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Functional recovery after critical illness

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Citation for published version (APA):

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Download date: 26 Sep 2019
CHAPTER 1

GENERAL INTRODUCTION AND OUTLINE OF THE THESIS
Intensive care is the advanced and highly specialized care provided to medical or surgical patients whose conditions are life-threatening and require comprehensive and invasive treatment and constant monitoring. It is usually administered in specially equipped units of a health care facility; i.e. the intensive care unit (ICU) that goes back to the acute polio epidemics in the early nineteen fifties. The traditional goal of intensive care has been to decrease short-term mortality, but the quality of survival has increasingly been regarded as another important outcome of interest. There is growing evidence that critical care treatments have important effects not only on short-term physiology and survival, but also on long-term quality of survival. Moreover, it has been recognized that quality of Life (QoL) is often reduced for a prolonged period of time in survivors of the ICU. The expertise of rehabilitation medicine could be beneficial to improve the quality of outcome in ICU patients. In order to target rehabilitation and to develop multidisciplinary therapy programs, knowledge on the course of functional recovery and on ICU sequelae complicating recovery after ICU, is an essential prerequisite.

**Intensive care**

Patients admitted to the ICU have a wide range of clinical conditions, however, multi-organ failure is often present particularly of the respiratory and cardiovascular system, often necessitating mechanical and pharmacological support including mechanical ventilation, renal replacement therapy, or vasoactive drugs, and require intensive monitoring. The length of patient stay varies widely. Most patients are discharged within 1-2 days, commonly after postoperative respiratory and cardiovascular support and monitoring. Some patients, however, may require support for several weeks or months. In the Netherlands, the ICU mortality in 2008 was 10.1%, and overall hospital mortality of patients admitted to the ICU was 16.2%. As a consequence of the developments in intensive care medicine, there has been an improvement in survival of ICU patients over time. However, as death is prevented or delayed, new physical and psychological complications and disorders arise. Critical illness polyneuropathy (CIP), critical illness myopathy (CIM) or a combination of CIP and CIM (CINM) are the most common manifestation of these neuromuscular abnormalities that can develop during critical illness. CIP is an acute and primary axonal motor and
sensory polyneuropathy. It occurs in critically ill patients, leading to severe limb weakness and difficulty in weaning from a ventilator. The term CIP was first used in 1986. Later on it became clear that in some patients the disease primarily affected the muscles and the term myopathy in critical illness or critical illness myopathy (CIM) was introduced. Clinical signs of CIP and CIM are basically the same and include flaccid tetraparesis. Although head, facial, tongue and jaw movement are relatively spared, facial muscles can be involved and ophthalmoplegia may occur. Involvement of the phrenic nerves and diaphragm may cause ventilator weaning problems.

Due to the difficulty in differentiating between CIP and CIM, and the frequent association of both, the disorders are frequently considered together as critical illness polyneuromyopathy (CINM) or critical illness polyneuropathy and myopathy (CIP/CIM). Although CIP/CIM has been recognized as a cause of prolonged rehabilitation in ICU survivors, little attention has been paid to the clinical consequences and the course of functional recovery. In addition, questions remain on the long-term prognosis with respect to functional status of patients with CIP/CIM.

**Outcome after ICU**

In the past, research concerning the outcomes of critical illness has often focused on physiological endpoints (such as oxygenation and ventilation) and clinical endpoints (such as extubation rates, ICU survival, and hospital survival). Such outcomes are important for evaluating quality of critical care because of the high short term mortality and life-threatening physiologic abnormalities in these patients. Nevertheless, recent follow-up studies have shown that patients do experience long-term problems with physical, psychological, and social functioning and reduced QoL after ICU treatment.

By 2002, methodological research on QoL measurement in ICU patients had increased such that a consensus conference recommended the questionnaires Medical Outcomes Study 36 Item Short Form (SF-36) and EuroQol-5D as the most appropriate instruments for future research. Consequently, a growing number of studies have reported on the QoL of ICU survivors using these instruments. Nevertheless, to date, comprehensive information is scarcely available on the impact of ICU stay on functioning in daily life and the factors that predict and modify diminished functioning in ICU patients.
The International Classification of Functioning, Disability and Health (ICF)

To characterize diminished functioning or disability at both individual and population levels, the World Health Organization’s (WHO) has developed a conceptual framework; the International Classification of Functioning, Disability and Health (ICF). Whereas the International Classification of Disease (ICD) classifies diseases as causes of death, the ICF classifies health by accounting for functioning.\textsuperscript{22,23}

As shown in Figure 1.1, the ICF consists of three key components: body functions and structures, activities, and participation. These components are seen in relation to a health condition (e.g. disorder or disease) as well as to contextual factors (i.e. environmental factors and personal factors).

Abnormalities in body functions and structures are referred to as impairments, defined as a significant deviation or loss of functions (e.g. muscle weakness) and/or anatomical structures (e.g. malformation). Difficulties in performing activities, which reflect a person’s individual functioning, are referred to as activity limitations (e.g. limitations in walking). Finally, participation restrictions refer to the problems a person may experience in societal functioning, i.e. in involvements in daily-life situations (e.g. restrictions in community ambulation). These three components are summarized under the umbrella terms functioning and disability. They are related to and may interact with the health condition (e.g., disorder or disease) and personal and environmental factors. The ICF classifies the consequences of health conditions as follows: A disorder or disease can lead to impairments in body structures and functions, which can result in activity limitations and participation restrictions. Environmental and personal factors may influence these consequences.

