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When is it safe to exercise mechanically ventilated patients in the intensive care unit? An evaluation of consensus recommendations in a cardiothoracic setting

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ABSTRACT

Rationale: Consensus recommendations have been developed to guide exercise rehabilitation of mechanically ventilated patients in the intensive care unit.
Objective: This study aimed to investigate the safety of exercise rehabilitation of mechanically ventilated patients and evaluate the consensus recommendations.
Methods: This was a prospective, single-centre, cohort study conducted in a specialist cardiothoracic intensive care unit of a tertiary, university affiliated hospital in Australia.
Results: 91 mechanically ventilated participants; 54 (59.3%) male; mean age of 56.52 (16.3) years; were studied with 809 occasions of service recorded. Ten (0.0182%) minor adverse events were recorded, with only one adverse event occurring when a patient was receiving moderate level of vasoactive support.
Conclusions: The consensus recommendations are a useful tool in guiding safe exercise rehabilitation of mechanically ventilated patients. Our findings suggest that there is further scope to safely commence exercise rehabilitation in patients receiving vasoactive support.

Introduction

Mechanically ventilated (MV) patients in the Intensive Care Unit (ICU) can be subject to prolonged immobility, which can lead to complications such as ICU-acquired weakness.[1] ICU-acquired weakness is characterised by rapid muscle wasting in critically unwell patients, particularly those with multi-organ failure.[2] Prolonged weaning from mechanical ventilation (longer than 7 days) may have a role in the development of ICU-acquired weakness.[3] There is potential that ICU-acquired weakness can lead to prolonged ICU and hospital length of stay. Early exercise rehabilitation of MV patients has been shown to be safe and feasible.[4–6] Benefits of exercise rehabilitation in MV patients in the ICU include shorter ICU and hospital length of stay, reduced days on the ventilator, increased peripheral and respiratory muscle strength, and increased health-related quality of life.[7]

It can be difficult to determine when it is safe to begin exercise rehabilitation with a MV patient in the ICU. There may be concerns regarding the type and number of attachments, as well as existing haemodynamic or respiratory instability that may be exacerbated by exercise. Barriers to exercise in the ICU have been described as being structural, cultural or patient-related.[8] Pain, clinical stability and level of cooperation are examples of patient-related barriers; while structural barriers can include staff experience, time constraints or equipment issues. Cultural barriers relate to attitudes or protocols that may exist in the ICU.[8] Hodgson and colleagues found that the most commonly reported barriers to early exercise in MV patients were intubation with an endotracheal tube and sedation.[9] While consideration of potential risks versus the possible benefits of exercise rehabilitation of MV ICU patients is

Abbreviations: BSL, blood sugar level; ECMO, extra-corporeal membrane oxygenation; HR, heart rate; ICU, intensive care unit; IDC, in-dwelling catheter; LL, lower limb; MAP, mean arterial pressure; MOS, march on the spot; MV, mechanically ventilated; PEEP, positive end expiratory pressure; RASS, Richmond agitation and sedation scale; RR, respiratory rate; SOEOB, sitting on the edge of the bed; STS, sit to stand; UL, upper limb.

Conflicts of interest: None.

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Table 1
Summary of parameters for each consideration outlined in the consensus recommendations.[10]

Respiratory considerations	Cardiovascular considerations	Neurological considerations	Other considerations
Intubation with ETT or tracheostomy tube	Blood pressure	Level of consciousness	Surgical (unstable major fracture, large open surgical wound)
Respiratory parameters (FiO_2, SpO_2, RR)	MAP‖	Delirium	Medical (known or suspected active/ uncontrolled bleeding or increased bleeding risk, febrile despite active cooling management, active hypothermia management)
HFOV mode	Known or suspected pulmonary hypertension	Intracranial pressure	Other considerations (ICU-acquired weakness, continuous renal replacement therapy, venous and arterial femoral catheters, femoral sheaths, all other drains and attachments)
PEEP	Cardiac arrhythmias (bradycardia, tachyarrhythmias, transvenous or epicardial pacemaker)	Other neurological considerations (craniectomy, open unclamped lumbar drain, subgaleal drain, acute spinal cord injury, subarachnoid haemohorrhage with unclipped aneurysm, vasospasm post-aneurysmal clipping, uncontrolled seizures and spinal precautions (pre-clearance or fixation))	
Ventilator dysynchrony	Cardiac devices (Femoral IABP, ECMO, VAD, pulmonary artery catheter or other continuous cardiac output monitoring device)		
Rescue therapies (nitric oxide, prostacyclin and prone positioning)	Other cardiovascular considerations (shock of any cause with lactate >4 mmol/L, known/suspected acute DVT/PE/severe aortic stenosis, cardiac ischemia)		

