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Electrophysiological abnormalities can differentiate pre-hospital discharge functional status in critically ill patients with normal strength

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ICU-acquired weakness (ICUAW) defines a heterogeneous group of critically ill patients with hospital acquired impairment in physical function. ICUAW is defined as a Medical Research Council (MRC) score < 48, or an average muscle strength of less than four out of five in six specified bilateral muscle groups. By definition, critical care patients with MRC scores of ≥ 48 are considered to not have ICUAW. However, many of these patients may have generalized impairment in muscle strength and function. In critical care patients that do not develop formal criteria for ICUAW, abnormalities on electrophysiological testing may help identify physical impairments and determine the etiology of this weakness. We hypothesized that a subset of critically ill patients without ICUAW have abnormal nerve conduction study (NCS) amplitudes that are associated with reduced physical function.

Our institutional review board approved the study. Using data from a prior prospective ICU study of neuromuscular function [1], patients with the following characteristics were included: a diagnosis of sepsis and/or acute respiratory failure, and no ICUAW defined as an MRC score < 48 (highest score is 60). Each week until ICU discharge, a neurologist performed NCS of six nerves of the upper and lower extremities. Each week until hospital discharge, a physical therapist (blinded to the results of NCS) administered the Functional Independence Measurement (FIM) scale that categorizes physical impairment and need for assistance to perform activities of daily living (ADLs) [2]. The physical therapist obtained 3 components of the FIM scale, specifically bed mobility, transfers and gait. Each component is scaled from 0 to 7, with higher scores indicating less assistance needed to perform the task. We determined differences in the last recorded FIM scores prior to hospital discharge between critically ill patients with and without two individual NCS amplitudes below the outpatient lower limit of normal. We selected abnormalities in NCS amplitudes for two

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nerves as a criterion because abnormalities in one nerve could be the result of an undiagnosed pre-existing focal unilateral neuropathy.

The study cohort comprised 22 patients (median age 52 years, 68% male, median MRC score 59/60, median admission APACHE II score 18.5), of whom 13 had at least two individual NCS amplitudes below the outpatient lower limit of normal (supplementary table 1). On the last testing before hospital discharge, patients with abnormal NCS amplitudes had lower FIM scores on the physical function tests of bed mobility ($p=0.04$), transfers ($p=0.02$), and gait ($p=0.01$) compared to patients without electrophysiological abnormalities (Table 1). Seventeen patients had peroneal nerve testing, which has been examined as a screen for critical illness polyneuromyopathy in patients with ICUAW [1, 3]. Patients with at least one peroneal nerve amplitude below the outpatient lower limit of normal had lower FIM scores on all physical function tests, although the results did not reach statistical significance (supplementary table 2).

This study is the first to demonstrate that a subset of critically ill patients without ICUAW have abnormal NCS amplitudes and associated functional limitations. Based on median FIM scores, patients with abnormal NCS amplitudes would still require in-person assistance to perform ADLs after hospital discharge, whereas patients without electrophysiological abnormalities would be completely independent. Functional status is an important outcome, since critical care survivors with lower FIM scores on bed mobility, transfers and gait at hospital discharge have increased 90-day post-hospital discharge all-cause mortality [4]. Functional limitations are also a possible explanation for the recent results of Hermans et al. showing that abnormal electrophysiology is associated with increased 1-year mortality, even in patients with normal strength [5]. The arbitrary selection of an MRC score <48 as defining ICUAW likely misses an important group of patients with normal-range strength but abnormal electrophysiology and functional limitations. Increasing the use of electrophysiological testing may assist with the diagnosis of neuromuscular disorders and improve ability to render a prognosis for critically ill patients without ICUAW.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Moss M, Yang M, Macht M, et al. Screening for critical illness polyneuromyopathy with single nerve conduction studies. *Intensive Care Med.* 2014; 40:683–690. [PubMed: 24623137]
2. Dodds TA, Martin DP, Stolov WC, Deyo RA. A validation of the functional independence measurement and its performance among rehabilitation inpatients. *Arch Phys Med Rehabil.* 1993; 74:531–536. [PubMed: 8489365]
3. Latronico N, Nattino G, Guarneri B, et al. Validation of the peroneal nerve test to diagnose critical illness polyneuropathy and myopathy in the intensive care unit: the multicentre Italian CRIMYNE-2 diagnostic accuracy study. *F1000Research.* 2014; 3:127. [PubMed: 25309729]

4. Rydingsward JE, Horkan CM, Mogensen KM, et al. Functional status in ICU survivors and out of hospital outcomes: a cohort study. *Crit Care Med*. 2016; 44:869–879. [PubMed: 26929191]
5. Hermans G, Van Mechelen H, Bruyninckx F, et al. Predictive value for weakness and 1-year mortality of screening electrophysiology tests in the ICU. *Intensive Care Med*. 2015; 41:2138–2148. [PubMed: 26266842]

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Table 1

Functional Independence Measurement scores in critically ill patients with normal strength

Outcome	2 individual NCS amplitudes below outpatient lower limit of normal (n=13)	Patients with MRC 48 and normal electrophysiology (n=9)	p
FIM bed mobility, median (IQR)	5 (3.5–7)	7 (5.5–7)	0.04
FIM transfers, median (IQR)	4.5 (2–6.25)	7 (5.5–7)	0.02
FIM gait, median (IQR)	4.5 (1.5–5.25)	7 (5.5–7)	0.01

FIM Functional Independence Measurement, *IQR* interquartile range (25th–75th percentiles), *MRC* Medical Research Council, *NCS* nerve conduction study