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LETTER

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Bedside voluntary and evoked forces evaluation in intensive care unit patients, not only force evaluation: a letter to the Editor

Paulo Eugênio Silva^{1*} , João Luiz Quaglioti Durigan² and Nicolas Babault³

Dear Editor,

We read with great interest the article by Kennouche et al. [1] related to the evaluation of force in intensive care units (ICU). As indicated in their paper, numerous ICU patients develop a specific disease affecting their future quality of life; the so-called intensive care unit-acquired weakness (ICUAW). Early diagnosis associated with early treatment could limit these long-term effects but is challenging. Indeed, while some tools can be used in awake and cooperative individuals, an ICUAW diagnosis in sedated patients is technically difficult. For this reason, in this very well-conducted narrative review, the authors presented protocols that could be used to measure evoked force using electrical or magnetic stimulation in sedated individuals. In addition, tools and reliability data are presented.

Because ICUAW is often related to a reduction in force and muscle atrophy, the authors focused on the assessments of force. Nevertheless, beyond the scope of this review, electrical stimulation also allows the measurement of some neuromuscular electrophysiological disorders and should not be considered only for force evaluation. For example, an evaluation based on stimulus

electrodiagnosis (i.e., motor excitability thresholds, for instance, with chronaxie data or H-reflex-Mwave recruitment curves) could be achieved with standard neuromuscular electrical stimulation [2]. Therefore, we believe this procedure should be used in complement with force evaluation. This is safe and feasible in the ICU and enables the detection of neuromuscular electrophysiological disorders [3].

As previously shown, force significantly decreases during the first days in the ICU. Early treatment with electrical stimulation is efficient to counteract these negative effects as it permits maintenance of force and avoids neuromuscular disorders [4]. However, early rehabilitation in the ICU is often complex for several technical reasons. As chronaxie rapidly increases over days in the ICU, we believe that electrodiagnosis could help prescribe optimized electrical stimulation treatments [4]. However, additional experiments should be conducted to determine the reliability of the different evaluation tools and protocols [1] and determine the best electrical stimulation rehabilitation procedure, characteristics, or modality (e.g., using belts or functional electrical stimulation) [5]. As indicated in this narrative review [1], electrical stimulation is an interesting tool for force evaluation in the ICU. However, electrical stimulation in the ICU should be considered in a more holistic manner as it represents a promising technique for improving patient health both during and after ICU stays.

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ICUAW: Let's focus on force evaluation

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We thank Silva and colleagues for their great emphasis and interest on our recent paper aiming at reviewing the different tools and methods allowing bedside force evaluation in ICU patients [1].

Although we appreciate the suggestion to add electrophysiological measurements in ICU patients, we believe this topic was beyond the scope of our review focusing on the impairment of muscle force during and after an ICU stay. We agree with Silva et al. that it can be an asset, as mentioned in the 'Perspectives' section: "*Evoked force measurements should also be combined with surface electromyography and ultrasound analyses [...] to get a clear picture of the deleterious consequences of an ICU stay on the neuromuscular system...*". Yet it should be kept in mind that (i) the use of chronaxie for ICUAW diagnosis has never been clinically validated; (ii) H-reflexes are usually absent in patients with critical illness polyneuropathy [6]; (iii) altered muscle membrane excitability [7] may prevent M-wave recordings (Kennouche et al., unpublished observations).

We also clearly highlighted the relevance of bedside evoked force measurements for ICUAW treatment. So far, the application of neuromuscular electrical stimulation (NMES), a potential strategy for limiting muscle weakness and/or atrophy in ICU patients, is empirical and relies on a subjective quantification of muscle contraction intensity (*i.e.*, inspection of visible/palpable contractions) [8] as done for the chronaxie assessment. Bedside ergometers would therefore offer the unique opportunity to accurately quantify isometric contractile responses to NMES in ICU patients and could be used to provide evidence-based recommendations in future critical care NMES interventions.

Considering the difficulty in evoking contractile responses in all stimulated muscles and all patients [8], the possibility to produce coordinated movements by

functional electrical stimulation (FES)-assisted cycling appears hypothetical in sedated patients. The effects of FES application on muscle strength of mechanically ventilated patients are also still equivocal [9].

As for NMES application, mechanical force/power output produced during FES cycling (e.g., using instrumented pedals) should be monitored to determine the effectiveness of FES on muscle force and mass of ICU patients. To conclude, bedside force measurements should remain at the heart of both diagnosis and treatment of ICUAW.

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PES and NB developed the letter concept and wrote the manuscript. JLQD revised the manuscript. All authors read and approved the final manuscript.

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