Impact of mechanical ventilation on quality of life and functional status after ICU discharge: A cross-sectional study

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SUMMARY

Objective: To evaluate the impact of the need for mechanical ventilation (MV) and its duration throughout ICU stay on the quality of life (QoL) and physical functional status (PFS) after the immediate ICU discharge.
Method: This was a cross-sectional study including all subjects consecutively discharged from the ICU during 1-year period. During the first week after ICU discharge, QoL was assessed through WHOQoL-Bref questionnaire and PFS through the Karnofsky Performance Status and modified-Barthel index, and retrospectively compared with the pre-admission status (variation [Δ] of indexes).
Results: During the study, 160 subjects met the inclusion criteria. Subjects receiving MV presented PFS impairment (Δ Karnofsky Performance Status [-19.7 ± 20.0 vs. -14.9 ± 18.2; p=0.04] and Δ modified-Barthel index [-17.4 ± 12.8 vs. -13.2 ± 12.9; p=0.05]) compared with those who did not receive MV. Duration of MV was a good predictor of PFS (Δ Karnofsky Performance Status [-14.6-1.12 * total days of MV; p=0.01] and Δ modified-Barthel index [-14.2-0.74 * total days of MV; p=0.01]). QoL, assessed by WHOQoL-Bref, showed no difference between groups (14.0 ± 1.8 vs. 14.5 ± 1.9; p=0.14), and the duration of MV did not influence QoL (WHOQoL-Bref scale [14.2-0.05 * total days of MV; p=0.43]).
Conclusion: Need for MV and duration of MV decrease patient PFS after ICU discharge.


INTRODUCTION

Critically ill subjects are often exposed to prolonged bed rest, dysfunction of vital organs, sepsis, hypoxemia and neuromuscular drug toxicity, resulting in an impaired cardiovascular system status and critical illness neuromuscular syndromes. Both of these conditions may delay ventilator weaning and increase ICU period and hospital stay. In particular, prolonged immobility and inactivity may result in the loss of muscle strength, endurance, balance and neuromuscular coordination, leading to further total functional impairment and a consequently reduced quality of life (QoL). It is suggested that some subjects benefit from critical care therapy, but many others do not.

Mechanical ventilation (MV) is the highest priority indicator for admission to ICUs, according to accepted guidelines. Subjects who require MV are usually the most severe ones. In addition, increasing numbers of these patients generate particular controversy regarding their uncertain long-term outcomes and disability. The greater is the duration of MV, the worse the prognosis appears to be. Some authors described that MV subjects experience poor survival, low QoL, reduced physical functional status (PFS) and poor cognitive functioning; the subjects also require substantial post-discharge care. Other authors demonstrated a survival benefit with MV.

A clearer description of the outcomes of MV subjects post-discharge can be observed in clinical decision-mak-
ing, institutional planning, payment reform and design of future interventions targeted to these unique subjects.6,9 There are no studies establishing the relation of PFS and QoL with MV dependency. Therefore, the objective of our study was to verify the impact of MV (need and duration) on QoL and PFS of subjects after immediate ICU discharge.

**METHOD**

**Design and participants**

The present investigation was a cross-sectional study that included all the subjects admitted to and discharged from the ICU of the Ernesto Dornelles Hospital (a 22-bed clinical-surgical ICU) during a 1-year period (from August 2012 to August 2013). Patients < 18 years of age, those who remained in the ICU for < 72 h, those subjected to elective surgery without clinical or surgical complications and those who refused to sign the informed consent were excluded from our study. Eligible subjects who were readmitted to the ICU during the study period were only included once. The study was approved by the research ethics committee of the Federal University of Health Sciences of Porto Alegre (no. 332.519) and consisted of a preliminary analysis of an ongoing multicenter cohort that is expected to include 1,500 participants.

