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RESEARCH PAPER (ORIGINAL)
ARTIGO DE INVESTIGAÇÃO (ORIGINAL)**Functional dependence at discharge from the intensive care unit: relevance for rehabilitation nursing**

Dependência funcional na alta dos cuidados intensivos: relevância para a enfermagem de reabilitação

Dependencia funcional del alta de cuidados intensivos: relevancia para la enfermería de rehabilitación

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The first intervention of rehabilitation nursing occurred, on average, on the 10th day and the patient got out of bed after 13 days.**Conclusion:** At discharge, there were high levels of functional dependence at the level of basic self-care and mobility/transfers, and their characterization should be improved for the continuity of rehabilitation care. Early mobilization of critical patients is necessary.**Keywords:** rehabilitation; self-care; muscle weakness; functional recovery**Resumo****Enquadramento:** O internamento em cuidados intensivos pode provocar efeitos adversos que originam situações de incapacidade funcional, que persistem por tempo prolongado. A reabilitação precoce pode impedir ou limitar essas situações.**Objetivos:** Caracterizar o nível funcional e dependências na alta dos cuidados intensivos e verificar o momento de início das intervenções de enfermagem de reabilitação.**Metodologia:** Estudo descritivo/exploratório, método quantitativo, numa amostra de 30 doentes.**Resultados:** Valor médio do *Medical Research Council* de 27 (primeira avaliação) e de 38 (alta). O valor médio da Medida de Independência Funcional, nos autocuidados, mobilidade/transferências foi de 2. A primeira intervenção de enfermagem de reabilitação ocorreu, em média, ao 10^o dia, e o primeiro levante após 13 dias.**Conclusão:** No momento da alta verificaram-se elevados níveis de dependência funcional no autocuidado básico e mobilidade/transferências, sendo necessário melhorar a sua caracterização para a continuidade de cuidados de reabilitação. A mobilização dos doentes críticos deve acontecer precocemente.**Palavras-chave:** reabilitação; autocuidado; fraqueza muscular; recuperação funcional**Resumen****Marco contextual:** El ingreso en cuidados intensivos puede causar efectos adversos que conducen a situaciones de incapacidad funcional, que persisten durante mucho tiempo. La rehabilitación temprana puede prevenir o poner límite a estas situaciones.**Objetivos:** Caracterizar el nivel funcional y las dependencias en el alta de cuidados intensivos y verificar el momento de inicio de las intervenciones de enfermería de rehabilitación.**Metodología:** Estudio descriptivo/exploratorio, método cuantitativo, en una muestra de 30 pacientes.**Resultados:** Puntuación media del *Medical Research Council* de 27 (primera evaluación) y 38 (alta). El valor medio de la Medida de Independencia Funcional en autocuidado, movilidad/transferencia fue 2. La primera intervención de enfermería de rehabilitación ocurrió, de media, en el 10^o día, y la primera vez que se levanta después de 13 días.**Conclusión:** En el momento del alta se observaron niveles altos de dependencia funcional en el autocuidado básico, así como la movilidad/transferencia, por lo que fue necesario mejorar su caracterización para la continuidad de los cuidados de rehabilitación. La movilización de los pacientes en estado crítico debe tener lugar en una fase temprana.**Palabras clave:** rehabilitación; autocuidado; debilidad muscular; recuperación funcional*MSc., Professional Category, Nurse Specialist, Abel Salazar Institute for Biomedical Sciences, 4050-313, Porto, Portugal [paulo.m.azevedo@gmail.com]. ^{ID} <https://orcid.org/0000-0003-4099-3329>. Contribution to the article: study coordinator, data analysis and article writing. 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Introduction

Thanks to scientific developments in the field of health care, it is currently possible to survive illnesses or trauma that were previously synonymous with fatalities, consequently widening the range of indications and ages for admission to the intensive care unit (ICU). As a result, there has been increasing demand for this resource and the number of people who survive the acute phase of illness/injury and are discharged from the ICU and, later, from the hospital is growing. For a significant proportion of patients discharged from both the ICU and the hospital, the recovery trajectories are not linear. On average, four to six patients out of 100 discharged from the ICU will be readmitted and between three and seven, on average, will die before hospital discharge (Hosein et al., 2014).

