REHABILITATION IN ACUTE TRAUMA CARE

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OVERVIEW

- Many trauma patients will have a new onset temporary or permanently disabling condition
  - TBI
  - SCI
  - Critical care polyneuropathy/ myopathy
- Addressing rehab related issues early improves care
  - Rehab team
  - Focus on rehab issues
  - Patient/family education
- Partnership to better study long-term meaningful outcomes
ROLE OF REHABILITATION MEDICINE IN ACUTE CARE OF TRAUMA

- Participate in Development of care pathways and protocols for care of patients with functional needs
- Consultation to acute care team on rehab related issues
- Patient/family education on functional outcomes and care pathways
- Establish therapeutic relationship
- Institute rehab interventions during ICU/acute care stay
- Coordinate rehab plan for ongoing care
- Facilitate transitions to appropriate post acute care settings
WHO IS PART OF THE REHAB TEAM

- Rehab medicine
- Therapists- PT/OT/Speech
- Rehab Psychology
- Critical care team-
  - Medical Providers
  - Nursing
  - Respiratory therapy
  - Ancillary services
  - Medical Social Work, Case management
- Patient and family
PHYSIATRISTS - SPECIALIST IN FUNCTIONAL IMPAIRMENT

- Focus on the Functional Diagnosis
- Provide care across continuum of recovery
- Direct therapy programs
- Provide direct interventions and suggest care to promote recovery and avoid secondary complications
- Coordinate with other medical specialists short and long term
- Prescribe specialized equipment to promote function
PHYSICAL THERAPY

- Posture and mobility
  - Flexibility
  - Strength
  - Endurance
- Acquisition and reacquisition of function
- Equipment and strategies
OCCUPATIONAL THERAPY

- Participation and independence in activities of daily living
  - Feeding
  - Self care
  - Work and play

- Promote physical readiness for skill development

- Neurobehavioral readiness

- Equipment and strategies
SPEECH

- Communication and oral motor skills; including feeding and swallowing
- Promote physical readiness
- Promote neurocognitive readiness
- Equipment
  - High and low tech
- Assess swallowing and feeding safety
  - Texture
  - Technique
  - Progression
REHABILITATION PSYCHOLOGY

- Assess neuropsychological function and anticipate needs and strengths
- Promote emotional regulation
- Support cognitive recovery
- Assist in coping with trauma and loss
- Support reintegration into school and work environment
  - Education
  - Assessment
  - Planning for supportive environment
NURSING WITH REHABILITATION FOCUS

- Provide care while promoting independence and functional recovery
- Provide a supportive environment to promote emotional regulation and safety
FAMILY EDUCATION AND SUPPORT

- What will life be like?
- Support in making treatment decisions
- What can I do to help my loved one now?
- What happens when we leave here?
SPINAL CORD INJURY REHAB CONSULT

- Exam
- Start ongoing interventions to establish consistency
- Screen for TBI and address neurocognitive and neurobehavioral issues
- Assist with neuropathic pain strategies-breath controlled analgesia
- Skin protection-mattress, transfers, sitting, pressure relief
- Urinary management
- Bowel management
- Feeding- positioning, assess swallowing need for g tube
- Rehab team immediately following injury

Consortium for Spinal Cord Medicine
Clinical Practice Guidelines 2008
Management
- Baseline renal function anatomy
- Start with Foley-
  - avoid trauma from increased pressure and reflux
- Transition to CIC
- Manage spasticity dysynergia,
- Surgical options

Functional Continence
- Achievable goal
- May be neglected in young children
- May not have been continent prior to injury
- CIC participation should be treated as a milestone

Generao Journal of Urology 2004
BENEFITS OF CIC

- High risk renal damage with cervical spine injuries

- CIC and Anticholinergics prevent
  - Hydronephrosis
  - Scarring
  - Reflux
  - Trabeculation

Generao, Journal of Urology 2004
GI COMPLICATIONS SCI

- Upper GI bleed- esp above T6
- Ileus
- Pancreatitis
- Appendicitis
- Cholecystitis
- Gall stones
- SMA syndrome- more common quadriplegia
- Neurogenic Bowel
  - Start program ASAP
SCI BOWEL PROGRAM

- Attitude
- Equipment
- Functional skill acquisition
- >80% require oral and/or rectal med regimen
- Surgical options

SKIN-INCIDENCE OF DECUBITI

- By age at injury
  - Model SCI
    - 33.5% acute phase
    - 15-20% 1-5 y post
  - Pediatric Center
    - 21% acute phase
    - 55% 1-5 y post

- By injury characteristics
  - Quadriplegia
    - 53.4% A
    - 28.7 % B+
  - Paraplegia
    - 39% A
    - 18.3% B+

Vogel Orthop Nurs 2004
Pyramid Approach to Management of Spasticity

- Prevention of Nociception
- Positioning
- Casting/ROM
- Medications
  - Botox/Phenol
  - Ortho/Tenotomy
  - SDR
  - ITB
AUTONOMIC DYSREFLEXIA

- T6 and above
- Noxious stim below level of injury
- Vasconstriction below/ Vasodilation above level of injury
- Increased vagal tone
  - Bradycardia
- Symptoms
  - Headache
  - Sweating above level
  - Flushing
  - Nasal congestion

