Enhancing post-CCU functional endurance with physical activity

By Mary Ann Wietbrock, MSN, RN, ACNS-BC

Mr. G is a 55-year-old male with a left ventricular ejection fraction of 10% (normal, 50%-70%).[1] He was transported to the ED last evening due to unintentional weight gain, fatigue, orthopnea, paroxysmal nocturnal dyspnea, and dyspnea on exertion. His oxygen saturations on room air were 89% sitting upright and 80% supine. He was admitted to the coronary care unit (CCU) with a diagnosis of heart failure with reduced ejection fraction (HFrEF) and started on a continuous infusion of I.V. furosemide. He is currently on supplemental oxygen to keep his SpO_2 above 95%. Mr. G is spending most of his time in the hospital resting in his bed or chair.

Background

Heart failure (HF) is on the rise. Currently, more than 6 million Americans are living with HF.[2] Critical oxygen transport pathways are impaired in patients with HF, resulting in poor sleep quality, fatigue, and exercise intolerance.[2]

Critically ill patients with HFrEF are at risk for physical deconditioning, respiratory complications, and emotional problems related to inactivity.[3] Often, patients with acute decompensated heart failure (ADHF) have limited physical activity levels, leading to a loss of muscle strength at discharge from the CCU. Patients have been found to spend at least 30% of their day alone while in the hospital and are physically inactive for most of this time, regardless of ventilation or sedation states.[4] Loss of muscle strength during the hospital stay reduces the patient's ability to resume adequate physical activity after discharge.[5]

This article will review muscle mass loss pathophysiology and clinical manifestations and provide evidence-based activities the clinical nurse can use with patients to enhance their post-CCU functional endurance.

A patient's fatigue level should be measured daily on a 5-point exertion scale to evaluate changes over time.

Muscle mass loss

Pathophysiology. HF involves cardiovascular structural and functional changes that blunt the speed and magnitude for microvascular perfusion to meet metabolic demands.[2] A reduced level of physical activity compounds the loss of muscle mass due to an accelerated reduction in the strength of fast-twitch (type II) muscle fibers. These fibers depend on oxidative metabolic processes for energy and muscle force.[5]

Mitochondrial function is critical for lactate clearance in the muscle so fat can be oxidized.[6] Fat provides prolonged energy for performance after the normal limited glycogen reserves are used. Inflammation has been found in the skeletal muscles of patients with HF, impairing mitochondrial function in patients' muscle cells. These factors limit glucose levels, as well as fatty acid breakdown, leading to muscle wasting.[4]

Lean muscle mass is reduced during bed rest in healthy young adults at a rate of 0.63 kg per week.[7] Muscle atrophy has been demonstrated, especially

Red flags to limit physical activity[3]

- Recent myocardial infarction
- Heart rate <40 or >130 beats/minute
- Mean arterial pressure <60 or >110 mm Hg
- Oxygen saturations ≤90%
- Fractional concentration of inspired oxygen (Fio_2) ≥0.6
- Positive end expiratory pressure ≥10 cm H_2O
- Respiratory rate ≥40 respirations/min
- Richmond Agitation Sedation Scale scores of -4 (deep sedation), -5 (unarousable), +3 (very agitated), +4 (combative)
- Dopamine infusion ≥10 mcg/kg/min
- Norepinephrine infusion ≥0.1 mcg/kg/min
- Temperature ≥101.3°F (38.5°C) or ≤96.8°F (36°C)
- Unstable hemoglobin levels and platelet counts
- Decreased level of consciousness or syncope on exertion
- Signs of shock—diaphoresis, cool extremities, cyanosis
- Level of pain, fatigue, shortness of breath, and appearance
- Presence of femoral lines

in antigravity muscle groups. The soleus, back extensors, and quadriceps fiber size and strength are reduced because of a loss of contractile proteins, as well as neural, hormonal, and cellular signaling processes.[4] Skeletal muscle strength decline of 1% to 1.5% per day of bed rest has been recorded.[8]

A decrease of 5% to 6% of knee extensors is found in healthy young adults in the first week of bed rest.[7] A consistent reduction is observed in stair-climbing power (-14 ± 4.1% in 10 days), and is a measure of functional capacity.[7] Knee extensor weakness has been linked with a 70% increased risk of severe physical activity limitations after discharge.[7]

Signs and symptoms. Muscle wasting results in muscle weakness.[5] Patients with a critical illness have limited muscle capacity to use fat for energy because of mitochondrial dysfunction.[6] Patients report feeling exhausted and have minimal energy for physical activity.

Patients with ADHF are often too tired and fatigued to participate in physical activity. During the first week of inactivity, muscles mass is lost, increasing fatigue, which is associated with a worsening clinical picture.[8,9] A patient's fatigue level should be measured daily on a 5-point exertion scale to assess fatigue on admission and to evaluate changes over time.[10]

Baroreceptor dysfunction can cause orthostatic hypotension within 24 hours of inactivity.[5,9,11] A reduction in overall blood volume causing orthostatic intolerance is still possible in patients with ADHF. In these patients, a large volume of fluid is sequestered in the third space and not in the vascular bed to support stroke volume.[5] Patients with ADHF are at risk for syncope on exertion.