For a large number of patients, this transition period means the beginning of a long journey, with the persistent adverse effects of illness or trauma, but also resulting from treatment thereof. Patients on mechanical ventilation (MV) face multiple care transitions that result in high costs (Unroe et al., 2010), persistent disabilities, physical and neuropsychiatric constraints and poorer quality of life (Desai, Law, & Needham, 2011), which continue in the long term (Herridge et al., 2011). After hospital discharge, these patients consume large amounts of health resources, including a high number of readmissions and deaths up to 5 years after discharge (Hill et al., 2016).

This study aims at characterizing the functionality and dependencies of critically ill patients at the time of ICU discharge, and determining the best time for initiating rehabilitation nursing interventions.

Background

The physical limitations of ICU-discharged patients largely result from the development of muscle weakness acquired during the hospital stay. Muscle weakness is the expression used to describe the muscle condition of the critical patient, which develops during ICU stay and for which there are no more causes other than severe and acute illness or treatment. Loss of muscle mass occurs rapidly during the first week,

and is more severe in patients with multiple organ failure compared with single organ failure, and there is a direct correlation between muscle mass loss, inflammation and acute lung injury (Puthuchearry et al., 2013), very common clinical events in critically ill patients. Recovery can take from some weeks to several months and persists even up to 2 years after ICU discharge (Hermans & Van den Berghe, 2015). Simultaneously, the development of muscle weakness during MV (even if only for 48 hours) was independently associated with increased mortality and a significant decrease in physical capacity 6 months after ICU discharge (Wieske et al., 2015).

Seeking to mitigate some of the harmful physical effects and the development of muscle weakness, rehabilitation has been referred to as a therapeutic tool, with early start of progressive mobilization regarded as added value in the process of patient recovery (Hermans & Van den Berghe, 2015).

Physical impairment during ICU stays triggered situations in which the capacity to perform activities of daily living (ADL) was severely hindered, in particular self-care activities, resulting in high degree of dependence, mainly due to the inability to perform basic tasks, such as eating, grooming, toileting, turning around, transfers, dressing oneself and walking.

As a highly important concept for nursing, self-care is a significant focal point of clinical practice, since the ability or inability to carry it out has a large impact on the health and well-being of human beings.

As a member of the health team, the nurse specializing in rehabilitation nursing plays a key role in assessing the functionality, limitations and disabilities of the individual and setting up an action plan to promote self-care during the transition between health and disease. To this end, knowledge of the self-care deficit rate and the capacity to perform self-care activities, in the specific contexts of professional intervention, is essential for implementing pro-rehabilitation strategies, functional readjustment and progress towards the highest possible degree of independence.

Research questions

What is the functional level of critical patients after being discharged from the ICU?

What dependencies do critically ill patients present at discharge from the ICU?
When do rehabilitation nursing interventions begin?

Methodology

We conducted a descriptive/exploratory study involving five intensive care units in the three hospitals in northern Portugal. Using a non-probabilistic sample, the study included, consecutively, patients over the age of 18 years, who stayed in the hospital for 5 or more days, on MV, were able to understand written and spoken Portuguese, could receive rehabilitation nursing care, with capacity to carry out simple orders and had no indication against getting out of bed.

In addition to the sample characterization data, clinical outcome data were collected, to understand the impact of prolonged sedation and MV on the functional state and the degree of muscle strength using the Medical Research Council score (De Jonghe et al., 2002) once patients awoke from sedation and were able to cooperate in the test (MRC 1). The assessment of muscle strength by the same method was repeated at ICU discharge (MRC 2). In order to guarantee consistency between the different test users, the conditions in which the test was conducted and the interpretation of results were assessed beforehand.

Data on the variables of the rehabilitation care were gathered, namely the instant of the first rehabilitation nursing intervention and the first time the patient was taken out of bed.

Concerning the functional capabilities at the time of discharge from the ICU, the functional independence measure is used (FIM) for assessing in greater detail the self-care subscale (eating, grooming and bathing) and the mobility/transfers subscale (bed, chair). Although the FIM is

a widely used tool for assaying functionality in the context of rehabilitation, it was not developed specifically for the intensive care patient population, so some items cannot be assessed in this environment (e.g., stairs). In order to reduce errors of interpretation, the measurement and scoring criteria for each item were previously assessed with all users. The self-care and mobility/transfer subscales were analyzed in more detail, since their evaluation in the intensive care context is feasible, albeit specific.