**Intervention**

Each eligible patient, or a close relative, was requested to sign the informed consent form during the first week following discharge from the ICU. The subjects who agreed to participate were subjected to an interview with physical therapists and psychologists previously trained to apply the following questionnaires and scales to assess the participants’ current condition: PFS (modified-Barthel index and Karnofsky performance status) and QoL (WHO-QoL-Bref). The PFS was also assessed in the period prior to ICU admission, retrospectively. The Portuguese translations of all these scales have already been validated.10-12

**Physical-functional status evaluation**

The modified-Barthel index objectively assesses the degree of dependence of individuals relative to 10 categories of activities of daily living (ADLs): personal hygiene, bathing, feeding, toilet use, climbing stairs, dressing, bladder and anal sphincter function, walking, and transfer from bed to chair.13,14 The score ranges from 0 to 100 and is interpreted as follows: 0-20, totally dependent; 21-60, severely dependent; 61-90, moderately dependent; 91-99, slightly dependent; and 100, totally independent.13,15,16 The questionnaire can be answered by the subjects, their relatives, or their caregivers. For the present analysis, the absolute values (from 1, totally dependent, to 5, totally independent) of each domain were used.

The Karnofsky Performance Status assesses the degree of functional impairment. It was initially designed to assess the physical performance of subjects with cancer, but its use was extended to other chronic disabling diseases.14 Based on their scores, the individuals were classified as follows: 100, normal, having no complaints and no evidence of disease; 90, capable of normal activity and with few symptoms of disease; 80, normal activity with some difficulty and some symptoms of disease; 70, capable of self-care and not capable of normal activity or work; 60, occasionally requires some assistance but can take care of most personal needs; 50, requires considerable assistance or frequent medical care; 40, disabled and requires special care and assistance; 30, severely disabled, with indicated hospital admission, although death is not imminent; 20, very ill, requiring hospital admission; and 10, moribund, with fatal process progressing rapidly.11

**Quality of life evaluation**

Data on QoL were collected using the World Health Organization Quality of Life Bref-Scale (WHOQoL-Bref). The WHOQoL-Bref is a shorter version of the original WHOQoL-100 and consists of 26 items that are scored over four major domains, namely physical, psychological, social relationships, and environment.12,17-19 The responses of the WHOQoL-Bref are scored in a Likert-type scale yielding 1 to 5 points, with higher scores denoting higher QoL and vice-versa.18,20

**Outcome measures**

The information relative to the participants, ICU stay was collected from their clinical records including the following data: demography, severity scores, reason for ICU admission, diseases before ICU admission, requirement for life support (e.g., invasive or non-invasive MV hemodialysis; vasopressors such as dopamine, noradrenaline and dobutamine; or blood-component transfusions such as red-blood-cell concentrates, plasma, and platelets) and ICU outcomes.

**Data analyses**

The data are expressed as mean ± standard deviation (SD) or absolute and relative frequencies. The Kolmogorov-Smirnov test was used to investigate the normal distribution of the data. The categorical variables were analyzed using Fisher’s exact test, and the quantitative
variables were analyzed using Wilcoxon-Mann-Whitney test. The comparison between the differences in score variation [score post-ICU immediate discharge (score before ICU admission [Δ]) in the Karnofsky Performance Status and modified-Barthel index scales and the average WHOQoL-Bref scores between subjects who required MV and those who did not were performed using the Wilcoxon-Mann-Whitney test. Linear regression was conducted to assess the impact of the length of MV on QoL scores. The significance level was established as p<0.05. The analysis was performed using Stata software version 12 (Stata Corp LP, USA).

**RESULTS**

During the study period, 160 subjects discharged from the ICU were included in the analyses. The data corresponding to the participants’ ICU stay are described in Table 1, and the following results stood out: subjects with MV were younger (69.5±15.3 years vs. 73.8±14.9 years; p=0.04) and had a higher ICU stay length (8.9±5.4 vs. 5.8±3.0 days, p<0.001).

The results from the modified-Barthel index indicated a tendency of higher difference in score variation of subjects with MV dependence compared with those of subjects without MV (Δ = -17.4±12.8 vs. -13.2±12.9; p=0.05). Furthermore, the Karnofsky Performance Status revealed a poorer functional capacity of subjects with MV after immediate ICU discharge (Δ = -19.7±20.0 vs. -14.9±18.2; p=0.04). However, the WHOQoL-Bref scores showed no difference between groups (14.0±1.8 vs. 14.5±1.9; p=0.14).

