128.587 Range 51.000-621.000 |
| White cell counts (cells/mm³) Mean ± SD 12.070±3.009 Range 5.600-18.300 |
| Blood glucose levels (mg/dL) Mean ± SD 161.21±48.65 Range 101.00-286.000 |

| Table 2. The Comparison of Hemodynamic and Respiratory Parameters between Premobilization, Postmobilization, and Recovery Period (mean ± standard deviation) |

<table>
<thead>
<tr>
<th></th>
<th>Premobilization</th>
<th>Postmobilization</th>
<th>Recovery</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (beat/minute)</td>
<td>91.56±17.50</td>
<td>94.45±15.97</td>
<td>90.40±14.91*</td>
<td>0.049</td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>130.94±15.89</td>
<td>134.08±17.85</td>
<td>130.72±16.68</td>
<td>0.194</td>
</tr>
<tr>
<td>DBP (mmHg)</td>
<td>70.00±12.30</td>
<td>72.56±12.80</td>
<td>69.56±11.63</td>
<td>0.081</td>
</tr>
<tr>
<td>MBP (mmHg)</td>
<td>91.48±14.92</td>
<td>94.37±14.75</td>
<td>90.56±13.88</td>
<td>0.119</td>
</tr>
<tr>
<td>RR (breath/minute)</td>
<td>23.32±4.97</td>
<td>25.89±5.51§</td>
<td>23.29±4.71§</td>
<td>0.000</td>
</tr>
<tr>
<td>SpO₂ (%)</td>
<td>98.0 (95.5-100.0)</td>
<td>99.0 (96.0-100.0)</td>
<td>99.0 (96.0-100.0)</td>
<td>0.020</td>
</tr>
<tr>
<td>PaO₂/FiO₂</td>
<td>230.15±85.80</td>
<td>276.82±99.46</td>
<td>-</td>
<td>0.000*</td>
</tr>
</tbody>
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HR: heart rate, SBP: systolic blood pressure, DBP: diastolic blood pressure, MBP: mean blood pressure, RR: respiratory rate, SpO₂: percutaneous oxygen saturation, %=percent, PaO₂/FiO₂: the ratio of partial pressure of oxygen in arterial blood to the fraction of inspired oxygen
* statistically different from post-mobilization values (p < 0.05).
† statistically different from pre-mobilization values (p < 0.05).
ANOVA, boldface p values were statistically significant.
paired sample t-test
* expressed as medians in combination with quartiles and percentiles.
bilitation is a common practice in most ICUs, there is a lack of data available on obese population. There is only one case report of a morbidly obese patient (BMI: 69 kg/m²) with multiorgan failure successfully mobilized throughout her ICU stay. However, that report did not investigate the hemodynamic and respiratory responses to mobilization. To the best of our knowledge, no previous studies have investigated the effects of mobilization on hemodynamic and respiratory parameters in critically ill obese patients. This study is the first research related to early mobilization in obese patients in ICU. Our current findings showed significant increases in RR after mobilization that returned premobilization values in the recovery period indicating the safety of mobilization as a consequence of normal responses to physical demand. Increases in SpO₂ and PaO₂/FiO₂ reflect the improvement of oxygenation and this result showed that mobilization may improve patient outcomes.

Our obese patients were able to participate in early mobilization and the patients demonstrated clinical stability through the ICU stay. Clinical and physiologic stability of a patient has been described as the whole state of neurologic and cardiopulmonary stability. Stiller et al has outlined the safety issues that should be considered when mobilizing critically ill patients. We selected the inclusion criteria according to these safety issues. The mobilization progression was based on the patients’ general clinical status, and ability. None of the patients had an adverse event in mobilization.

The majority of the patients (n=28, 90.3%) in the current study had surgery. Although our patients did not have pulmonary complications, it is well documented in the literature that obese patients have been reported to have a higher incidence of postsurgical pulmonary complications. Efficacy and safety of early postoperative mobilization in critically ill patients has been shown in prior studies. All the patients in Senduran’s and Zafiropoulos studies and 38.7% of the patients in Stiller’s study were postoperative. All of these authors applied early mobilization in ICU and found that mobilization is feasible and safe in patients postsurgery. Our findings support these literature findings.

Zafiropoulos et al investigated the effects of mobilization on respiratory and hemodynamic variables in intubated, ventilated abdominal surgical patients and found that mobilization was associated with significant increases in RR. Similar to Zafiropoulos et al’s finding an increase in RR was found in our study after mobilization. We did not include the intubated and mechanically ventilated patients in our study. However, in Stiller’s study, 7 patients (22.6%) were intubated, ventilated and they found the same result as well. In contrast with results of Zafiropoulos’, Stiller’s, and Senduran’s studies, we did not find a significant increase in HR after mobilization.

We found that the respiratory reserve of the patients significantly increased after mobilization and SpO₂ significantly increased after 5 minutes recovery. It was expected that the mobilization would enhance the oxygen transport of these patients, due to positive effects of erect position on alveolar ventilation and ventilation/perfusion matching.

Researchers have speculated that duration of sitting and walking distance may affect the cardiopulmonary responses to a recovery period. In our study, we did not measure the duration of sitting and walking distance to the chair. This is a limitation of our study.

In our study, only 8 patients (21.6%) managed to walk to the chair and sit in the chair. The majority of our patients (n=26, 70.3%) were seated on the edge of the bed. We think that participation of a large number of subjects in higher level of mobilization stages may affect the results. This may be a limitation of our study.

CONCLUSION

We conclude that early mobilization is feasible and safe in critically ill obese patients. Additionally, our study shows the benefits of early mobilization on oxygenation improvement. Further randomized-control studies with larger number of patients are needed to contribute new knowledge to physiotherapy literature for the obese population in the ICU setting.

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REFERENCES