The stakeholder institutions, in particular the Boards of Directors and Ethics Committees, granted their permission for carrying out the study, and patients or their legal representatives gave their informed consent.

Results

The services where the study was carried out have nurses specialized in rehabilitation nursing. However, protocols with start and progression criteria are not implemented. Motor function rehabilitation care is provided, beginning with passive mobilization, progressing towards resistance exercises, until the patient is taken out of bed. Walking exercises are only performed on extubated patients. Simultaneously, pulmonary rehabilitation care is provided, with emphasis on respiratory rehabilitation, for weaning from mechanical ventilation.

Thirty-three patients were included in the study. However, since three patients died, the end sample consisted of 30 patients (Table 1). In this group of patients, the average age was 58.5 years and the most frequent age (mode) was 63 years. As for clinical severity, the mean value of the Simplified Acute Physiology Score (SAPS II) was 42 points (probability of mortality of 28.5%), the most frequent value (mode) being 32 points (probability of mortality of 12.8%).

Table 1
Patient characteristics

Variable	(n = 30)
Male gender	56%
Female gender	44%
Age [mean, in years (from eldest to youngest)]	58.5 (82 - 25)
ARDS	1
Distributive shock	1
Hypovolemic shock	1
Septic shock	3
Epilepsy	2
Subdural hematoma	2
Brain hemorrhage	4
Respiratory failure	4
Lithium toxicity	1
Myasthenia gravis	2
Acute pancreatitis	1
Nasal tumor excision	1
Post Cardio-respiratory arrest	2
Sepsis	2
TBI	1
Guillian Barré	1
Ischemic stroke	1
SAPS II [mean value (highest value - lowest value)]	42 (79 - 13)

Note. ARDS = acute respiratory distress syndrome; SAPS II = simplified acute physiology score; TBI = Traumatic brain injury.

The length of stay in the ICU was on average 20 days (amounting to 614 days of hospitalization) and the mean length of hospital stay was 43 days (amounting to 1298 days of hospitalization). On average, these patients were sedated for nine days and MV for 15 days (Table 2).

The evaluation of the functional capacities of the study patients (26 due to data loss) hinted at high assistance needs. The MRC 1 value

was low, on average 27 points, the highest value being 48 points. The MRC 2 increased slightly, with an average value of 38 points, the highest value being 60 points (maximum test score).

The mean value of the FIM was 50 points, reflecting high levels of functional disability, with the highest value at 92 points (the maximum achievable FIM being 126 points, reflecting total independence in all areas).

Table 2
Clinical results

Variable	
ICU length of stay (<i>M</i> , no. days, <i>n</i> = 30)	20 (6 - 51)
Hospital length of stay (<i>M</i> , no. days, <i>n</i> = 30)	43 (8 - 129)
Duration of sedation (<i>M</i> , no. days, <i>n</i> = 30)	9 (0 - 32)
Duration of MV (<i>M</i> , no. days, <i>n</i> = 30)	15 (0 - 45)
Muscle strength MRC 1 (<i>M</i> , <i>n</i> = 28)	27 (0 - 48)
Muscle strength MRC 2 (<i>M</i> , <i>n</i> = 21)	38 (8 - 60)
FIM (<i>M</i> , <i>n</i> = 26)	50 (18 - 92)

Note. *M* = mean; ICU = intensive care unit; MV = mechanical ventilation; MRC 1 = Medical Research Council, first assessment; MRC 2 = Medical Research Council, at discharge; FIM = functional independence measure.

Concerning self-care and mobility/transfers, this study confirmed that at discharge from the ICU these patients were highly dependent in terms of basic self-care and mobility (Table 3).

Note that the mean value was two points and the mode was one, that is, most patients were totally dependent.

Table 3
Self-care and mobility/transfers

Variable	FIM average score (<i>n</i> = 28)
Eating	2
Grooming	2
Bathing	2
Bed, chair, wheelchair	2

Note. FIM = functional independence measure.

Concerning rehabilitation nursing (Table 4), it was found that, on average, the first intervention occurred within 10 days of admis-

sion, while the patient was taken out of bed, on average, within 13 days of admission.

Table 4
Variables of rehabilitation interventions

Variable	
No. days until 1st rehabilitation intervention (<i>M</i> , no. days, <i>n</i> = 30)	10 (1 - 29)
No. days until patient is taken out of bed 1st time (<i>M</i> , no. days, <i>n</i> = 27)	13 (1 - 31)

Note. *M* = Mean.