Table 2 describes the individual variation of each ADLs category in the modified-Barthel index. The comparison of the categories before and after ICU showed that the group of subjects with MV had a poorer performance in dressing and climbing stairs. Table 2 also describes the WHOQoL-Bref domains, which showed no difference between groups.

The duration of MV was a good predictor of PFS impairment in the immediate ICU discharge (Figures 1A and 1B), but not of QoL (Figure 1C).

**DISCUSSION**

The main finding of the present study is that MV during ICU stay is an indicator of poor physical functional capacity immediately after ICU discharge. Impairment has been reported in the ADLs of almost all ICU survivors in studies that evaluated subjects immediately after ICU discharge. Nevertheless, the literature is controversial regarding the association between PFS and the MV need. Some authors suggested that functional status during post-hospital follow-up does not seem to be influenced by the use of MV. Other study reported that ICU survivors have a reduced functional capacity in ADLs immediately after ICU discharge, and these limitations are associated with the duration of

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Characteristics of the participants.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variables</td>
<td>Subjects with MV (n=107)</td>
</tr>
<tr>
<td>Male gender, n (%)</td>
<td>64 (59.8)</td>
</tr>
<tr>
<td>Age (years), mean ± SD</td>
<td>69.5±15.3</td>
</tr>
<tr>
<td>Body mass index (kg/m²), mean ± SD</td>
<td>26.5±5.9</td>
</tr>
<tr>
<td>Previous diseases, n (%)</td>
<td></td>
</tr>
<tr>
<td>Heart failure</td>
<td>17 (15.8)</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>6 (5.6)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>20 (18.6)</td>
</tr>
<tr>
<td>Peripheral artery disease</td>
<td>5 (4.6)</td>
</tr>
<tr>
<td>End-stage chronic kidney failure</td>
<td>5 (4.6)</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>16 (14.8)</td>
</tr>
<tr>
<td>Dementia</td>
<td>10 (9.3)</td>
</tr>
<tr>
<td>Bronchial asthma</td>
<td>3 (2.8)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>15 (14.0)</td>
</tr>
<tr>
<td>Depression</td>
<td>7 (6.5)</td>
</tr>
<tr>
<td>APACHE-II, mean ± SD</td>
<td>20.1±7.9</td>
</tr>
<tr>
<td>ICU length of stay (days), mean ± SD</td>
<td>8.9±5.4</td>
</tr>
</tbody>
</table>

MV: mechanical ventilation; SD: standard deviation; APACHE-II: Acute Physiology and Chronic Health Evaluation II; ICU: intensive care unit.

Note: Difference between qualitative variables evaluated by Fisher’s exact test. Difference between quantitative variables evaluated by the Wilcoxon-Mann-Whitney test.
### TABLE 2  Comparison of the score variation* in categories of modified-Barthel index and comparison* of the WHOQoL-Bref domains between critically ill subjects receiving or not mechanical ventilation.

