Institute for Limb Preservation
At Presbyterian/St. Luke's Medical Center

Clinical Pearls:
Rehabilitation of Sepsis Survivors with Limb Loss

In the face of severe sepsis and limb loss, recovery can be very prolonged due to a multitude of issues. Initially, life-saving measures drive treatment. Once it is determined the limbs cannot be saved, the amputations typically are bilateral and portions of limbs are likely involved in the upper and lower limb. Although the missing limbs can take much of the attention, be sure to also evaluate the following:

1. **Critical Illness polyneuropathy and myopathy (CIP, CIM):** Neurological deficits are slower to recover when central structures and pathways are involved. CIP is patchy and variable, not following any patterns, while CIM typically effects the proximal muscle groups. Specific muscle loss is often overlooked in the following:
    a. **Diaphragmatic function** decrease after mechanical ventilation (1,2,3):
        I. Decreased lung capacity and functional endurance
        II. Diaphragm is working on breathing, less able to contribute to other functions including venous return, proprioception and balance control through abdominal pressure stabilizing the lumbar spine(4)
        III. Decreased mobility in thoracic spine limits extremity mobility which is key for independence (self-care, don/doff)
    b. **Dysphagia**:
        i. Higher incidence of swallowing difficulty after sepsis which an contribute to aspiration pneumonia and hospital readmission(5)
        ii. Affects core stability and maintenance of thorax and abdominal pressure(6)
    c. Pelvic floor dysfunction
        i. When dysfunction is present: it can an alter core stability, create pain, be exacerbated with constipation(7) and can be related to increased phantom pain
        ii. Alterations of pelvic floor dysfunction also contribute to urinary and bowel incontinence as well as voiding issues (7)
    d. Sensory changes:
        i. Physical representation of the body in space is often impaired, but unrecognized, this may slow rehabilitation progress once they are mobile(8,9)
2. **Skin integrity**:
    a. Skin can have decreased resistance to shear forces, and early prosthetic wear needs to be monitored closely for skin break down, particularly in the face of skin grafts and sweating, wear time may need to be individually progressed(10)
    b. Sacral decubiti can limit pre-prosthetic training mat activity, transfers and independent function(11)
    c. With prolonged bed rest the scapula, occiput and heel skin is also at risk for breakdown
3. **Critical illness encephalopathy cognitive changes**:
    a. If there are even mild executive function changes, it can strongly affect problem solving and spatial orientation with donning and doffing prosthetics(12)

   b. Can increase the amount of training/instruction for more advanced prosthetics, and may involve more time spent training/instructions of care-givers and/or family
   c. May impede the vital ability to adapt, most recovery of function with prosthetics involves individual choices
   d. May need repetition to master new skills in rehabilitation beyond expected timeframe
4. **Vestibular dysfunction**:
   a. Common with severe illness, may not present with dizziness complaint, but difficulty with stable gaze, balance reactions and hearing loss(13)
   b. The vestibular system is very sensitive to blood pressure changes and has no redundancy built in to the vascular supply(14)
   c. Many of the medications used to treat sepsis can have ototoxic ramifications(15)
   d. Otolithic loss can present as decreased exercise tolerance, mental fog, chronic, migrating pain, headaches and lightheadedness with sitting up (vestibular-sympathetic-reflex) that may be mislabeled as deconditioning(16,17,18)
5. **Contractures**:
   a. Decreased motion in joints limits adaptability in prosthetics
   b. Contractures in knees and hips can lead to pain and increase the metabolic cost of ambulation(19)
   c. Limb salvage can be important, need more time for joint mobilization, scar management and soft tissue mobilization
6. **Nutritional and GI absorption changes**:
   a. May have slowing of GI function and ability to process nutrients, consider evaluation(10)
7. **Advanced prosthetics in the lower limb:**
   a. Increase in adaptability of foot/ankle, but need a very strong core to engage and benefit from them. May be very appropriate with time, but can be hard to progress and exchange for appropriate components(19)
   b. Expensive and difficult to get commercial insurance coverage(20)
   c. For example: vacuum suspension system cannot have any holes and good fit must be maintained, may need multiple return visits to prosthetist
   d. Critical for coordination of prosthetic prescription with MD, PT, and OT for maximal independence
8. **Advanced prosthetics in upper limb:**
   a. Very expensive, difficult to get authorization
   b. More complex components require more training; will insurance pay for more therapy? (Powered thumbs, fingers multi-function grips)
   c. “Fiddle factor”: have to be comfortable with tweaking computer programing, recalibration, modifying fit and conduction of electrodes. Many times the UE needs to be returned for repair
   d. Back-up prosthetics: what happens when you send an item for repair?(19)
   e. Durability is not where it needs to be if patient is using UE prosthetics for transfers or other weight-bearing ADLs.
   f. Critical for coordination of prosthetic prescription with MD, PT, and OT for maximal independence
9. **Assess for home modification and assistive device needs as early as possible:**
   a. This population also can benefit from counseling, peer visitation, care-giver support, social work, vocational rehabilitation and many other ancillary services(18)
10. **Very few medical teams have experience managing these patients:**
   b. The circumstances can be overwhelming for the survivors and the medical team.
   c. Insurances vary significantly in how to navigate all of the needs

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