The results also suggest that these patients, although not presenting high severity levels, had a lengthy ICU and hospital stay. All patients showed muscle weakness when they woke up from sedation and managed to collaborate in the test, and although they began receiving rehabilitation nursing care at ICU discharge, they

showed a high degree of care dependence for self-care and mobility/transfers, requiring maximum assistance for carrying out these activities. Rehabilitation care was delivered later than is currently recommended, and the time when patients are taken out of bed for the first time was indicative of prolonged bed rest.

Discussion

Patients on mechanical ventilation, with prolonged mean length of ICU stay, were studied in different intensive care units. The negative correlation between hospital stays longer than 72 hours and increased mortality, complications, decreased quality of life (Steenbergen et al., 2015) and high resource utilization by ICU survivors with discharge is known (Hill et al., 2016). These were also patients who had, on average, long hospital stays (43 days on average), representing a subgroup where high health and, in particular, rehabilitation care requirements would be expected, during hospitalization and after hospital discharge. Most patients also required long-term (MV), the study showing, similarly to other studies (Chlan, Tracy, Guttormson, & Savik, 2015), correlation between the use of MV and sharp decline in peripheral muscle strength. This study assessed muscle strength using the MRC score, which ranges from 0 (complete paralysis) to 60 (normal muscle strength), considering according to De Jonghe et al. (2002) that a *score* ≤ 48 points indicates muscle weakness acquired in the ICU. The average value obtained in the first evaluation (MRC 1) was 27 points, the maximum score obtained by patients equal to 48 points or less, suggesting the presence of muscle weakness in all cases. In the second moment (MRC 2), the mean value was 38 points, and only two cases achieved a score above 48 points (58 and 60 points). However, due to the loss of data in the first evaluation ($n = 28$) and in the second evaluation ($n = 21$), it was not possible to compare the progress in muscular strength in all patients during the hospital stay. This comparison was possible in 21 patients, in which subtle improvement was verified in all cases. However, there were positive developments in only two cases. The development of this condition is independently correlated with increased mortality and clinically significant decrease in functionality 6 months after discharge from the ICU (Wieske et al., 2015). The reported rate varies according to the patient population studied and the moment of their evaluation. A recent systematic review (Appleton, Kinsella, & Quasim, 2015) reported a 40% rate among heterogeneous populations of patients admitted to the

ICU. In this study, it is further mentioned that the rate also varies according to the diagnostic technique; it is lower when clinically evaluated in comparison with electrophysiological techniques. In patients with acute lung injury, the reported rate at hospital discharge was 36% (Fan et al., 2014).

In this study involving patients from different units and representing a population with diverse characteristics, 19 (90%) out of the 21 patients received ICU discharge with a diagnosis of acquired muscle weakness. This is clearly an area requiring further research, as corroborated by a recent review (Mehrholz et al., 2015) that highlights the need for methodologically sound studies for assessing the positive impact of physical rehabilitation on improving the performance in ADL of patients who develop this condition.

It is believed that a high rate of muscle weakness affected the course of functional recovery, given the relatively low value obtained in the FIM at ICU discharge (50 points). An in depth analysis highlighted further that the most frequent value (mode) was 18 points, that is, the minimum value obtainable on the scale, and that was seen in five patients (19% of the sample), meaning that patients required full assistance in all areas evaluated.

Critical patients' capabilities in the areas of basic self-care, mobility and transfer, which are crucial to performing ADL, were also characterized. The results indicate a high level of dependence at discharge from the ICU, the average value obtained corresponding to the need for maximum help for the performance of these activities. However, the most frequently obtained value was one, hinting at the need for total support, which means that these patients' capacity to perform these activities was less than 25%.

These data indicate that the high degree of muscle weakness is a constraint on the ability to carry out basic self-care, mobility and transfer activities, restricting autonomy severely and causing high degree of dependence.

It is known that patients who survived an episode of severe illness with admission to intensive care are highly dependent. This study characterizes this dependence, not only operational dependence, but more specifically at the level of the capacity to perform basic self-care activities,

focusing primarily on rehabilitation nursing. The disabilities found, arising from the development of muscle weakness, prompted the need to adapt the effort required in rehabilitation interventions to the patient's real capabilities and the introduction of energy saving strategies that allow the patient to participate more in the proposed interventions in a technologically complex environment, as is the case of intensive care units.