<table>
<thead>
<tr>
<th>Barthel’s categories</th>
<th>Subjects with MV (n=107)</th>
<th>Subjects without MV (n=53)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding</td>
<td>-1.58±1.38</td>
<td>-1.24±1.43</td>
<td>0.10</td>
</tr>
<tr>
<td>Bathing</td>
<td>-1.71±1.30</td>
<td>-1.32±1.42</td>
<td>0.05</td>
</tr>
<tr>
<td>Dressing</td>
<td>-1.82±1.63</td>
<td>-1.22±1.58</td>
<td>0.04</td>
</tr>
<tr>
<td>Personal hygiene</td>
<td>-2.09±1.66</td>
<td>-1.69±1.61</td>
<td>0.13</td>
</tr>
<tr>
<td>Anal sphincter function</td>
<td>-1.91±1.62</td>
<td>-1.47±1.51</td>
<td>0.09</td>
</tr>
<tr>
<td>Bladder function</td>
<td>-1.44±1.46</td>
<td>-1.00±1.37</td>
<td>0.06</td>
</tr>
<tr>
<td>Toilet use</td>
<td>-1.46±1.76</td>
<td>-1.05±1.59</td>
<td>0.17</td>
</tr>
<tr>
<td>Transfer from bed to chair</td>
<td>-1.36±1.65</td>
<td>-1.13±1.72</td>
<td>0.28</td>
</tr>
<tr>
<td>Walking</td>
<td>-2.0±1.64</td>
<td>-1.54±1.55</td>
<td>0.08</td>
</tr>
<tr>
<td>Climbing stairs</td>
<td>-1.84±1.47</td>
<td>-1.26±1.44</td>
<td>0.01</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WHOQoL-Bref domains</th>
<th>Subjects with MV (n=60)</th>
<th>Subjects without MV (n=34)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>11.7±3.1</td>
<td>12.3±2.1</td>
<td>0.48</td>
</tr>
<tr>
<td>Psychological</td>
<td>14.8±2.1</td>
<td>14.8±2.5</td>
<td>0.92</td>
</tr>
<tr>
<td>Social relationships</td>
<td>15.9±2.6</td>
<td>17.0±1.9</td>
<td>0.07</td>
</tr>
<tr>
<td>Environment</td>
<td>14.9±2.2</td>
<td>14.4±2.5</td>
<td>0.29</td>
</tr>
</tbody>
</table>

MV: mechanical ventilation. Variables expressed as mean ± standard deviation.

* Wilcoxon-Mann-Whitney test.

* Score variation = score post-ICU immediate discharge − score before ICU admission.

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### FIGURE 1

A. Linear regression between duration of mechanical ventilation and the score variation of modified-Barthel index*.

B. Linear regression between duration of mechanical ventilation and the score variation of Karnofsky Performance Status**.

C. Linear regression between duration of mechanical ventilation and WHOQoL-Bref scale**.

** WHOQoL-Bref scale = 14.2–0.05* total days of MV; p=0.43.

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\* Score variation = score post-ICU immediate discharge − score before ICU admission.

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MV. A previous study by our group demonstrated that the use of MV ≥ 8 days reduced the ability to perform ADLs by 1.48 times (RR = 1.48; 95CI 1.02-2.15; p=0.03). ADLs impairments may be more prevalent in MV subjects because 86% of subjects ventilated for ≥ 48h had limitations in physical function, and approximately 75% of these limitations were severe by the 12th month after discharge. Our study also demonstrated the loss of PFS associated with the use of MV. We believe that because MV is used in more severe cases, which require longer ICU stay, these patients are more often exposed to hypoxemia, bed immobility, use of sedatives and risk of nosocomial infections (not measured by us). The use of MV is not complication-free, affecting the patient as a whole by impairing their physical condition and thus worsening their functional capacity.

Most subjects using MV for longer periods and who survive one year report significant deficits in physical functioning, energy, and sleep. More specifically, measures of functional status were significantly worse in MV subjects, especially for subscales which measured mobility, body care, and movement. Walking ability and upper-extremity grip strength were identified as independent-explanatory consequences of poorer PFS. In another study, the authors demonstrated that more than 25% of subjects report restrictions in activities related to walking such as walking slowly and having problems with walking stairs, hills, and distances. These results corroborate ours, in which subjects of the MV group also showed deficit in climbing stairs and dressing.

