training, family presence, involvement and engagement, provision of consultative resources and environmental and organisational processes are all elements to consider when building an optimal programme of family-centred care in the ICU.[17]

Portia Jordan
School of Clinical Care Sciences, Nelson Mandela University, Port Elizabeth, South Africa
portia.jordan@mandela.ac.za

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There's more to weaning than just the lungs!

Although life-sustaining, mechanical ventilation is associated with complications that can impact on mortality and morbidity. Therefore, weaning is initiated early during the course of mechanical ventilation, with the aim of liberation as soon as possible. In some cases, patients can be weaned quickly from mechanical ventilation, while others may take significantly longer, regardless of whether there are protocols or not.[1]

Extubation failure is associated with longer periods of mechanical ventilation, longer hospital stays and increased mortality.[1] There are numerous measures and indices that have been developed to determine weaning and extubation suitability; however, the accuracy of these indices is yet to be convincingly and consistently shown.[2] Of note, muscle strength and endurance have not been assessed as factors in any of the identified studies for weaning/extubation success, but both impact on weaning. One of the reasons for the lack of accuracy of weaning indices may be that the majority of these indices are derived from ventilatory parameters. Cardiovascular dysfunction prior to or during weaning is being increasingly recognised as a contributor to weaning failure.[3] Consciousness and psychological factors such as delirium, depression and anxiety have also been shown to affect weaning outcome.[4] Nutrition and the underlying physiological status of the patient are also factors to consider.[2] Furthermore, muscle weakness of both respiratory and peripheral muscles has also been associated with weaning failure.[5-9] Many of the aforementioned factors may be ameliorated through rehabilitative interventions during the course of mechanical ventilation.[10]

In this issue of *SAJCC*, de Beer *et al.*[11] aimed to determine, in a pilot study, whether measures of upper-limb and neck-muscle strength, as well as muscle endurance, are associated with spontaneous breathing trial (SBT) and/or extubation failure. The assessment of these potential contributors could provide a more holistic assessment of readiness to wean/extubate. Furthermore, assessment of these factors could help to develop patient-tailored rehabilitation interventions to assist with earlier liberation from mechanical ventilation. Upper-limb and neck muscles (upper trapezius, neck flexors and middle deltoid) were assessed using the Oxford scale, owing to their common innervation pathways with the respiratory muscles. The authors found that deltoid and neck flexor strength was associated with extubation failure, but not SBT failure. Additionally, a longer active cycling distance and time were associated with successful SBT or extubation.

While the concepts examined certainly warrant investigation, and a more holistic assessment of weaning readiness is needed, the results do, however, require caution and further validation. Admittedly, this is a pilot study with a relatively small population, with only two participants failing extubation (and likely owing to medical reasons). Additionally, the groups differed in age, length of stay in the intensive care unit (ICU) and duration of mechanical ventilation, all of which may impact negatively on weaning/extubation outcome. It is essential that other factors impacting on weaning/extubation outcomes, such as comorbidities and disease severity, are accounted for in the analysis, to fully understand the value of assessing upper-limb and neck-muscle strength and endurance to determine extubation readiness.

One has to question whether muscle endurance was adequately assessed in this study.[11] Muscle endurance, by definition, is the ability of a muscle to sustain a submaximal load for a period of time, according to the American College of Sports Medicine guidelines.[12] The submaximal load should be individualised to the patient in a standardised manner (e.g. a percentage of their one-repetition maximum). In the present study, the same load was applied to all participants, regardless of their underlying strength. This raises the question as to whether endurance was adequately assessed in stronger patients, and assessed at all in the very weak patients.

Inspiratory muscle training (IMT) has the potential to improve weaning outcome in certain groups of patients; however, often it can only be initiated once patients can tolerate time off the mechanical ventilator.[13] The concept of interneuron activation is interesting, and may provide the opportunity to indirectly train respiratory muscles in ventilated patients. Given that muscle weakness of both peripheral and respiratory muscles, often coexisting, is common in critically ill patients, confirmation of such interneuron activation in critically ill patients is required.[5] There are various means to test muscle strength in critically ill patients, each with varying degrees of reliability. The Medical Research Council Sum Score (MRC-SS) assesses six muscle groups of the upper and lower limbs. It is frequently used in critically ill patients, and can identify ICU-acquired weakness.[14,15] Furthermore, it has very good inter-rater reliability (intraclass correlation coefficients (ICC), 0.86 - 0.99), handgrip strength was also very good (ICC 0.89 - 0.97) and dynamometry was fair (ICC 0.62 - 0.96).[16] Therefore, using a more comprehensive assessment of muscle strength (including respiratory muscles) could aid in more holistic intervention to facilitate liberation from the mechanical ventilator, and improved functional outcomes. The reliability of the Oxford scale in the ICU is yet to be determined, particularly regarding muscles such as the neck flexors and upper trapezius, and therefore requires further validation before being recommended as an assessment of weaning/extubation readiness.

Given the impact of weaning/extubation failure on mortality and morbidity, as well as the contribution of the musculoskeletal system to the success or failure of being liberated from mechanical ventilation, physiotherapists and rehabilitation specialists are integral to the weaning process. Many studies have investigated interventions such as IMT and peripheral muscle strengthening, using techniques such as neuromuscular electrical stimulation and early rehabilitation, to improve muscle strength and outcomes; however, these interventions have varying efficacy.[13,17-19] Many questions remain as to how to identify at-risk patients early during the course of mechanical ventilation. What type of intervention should be initiated, when should it be initiated and at what dosage and frequency should it be performed? Furthermore, an understanding of the time course and underlying pathophysiology of muscle dysfunction is critical in developing assessment strategies and interventions in critically ill patients. In order to comprehensively answer these questions, we need rigorous studies of excellent methodological quality, and clearly defined outcome measures.

A Lupton-Smith
Division of Physiotherapy, Stellenbosch University, South Africa
aluptonsmith@gmail.com

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