This study also showed that, despite the rehabilitation nursing interventions, the disabilities and dependence in the area of self-care remained high at discharge, meaning that patients were transferred with high levels of dependency. Thus, when transferred to services where nurse/patient ratio is lower, the patient may be expected to participate more in the rehabilitation process, with objectives being set at inadequate levels compared to their real capacity. Therefore, the characterization of both the functionality and the capacity to carry out activities inherent to basic self-care and their conditioning factors, such as muscle weakness and effort tolerance, are fundamental to guarantee the best continuity of the rehabilitation process.

The time until the start of rehabilitation nursing interventions and when the patient is taken out of bed for the first time hint at the late onset of rehabilitation care and prolonged immobilization of the patient in bed, which alone are considered factors that contribute to the worsening of recovery conditions. Long periods of immobility and bed rest are an important risk factor of loss of muscle mass and weakness. In patients admitted to intensive care, loss of muscle mass occurs rapidly in the first week in the hospital, with up to about 12.5% of loss of skeletal muscle (Puthucherry et al., 2013). Simultaneously, the length of time during which patients are bedbound has been associated with long-term muscle weakness (Fan et al., 2014), which is why this is an important, potentially reversible, risk factor.

Early mobilization has been referred to as an effective intervention strategy for mitigating this problem, backed by recommendations for its implementation in the ICU (Hodgson et al., 2014). However, despite the recommendations, in practice early mobilization of critically ill patients is uncommon, especially

for patients on MV (Hodgson et al., 2015). In a recent randomized study, Winkelman et al. (2018) implemented a mobility protocol for critical patients led by nurses, involving 54 patients admitted to four ICUs in two academic centers, concluding that early mobilization had beneficial effects, but that dose is also an important factor. In this study, patients mobilized twice daily stayed for a shorter time in the ICU and patients subject to moderately intense mobilization with activities out of bed had stronger muscles.

Thus, early mobilization, intensity and frequency should be introduced in rehabilitation nursing and measured in order to assess its impact on the results obtained.

This study presents some relevant points, but also some limitations. It involves a patient sample from different intensive care units, where there are rehabilitation nurses, featuring aspects of nursing care in this area that are common to the participating units and have shown to be essential in formal referral. However, it is a convenient, non-probabilistic sample with a limited number of participants. Therefore, a more precise characterization of results and needs requires a stronger sample, wherefore applying the results to populations with similar characteristics should be done sparingly. On the other hand, in some cases there was loss of data, namely at ICU discharge, which did not make it possible to check with all the patients whether there had been improvements in functional recovery. However, these results do not differ much from those found in the literature (Appleton et al., 2015), although the assessment of results at discharge or immediately after discharge from the ICU are lacking. They highlight further the characterization of the capacity to carry out basic self-care, mobility and transfer activities, an area of great importance in the context of rehabilitation nursing aimed at recovering motor functions and independence.

Conclusion

Since studies that assess functionality at ICU discharge are scarce, these results indicate that there are patients who are transferred with very weak muscle strength and high level of func-

tional dependence, which strongly affects the capacity to perform basic self-care, mobility and transfer activities and, consequently, ADL. It is important to characterize the capacities to carry out the activities inherent to basic self-care, both during the ICU stay and at discharge from these services, for the planning and continuity of rehabilitation nursing care, involving substantive changes in the way these patients are referred between different levels of care and the setting of short, medium and long-term goals. The cases included in this sample make up a subgroup of patients whose characteristics are predictive of the development of functional morbidities, so early identification of potential risks and rehabilitation nursing requirements is necessary. There is evidence of the need for the development of more sensitive self-care assessment tools for ICU patients, since the existing tools, such as FIM which is widely used, do not cover the full range of activities required for the performance of self-care, in particular in rehabilitation nursing. In addition to prolonged immobility, rehabilitation nursing interventions, such as early mobilization and taking patients out of bed, occurred late in comparison to current recommendations. The mobilization of bedbound patients is a critical nursing activity that requires knowledge and skills in order to be performed efficiently and safely on critically ill patients with hemodynamic and/or respiratory instability. Therefore, it is necessary to look into the reasons for the late onset of such interventions, especially in services that have rehabilitation nurses working on a permanent basis. The introduction of protocols for the rehabilitation of the critically ill patient with emphasis on early mobilization can help optimize the start time and response to intervention.

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