Studies assessing QoL after intensive care suggest that this parameter improves over time, but is worse than that before the ICU admission, and worse than expected for the general population. The association between QoL and MV remains unclear. Subjects using long-term MV had consistently worse overall QoL than short-term subjects, but the differences were not statistically significant. Another study that compared long-term and short-term MV found that, in the analysis of the physical domain, the long-term MV group showed worse results, specifically in mobility and body care. A 3-year follow-up study showed that subjects that used MV for > 14 days, and another study with subjects who remained in the ICU for > 24h, found no correlation between the duration of MV and overall QoL. Some authors described that intubation was not significantly associated with either physical or mental domain scores one month after ICU discharge. In our study, MV showed no association with QoL at immediate ICU discharge. Most of our subjects underwent short-term MV, which may have influenced our results. It is also known that subjects who are in stable conditions after ICU stay may be more likely to express positive perceptions in their QoL than subjects with unstable disease. It is important to note that QoL is a dynamic and variable phenomenon across different subjects and presents time variation for the same patient. In any case, the ideal time to evaluate QoL has not yet been established. Although many of the subjects reported a decline in functional status and many other symptoms, they were satisfied with their QoL. The majority of survivors described their health as good or better and would opt for MV support again if they had to relive the experience. However, it is unknown if family members think the same way.

The immediate post-discharge period remains an important target for improving outcomes and disease management models and should be further evaluated. It is believed that the care provided in ICU settings and the assessment of the interventions performed should be determined earlier along the interval between discharge from the ICU and discharge from the hospital. These measures would have a long-term impact on the QoL of critically ill subjects. Although it is known that no single variable such as the use of MV has a significant and accurate prognosis, it may have implications for patient care, family planning and decision-making. The simple health grouping model outcomes we reported may help in this regard.

Concerning the limitations of our study, we should first mention the selected assessment method (i.e., the use of questionnaires). Although this technique is not subjective, it depends on the individuals’ reading and understanding skills, their honesty and their hearing capacity during the interviews; also, the questionnaires may present measurement bias. Moreover, a memory bias should be considered if the questionnaires included information regarding the patient’s conditions before ICU admission. In this context, it is noteworthy that survivors of severe diseases might overestimate their state before admission, as reported by other authors. The large number of subjects excluded should be addressed, which led to a small sample that may not be representative, especially because few of the study’s subjects used MV for more than 10 days. Furthermore, our study was conducted in a single center, as a preliminary analysis of an ongoing multicenter cohort.

**Quick look**

Mechanical ventilation is an indicator of poor physical functional capacity after ICU discharge.

Mechanical ventilation can decrease the quality of life after ICU discharge.
Duration of mechanical ventilation decreases the physical functional status after ICU discharge.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

RESUMO

Impacto da ventilação mecânica na qualidade de vida e no estado funcional após alta da UTI: um estudo transversal

Objetivo: Avaliar o impacto da necessidade de ventilação mecânica (VM) e sua duração na qualidade de vida (QV) e no estado funcional físico (EFF) dos pacientes após a alta imediata da UTI.

Método: Estudo transversal incluindo todos os pacientes que, consecutivamente, tiveram alta da UTI durante um período de um ano. Durante a primeira semana após a alta da UTI, a QV foi avaliada através do questionário WHOQoL-Bref e o EFF através do índice de Karnofsky e do índice de Barthel modificado, comparados retrospectivamente com o estado pré-admissão (variação [Δ] dos índices).

Resultados: Durante o estudo, 160 indivíduos preencheram os critérios de inclusão. Os indivíduos submetidos a VM apresentaram maior prejuízo no EFF (Δ Karnofsky [-19,7 ± 20,0 vs. -14,9 ± 18,2; p<0,05] e Δ Barthel modificado [-14,2 ± 20,0 vs. -14,9 ± 18,2; p=0,04]) e Δ Karnofsky ([-17,4 ± 12,8 vs. -13,2 ± 12,9; p<0,05]) quando comparados aos pacientes sem VM. A duração da VM foi um bom preditor de redução do EFF (Δ Karnofsky [-14,6-1,12 * dias totais de VM; p=0,01] e Δ Barthel modificado [-14,2-0,74 * dias totais de VM; p<0,01]). A QV, avaliada pelo WHOQoL-Bref, não mostrou diferença entre os grupos (14,0 ± 1,8 vs. 14,5 ± 1,9; p=0,14) e a duração da VM não influenciou a QV (WHOQoL-Bref [14,2-0,05 * dias totais de VM; p=0,43]).

Conclusão: A necessidade e a duração do VM reduzem a performance física dos pacientes após a alta da UTI.


REFERENCES