HFOV, High frequency oscillating ventilation; IABP, Intra aortic balloon pump; PEEP, Positive end expiratory pressure; ECMO, Extra-corporeal membranous oxygenation; MAP, Mean arterial pressure; VAD, Ventricular assist device.

important, undue concerns regarding adverse events may lead to exercise rehabilitation being withheld or delayed unnecessarily.[10]

International consensus recommendations for exercising MV patients in the ICU were developed in 2014[10] by a group of 23 ICU experts. These consensus recommendations have not yet been evaluated in a clinical setting. The recommendations comprise of four considerations: respiratory, cardiovascular, neurological and other. The considerations consist of multiple parameters. Respiratory considerations, for example, consist of parameters such as fraction of inspired oxygen (FiO_2), positive end expiratory pressure (PEEP) and respiratory rate, and neurological considerations consist of parameters such as level of consciousness, intracranial pressure and delirium. The parameters that comprise each consideration are further summarised in Table 1. The recommendations employ a "traffic-light" colour coding system (green, yellow, red) and classify each parameter into a corresponding colour when considering exercise rehabilitation, as illustrated in Figure 1.[10]

The panel members who formulated the recommendations and classified each parameter with a corresponding colour were unable to reach consensus regarding the dose of vasoactive drugs (and combinations of these drugs) at which it is considered safe to commence exercise rehabilitation.[10] Views about the dose, unit of measurement and combinations of these drugs were variable across the panel members of the consensus group. To our knowledge, there is no literature regarding the safety profile of exercise rehabilitation with MV patients on vasoactive support in the ICU.

Therefore, the study aims were to investigate the safety of exercise in patients within a predominately cardiothoracic intensive care unit and relate this to the current consensus recommendations.[10] We aimed to describe any adverse events that occurred while exercising MV patients and to observe if there was a relationship between any adverse events and if a patient was receiving vasoactive medications.

We hypothesised that the consensus recommendations[10] are a useful tool to help guide safe exercise rehabilitation of MV patients in a cardiothoracic ICU and in predicting the risk of adverse events.

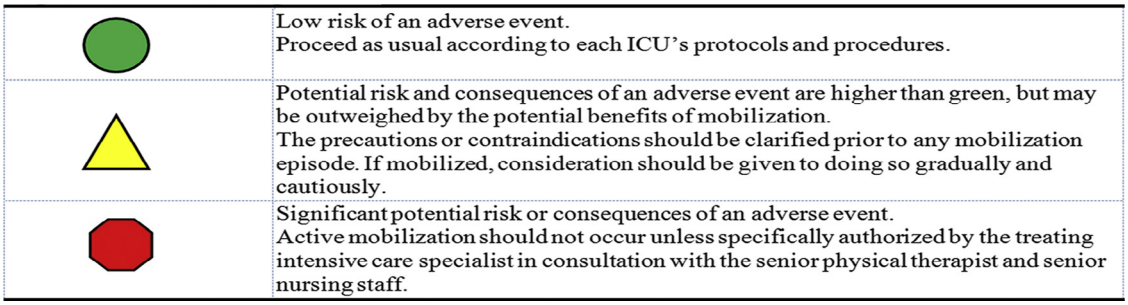

Fig. 1. Colour coding system of recommendations.[10] Permission to use this image has been obtained.