

Perioperative Mechanical Circulatory Support Symposium

Cutting-Edge Physical Therapy in Mechanical Circulatory Support: Critical Care Physical Therapy Perspectives

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Introduction

Patients on mechanical circulatory support (MCS) are at particularly high risk for deconditioning during a stay in the intensive care unit (ICU). Although mobilization of the general ICU population has been proven safe, effective, and feasible,¹ the mobilization of the critically ill MCS population requires specific knowledge of support devices and may present specific barriers to mobilization. Patient factors such as anxiety, motivation, difficult ventilator weaning, diaphragmatic weakness, femoral cannulation concerns, and sedation practices often limit mobility progression with traditional rehabilitative methods. Although physical therapy (PT) interventions for patients on MCS still primarily emphasize functional deficits, a growing body of rehabilitation research is emerging that promotes cutting-edge interventions, including specialized equipment and technology. These new approaches, such as virtual reality, biofeedback, inspiratory muscle training, neuromuscular electrical stimulation, verticalization, cycling, and body weight support treadmill training, can bridge the gap between functional deficits and progressive mobilization for this complex patient population.

Recent Developments

Physical therapy interventions require consistent and careful consideration of patient needs, which become even more crucial in the MCS population. Protocolized multidisciplinary team communication and the use of outside-the-box strategies with individualized PT interventions can facilitate progress in patients with significant mobility deficits.

Formal multidisciplinary communication is imperative for communicating important patient information between the nursing and medical teams before, during, and following PT sessions. Recommendations have been suggested in the PT literature that may translate well to the MCS population. Hodgson et al² developed recommendations for mobilization of adult patients who are mechanically ventilated that correlate well with the precautions needed for postoperative patients on MCS. Johnson et al³ established a flowsheet for early mobility progression in critically ill patients through a natural evolution of traditional functional and exertional activities. Each of these protocols addresses a variety of patient conditions and safety factors.

When a patient on MCS meets safety criteria for mobilization, PT therapeutic interventions may still be limited because of anxiety, limited endurance, or physiologic restrictions. Situational anxiety is often a crippling result of the numerous physical, mental, and emotional stressors that patients on MCS experience in the ICU. Research is emerging on the use of virtual reality and biofeedback, which enable patients to directly visualize their body's response

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to position changes, ventilator weaning, or anxiety-targeted therapies (such as diaphragmatic breathing), thereby giving them a sense of control as they increase mobilization.⁴ Virtual reality can help patients simulate functional tasks to increase their confidence in initiation of movement.

Dyspnea and ventilator dependency are also common challenges to mobilization. Often, patients benefit from focused diaphragmatic weakness assessment. Evidence exists to support the use of inspiratory muscle training for ventilator weaning.⁵ Global deconditioning can also significantly limit mobilization out of bed. Similarly, neuromuscular electrical stimulation has been used in several studies with the intent of targeting focal muscular weakness to prevent ICU-acquired weakness.⁶

Patients with low Richmond Agitation-Sedation Scale scores, patients who do not tolerate being upright, and those with femoral device cannulation are often restricted to bed-level interventions. Postural activation and muscular strengthening, however, can be achieved effectively with bed-level activities through the use of a tilting frame bed or tilt table, which helps patients achieve verticalization passively. This intervention significantly promotes upright posture and lower-limb weight bearing for muscular strengthening and joint stimulation without having to flex the hip and risk bending femoral cannulas.⁷ Similarly, the Ramsey Protocol established a guide to ambulation in patients with femoral intra-aortic balloon pumps.⁸ Cycling is an effective cardiorespiratory modality that can take place both in bed or in a bedside chair, thereby improving endurance and activity tolerance, despite minimal mobilization.⁹ In cases where patient progress to standing is minimal, use of a mechanical stand-assist frame can be used (Fig. 1). In cases where progress to gait reeducation activities is limited, body weight support treadmill training can be considered. Although body weight support treadmill training has been shown to be beneficial in the neurologic population, it is not widely practiced in the critical care setting.¹⁰

Finally, generalized dizziness can often limit PT in the ICU. In complex patients on MCS, multidisciplinary collaboration is essential to optimize sedation strategies, address orthostasis, and evaluate patients for any alternative pathology that may contribute to symptoms. Physical therapists are uniquely trained to screen for and treat vestibular dysfunction if other causes for dizziness have been excluded.

Abbreviations and Acronyms

ICU	intensive care unit
MCS	mechanical circulatory support
PT	physical therapy

Future Directions

The cardiorespiratory and strengthening PT interventions discussed here provide unique methods to help meet goals, such as ambulation, but incorporating patient-centered activity, such as sports or games, can contribute to improved patient motivation and reduce anxiety while continuing to address balance, coordination, neuromuscular, strength, and endurance deficits. Aligning **patient-centered mobility goals** through



Fig. 1 A patient with tracheostomy recovering from acute respiratory failure secondary to COVID-19 practicing sit-to-stand transfers with a mechanical stand-assist frame, overcoming knee extension contractures sustained while being prone for a prolonged time while on extracorporeal membrane oxygenation.

A video of this patient's functional recovery is available at https://www.youtube.com/watch?v=Lfhr0lc_oVw

activity-based interventions can increase levels of functional mobility and improve patient participation during PT sessions. A creative, dynamic, and patient-centered approach is the key to successful PT and to providing meaningful mobility interventions for patients on MCS.

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