

ACADEMY OF SPINAL CORD INJURY PROFESSIONALS



Concomitant Spinal Cord Injury, Traumatic Brain Injury, and Amputation

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INTRODUCTION

46 year-old female who sustained polytrauma. Cause of injury: Helmetless motorcycle crash Injuries:

- **Spinal cord injury (SCI)** - C5 American Spinal Cord Injury Association Impairment Scale (AIS) C
 - **Traumatic brain injury (TBI)** - Moderate with initial Glasgow Coma Scale (GCS) 12
 - MRI of brain – negative
 - Left tibial-fibular open fracture and left tarsal-metatarsal joint fracture s/p **left transtibial amputation (TTA)** and skin graft placement.
 - Stenotrophomonas maltophilia infection of left residual limb surgical site
- Multiple fractures including left occipital condyle, Maxillomandibular, left scapular, L2-5 transverse process, and left femoral fracture s/p external fixation

REHABILITATION STRATEGIES

- Private room near nurse station
- Minimize over-stimulation/distractions
- Structure and consistent daily routine
- Covering brace, wounds, and feeding tube with shirt/abdominal binder to decrease agitation and risk of removal
- Maintain appropriate sleep-wake cycles – avoid daytime sedation, daytime therapy, use of sedating medications at night

Progression of therapy:
When patient was in lower Rancho stages confused-agitated or confused-inappropriate:

- Greater proportion of passive exercise: ROM, proper positioning, wound massage, equipment (Pre-prosthetic)
- Cotreatment with 1 therapist giving precise, 1-step instructions in a non-distracting quiet area
- Maintenance of a small rotation of a therapists to build familiarity
- Firm and instant handling of inappropriate behavior; Reward success with positive feedback
- Provide options for various therapeutic activities, but not for refusal of therapy
- Basic cognitive therapy, daily orientation and familiar objects in patient's room
- Involvement of psychology for patient/family support and therapy.

When patient's Rancho stage advanced (in addition to the above strategies):

- Increased proportion of active exercise: Ambulation with assistive device
- Patient education: Self-ROM exercise to prevent joint contracture s/p amputation, prone positioning, self-desensitization for phantom limb sensation, don/doff of splints, abdominal binder.
- Therapy to occur in open gymnasium
- Advance cognitive therapy, more 2-step instructions, memory and attention exercise
- Discussion with patient about weekly functional progress in order to provide objective positive feedback
- Educate patient and family about bowel, bladder, and G-tube management
- Involvement of psychology, physicians to educate patient about TBI, SCI, and amputation issues
- Include patient and family in peer support group

Medical complications during Acute inpatient rehabilitation

Medical Issues	SCI	Moderate TBI	s/p Transtibial Amputation
Pain	Post-traumatic & post-surgical pain: Low-dose narcotics, acetaminophen, exercise Neuropathic pain: Venlafaxine and duloxetine were tried, but later discontinued for side-effects. Symptom improved without additional medications Phantom limb sensation: Self-desensitization techniques		
Edema	Secondary to decreased mobility: Compressive stockings Physical therapy		Left residual limb: Proper positioning Knee immobilizer ROM exercise
Contracture	Secondary to decreased mobility: ROM exercise Proper positioning Pressure relief ankle foot orthosis (PRAFO™) Hand and wrist splints		Treatment and prevention of left hip flexion, knee flexion contracture ROM exercise (passive and active) Prone positioning Teaching of self-exercise (May exacerbate contracture)
Spasticity	Spasticity of all extremities, with finger flexors being the most affected : Therapy, stretching exercise, E-stim Pharmacologic – Baclofen, later added diazepam		
Metabolic disturbance Vitamin D deficiency Malnutrition	Supplemental vitamin D and Calcium	G-tube feeding Supplement Treatment of depression Mirtazapine	(Malnutrition is a challenge to proper wound healing)
Depression/Anxiety Emotional lability	Adjustment disorder	Behavioral - Health psychology Pharmacologic – Did not tolerate duloxetine or venlafaxine for nausea Mirtazapine and diazepam improved symptoms	Adjustment disorder
Neurogenic bladder	Detrusor-sphincter-dysynergia Timed voiding Indwelling catheter initially Intermittant catheterization Tamsulosin	UMN bladder Timed voiding Tamsulosin	
Specific medical issues experienced by patient	Neurogenic bowel Bowel program with stool softener, stimulants, and suppository as needed	Post-traumatic amnesia Present initially, resolved GOAT score 92	Residual limb wound Single layer of cuticerin over crusted skin and cover with Combiderm dressing
	Autonomic dysfunction Orthostatic hypotension – Caution with position change, abdominal binder	Insomnia Ambien initially, D/C'd secondary to excessive daytime somnolence Agitation Elimination of underlying causes Pharmacologic – Quetiapine	

REHABILITATION PROGRESS

Muscle groups	MMT (Manual muscle test /5)	Admission to inpatient rehab	Discharge from inpatient rehab
Bilateral shoulder abduction elbow extension, pronation, supination, wrist extension	4 -> 5	Bed mobility: Rolling: 2 person assistance Supine to sit: 2 person assistance Sit to supine: 2 person assistance	Bed mobility: Supine to sit: Minimal assistance Sit to supine: Stand-by assistance Scooting when sitting: Minimal assistance
Bilateral finger flexion and extension	0 -> 2	Sitting balance: Poor. Sat at the edge of bed x 5-6 min with moderate assistance. Unable to actively extend arms and bear weight when sitting	Transfers: Seated sliding board transfer: stand-by assistance Locomotion: Manual wheelchair: Modified independent 200 feet
Left hip flexion, abduction, adduction	2 -> 2		
Right hip flexion	2 -> 2+		
Right hip extension, abduction, adduction	1 -> 2	Use of mechanical ceiling lift	



Cervical spine MRI (T2 image) – Impingement of C5-C6 with cord signal change

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- Conclusion**
- No large, published outcome studies of concomitant SCI, TBI, and amputation is available to our knowledge.
 - Additional challenges of amputation beyond dual diagnosis include:
 - Cognitive function to maintain residual limb shaping, wound care, and future prosthesis management.
 - Shift of center of gravity, reduced sitting balance, and change in pressure distribution with consideration of wheelchair fitting, pressure mapping, and safety.
 - Prone positioning may be avoided in patient with complicated TBI with hemorrhage
 - Patients with a trio diagnosis of SCI, TBI, and amputation present complex situation. This case highlights the challenges presented by the cognitive impairments of a TBI in combination with the motoric deficits of SCI and mechanical difficulty with amputation. A multi-disciplinary team approach led to a meaningful gain of functions in our case.