Safety assessment

The ABCDEFG assessment is a vital checklist for improving patient outcomes after CCU discharge.[6] First assess that the patient is **A**wake and **B**reathing and **C**hoose light sedation. Then, monitor for **D**elirium. Encourage **E**arly mobility and exercise. Assess for the **F**eeding of adequate protein and that the patient has **G**ained function and grown muscle.[6]

Baseline nutrition and physical activity levels identify patients at risk and their ability to recover. The nursing admission assessment should include questions of prehospital nutritional intake and physical activity levels. The risk during hospitalization is the further 40% loss of lean muscle mass causing high mortality.[6]

Ongoing monitoring is essential during all physical activity, either in or out of the bed, to identify hemodynamic status and tolerance to physical activity. The nurse should follow unit monitoring policies based on the American Heart Association's 2017 Update to Practice Standards for Electrocardiographic Monitoring in Hospital Settings.[12] Heart rate and rhythm, and BP assessments help the nurse determine if physical activity is possible, and if the patient is tolerating the physical activity.[6,13]

Clinical reasoning skills are needed to assess if the patient is safe to get out of bed. (See *Red flags to limit physical activity*.) The presence of femoral arterial catheters impairs mobility for the cardiac care patient.

Ventricular assist devices, extracorporeal membrane oxygenation, and intra-aortic balloon pump counterpulsation limit a patient's physical activity. Interventions are provided in previous articles with recommendations for safe ambulation of critical care patients with invasive catheters and devices.[13,16]

Progressive mobilization

Early progressive mobilization is a safe way to improve patients' functional outcomes and reduce their hospital length of stay. Bed mobility is recommended for patients with red flags. Passive or active range of motion will prevent joint contractures and provide some muscle tone.[3,14]

Physical activity should start in the bed with passive or active stretching and range of motion of all extremities.[3,13] Physical activity during bed rest is safe, if the limited extremity is used without causing complications.[3,13] A patient with an invasive femoral arterial catheter can still stretch toes on the affected side and fully participate with the remaining extremities.[3,13]

When the patient has successfully completed active stretching and range-of-motion exercises without hemodynamic compromise, physical activity should progress to multiple slow repetitions of raising arms and legs against gravity. Repetitions, without weight, should start with one set of 8 to 10 for 1 day and progress each day to three sets of 8 to 10 repetitions. These simple bed-rest activities can improve oxygen extraction for use by the muscle to generate force.[3,10,11]

Although sitting in a chair is valuable for better lung expansion, sitting is a passive act.[9] Sitting on the side of the bed will strengthen the core and balance. The simple act of sitting, whether in the bed, on the side of the bed, or in a chair, can minimize orthostatic intolerance that can occur after only 24 hours of bed rest.[11]

Patients with HFrEF have a low cardiac output that makes it difficult to participate in high-intensity interval training. Knee extension exercises, while sitting, have been found to use a small muscle mass to prevent the reduced loss of strength.[2] Knee extension increases muscle capillarity, mitochondrial volume density, and maximum rate of oxygen consumption resulting in improved exercise tolerance.[2] This training is easily applied at the bedside during the hospital stay for a patient with hemodynamic stability.

Progressive mobilization involves moving the patient safely from the bed to ambulation in stages.[11] The nurse should first assess the patient for readiness to safely stand and bear weight. When the patient can lift one leg off the bed, against gravity, the patient has strength to tolerate standing at the bedside. It is then safe to move the patient to a chair if the patient can bear weight and stand at the bedside.[3,17]

Mobility has been achieved when the patient can move from the bed, stand and bear weight, and move to sit in a chair.[9] The patient should stand and bear weight for several minutes, with assistance if needed.[11] Increasing the time the patient bears weight can improve endurance and strengthening.[8] Marching on spot and ankle pump exercises to raise and lower the body with the toes will help increase oxygen and nutrient delivery to the foot and calf muscles.[11] These types of physical activities are vital to ensure patient safety and reduce falls.

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Use of stretch bands and hand weights under the direction of a physical therapist can be helpful. Specific intensity, duration, and number of sets are individualized for each patient daily.[5,9,14] A pedal device or stretch bands can be used to work the feet and knees to provide greater mobility in the extensor muscles.[9] Bedside stationary cycle equipment may be used to increase quadriceps strength and reduce loss of muscle mass.[14]

Ambulation to the bathroom can then be considered.[11] Preparation before mobility is essential to protect the patient from harm. Identify the appropriate equipment, staff, and distance to reduce harm. Walkers, rolling poles, oxygen, and a gait belt may be required. Several staff may be needed. If ambulating, a wheelchair can be used to add a safety net if needed.[11,16]

At least one-third of patients with HFrEF have inspiratory muscle weakness compromising exercise tolerance. Diaphragmatic breathing may reduce the maldistribution of cardiac output and improve oxygenation for ambulation.[2] The simple task of deep breathing and coughing every 2 hours is still the cardinal nursing intervention to enhance oxygenation.[18]

Evidence-based support

Functional recovery at discharge can be improved with early physical activity within the first 48 hours of CCU admission.[5] Improvements have been shown in strength and work capacity when a group of patients with HF participated in resistance and endurance exercise programs.[5]

Weight bearing while standing at the bedside and walking short distances are low-intensity, short bursts of physical activity. NASA has found that 1 hour per day of gravity on the feet can maintain muscle protein synthesis and performance in knee extensors and plantar flexors.[7] Ability to walk at a moderate level of activity is vital for independence. This functional capacity is required for activities of daily living, physical activity, and social activities.[7] Quality-of-life studies on the SF-36 have found a greater than 10% change for physical functioning and a greater than 12.5% change for role-physical with clinical implications for patients with chronic pulmonary diseases that participated in exercise.[6] Adequate nutrition and mobility are essential to combat the hypermetabolism and catabolism of HF, which may persist for months to years after an acute illness of this chronic disease.[6]

Conclusion

Mr. G was able to stand hourly during his hospitalization to improve his outcomes at discharge. This enabled him to return to his full-time job within 2 weeks and limited his fatigue during his work day. ■

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