The concept of functioning within the ICF framework is different from the concept of QoL. Whereas QoL refers to global or highly personalized evaluations of functioning referring to satisfaction or feelings\textsuperscript{22,23}, the ICF assesses functional capacity, such as physical endurance and muscle strength, and the impact of health on the performance of activities and disability.

Given the numerous impairments and widespread functional restrictions that may persist in ICU survivors, the ICF framework enables a comprehensive description and better understanding of disability in survivors of intensive care.
Follow-up care

Follow-up care has been recommended to improve outcome in ICU survivors.\textsuperscript{2,24} With the recognition of problems in daily functioning within the different health domains, it is remarkable that survivors of a critical illness are not routinely referred to rehabilitation services. Rehabilitation is the health strategy that aims to enable people with limitations of functioning and disability associated with health conditions to achieve and maintain optimal functioning in the interaction with the environment. The term “rehabilitation” refers to a multidisciplinary strategy that may be applied by professional disciplines within the health sector. Furthermore, rehabilitation is patient-oriented, by which the care that is provided is guided by patient relevant problems. These problems usually concern limitations in daily-life activities and restrictions in participation in society.\textsuperscript{23} A rehabilitation treatment plan may include treatment by one or more of the following disciplines; physiotherapy, occupational therapy, speech therapy, and counselling by a social worker or psychologist, which is coordinated by a rehabilitation physician.

To date, there is no evidence with respect to the optimal structure, timing, and content of follow-up care for ICU patients\textsuperscript{25,26} and in the Netherlands structured follow-up care is rarely available. Early interdisciplinary follow-up treatment for these patients, may be able to reduce, or even prevent, long-
term restrictions in physical and psychological functioning. In this respect, the relative contribution of restrictions in physical and psychosocial functioning on daily functioning may have considerable therapeutic consequences. This, in turn, requires a thorough understanding of the course of recovery, predictors for functional outcome and the identification of rehabilitation needs. Therefore, the impairments that hinder the ability to perform activities first need to be identified. Once these have been identified, an intervention, likely a multidisciplinary rehabilitation intervention, needs to be investigated to determine if disability in ICU survivors can be reduced.

**Aims and outline of the thesis**

The aims of this thesis are, to describe, in concordance with the ICF, the course of impairments in body functions, limitations in activities, and restrictions in participation, and to identify determinants for functional outcome in ICU survivors during the first year after discharge from the ICU. This thesis focuses on patients whose functional recovery is expected to be prolonged and hence most likely to benefit from interventions to improve outcome. Therefore, patients admitted to the ICU for a short period of time for treatment or observation as part of a routine preventive measure were excluded. Consequently, in the studies in this thesis, patients with CIP, or with an ICU stay of more than 48 hours were included.

**Chapter 2** reviews the literature on functional outcomes of patients with CIP. In the appendix of chapter 2, an update of the literature on functional outcome in patients with CIP/CIM is added (May 2009).

In **chapter 3** the course of functional recovery in terms of the ICF (i.e. body functions and structures, activities, participation) and QoL is evaluated in a case series of 8 patients with CIP. It was our impression that significant weakness following critical illness was more common than previously thought. We therefore preformed a preliminary prospective study to evaluate the incidence and nature of impairments in functions (muscle strength and sensory function), limitations in activities and restrictions in participation (hand dexterity, activities of daily living, mobility, walking capacity, participation in society), and QoL, 6 and 12 months after the diagnosis CIP.

In **chapter 4** the functional status of patients within the first week of discharge from an ICU is described and it’s potential determinants are investigated. In this observational study basic activities of daily living, walking capacity, muscle strength, sensory and cognitive functions were assessed in 69 patients who stayed in the ICU for longer than 48 hours. Furthermore, the predictive value of functioning prior to ICU admission, age, severity of illness, and
duration of mechanical ventilation for functional status within the first week after discharge from the ICU was examined.

**Chapter 5** describes restrictions in daily functioning in patients one year after discharge from the ICU. In addition, the results of the investigation of potential prognostic factors for functional status after one year and their predictive value, are discussed. In a consecutive series of 255 ICU survivors who were admitted to the intensive care unit for more than 48 hours, functional status, QoL, anxiety and depression, and post traumatic stress disorder were evaluated one year after discharge from the ICU.

**Chapter 6** investigates the time course of functional status, and inventories impairments in body functions, limitations in activities, and restrictions in participation of 116 patients during the first year after discharge from the ICU who were ventilated in the ICU for more than 48 hours. Functional status was assessed 3, 6, and 12 months after discharge from the ICU using the Sickness Impact Profile. Impairments in body functions, limitations in activities, and restrictions in participation were evaluated after 3 and 12 months.

**Chapter 7** investigates whether functional status after one year can be predicted from physical, and mental functioning before admission to the ICU, immediately after ICU discharge, or at 3 months after ICU discharge.

**Chapter 8** discusses the results, and reflects on the clinical implications of the studies. Furthermore, the possibilities and limitations for the development of rehabilitation care for ICU survivors are discussed and recommendations for future research are made.

**References**


CHAPTER 1


General introduction