- Acute Management
  - Drain bladder
  - Sit up
  - Treat discomfort
  - Nifedipine/ Nitroglycerine paste

- Prevention
  - Effective bowel and bladder program
ACUTE SCI REHAB

- 44% significant improvement in function
  - No ASIA change
- Longer LOS
  - Higher discharge function
- Longer time to start rehab
  - Lower amount of change
- Lower initial function
  - Greater amount of change

Allen Spinal Cord 2009
CAREGIVER PERSPECTIVES OF ACUTE SCI REHAB

- What encouraged participation in school and community activities?
  - 41% technical support
  - 25% motivation and encouragement
  - 17% education

- What was important post discharge?
  - 30% involvement in activities
  - 22% personal resilience
  - 13% involvement with others with disabilities

House, Spinal Cord 2009
CRITICAL CARE RELATED NEUROMUSCULAR WEAKNESS

- Evil sequelae of complete bedrest - physiologic and psychologic consequence 1944
- 28 days bedrest - 23% decrease in strength in healthy subjects
- Scope:
  - 25-50% critically ill patients
  - Up to 100% with SIRS and MOF
  - Can start as early as 2 days
- Ventilated >7 days
  - 45-58% abnormal EMG
- Long term ICU patients with NM weakness
  - 50% return to work in 1 year
  - 1 y post ICU d/c 66% 6min walk
  - 5y subjective weakness

Dock JAMA 1944
Lipshutz Anesth 2013
Fan Respir Care 2012
**MUSCLES-MNEMONIC**

- Medications
- Undiagnosed neuromuscular disorder
- Spinal cord disorder
- Critical Illness Myopathy Polyneuropathy
- Loss of muscle mass
- Electrolyte disturbance
- Systemic Illness

Maramattom Crit Care Med 2006
CRITICAL ILLNESS NEUROMYOPATHY

- Disorder of
  - Peripheral nerve
  - NM junction
  - Muscle
  - Often coexist

- Work up
  - EMG CIP described 1984 sensorimotor axonal neuropathy
  - CK levels
  - Diagnosis impeded by sedation, delirium, encephalopathy

- Physical Exam
  - Nonfocal
  - Prox vs distal
  - Hyporeflexia
ETIOLOGY CRITICAL ILLNESS RELATED WEAKNESS

- Correlative/causative to
  - Bedrest
  - Inflammation, cytokines
  - Medications eg.
    - Neuromuscular blockers, corticosteroids
  - Malnutrition
  - Electrolyte imbalance, hyperglycemia

- Direct
  - Critical illness neuromyopathy
  - Toxicity
  - Hypoxia
  - Catabolism, decreased repair

- Indirect
  - Immobility, disuse atrophy

Hermans Cochrane Database Sys Rev 2009
Fan Respir Care 2012
INTERVENTIONS

- Limit triggering processes-excellent critical care
- Tight glycemic control best evidence
- Corticosteroids significant risk

- Mobility therapy in ICU, while intubated,
  - Sitting, progressing to ambulation goal
  - Cycle ergometer,
  - NMES
  - Video games
- More aggressive with PT vs nurses
- Family participation-14% spontaneously

Hermans Cochrane Database Sys Rev 2009
Lipshutz Anesth 2013
ICU MOBILITY

- Early mobilization safe and feasible 24-72h in ICU
- Combine with sedation “holidays”
- No increase in cost
- Implement in 4 m
  - Culture change
  - Representation and champions
    - ICU providers
    - Physiatry
    - PT/OT
    - Nursing
    - RT

- Greater activity levels
- Improved functional outcomes,
- Shorter time to oob
- Decreased LOS-ICU and Hospital stay
- Decreased duration of ventilation
- Reduced mortality
- Shorter duration delirium
- More active rehab

Schweickert Lancet 2009
Needham, Arch Phys Med Rehabil 2010
ABC DE BUNDLE

- Awakening
- Breathing
- Coordination
- Delirium
- Early Mobility

Barriers
- Patient
- Clinician
- Protocol
- ICU contextual

12% implementation in setting of statewide initiative

Bundle compliance 53% less with perceived high workload burden

Early mobility adherence 59% less with perceived high difficulty to carry out

72% adherence on ventilator

97% adherence off ventilator

Costa Chest 2017
Boehm Am J Crit Care 2017
TBI REHAB IN CRITICAL CARE

- Education
- Consult on rehab issues presenting in acute phase
  - Autonomic dysfunction
  - Neurocognitive and Neurobehavioral dysfunction
    - Decreased arousal
    - Agitation
    - Executive dysfunction
  - Spasticity
  - Functional impairments
- Facilitate transitions for acute rehab
FAMILY EDUCATION

- Prognosticate and start family education
  - Anticipate potential areas of need based upon:
    - Injury characteristics
    - Initial course
    - Premorbid state
  - Care course
  - Guide family interactions and opportunities for care
TBI COMMONLY INJURED AREAS

- Areas of vulnerability
  - Frontal lobes
  - Temporal lobes
  - Midbrain
  - White matter connections
FUNCTIONS OF VULNERABLE AREAS

- Arousal
- Processing
- Attention
- Autonomic regulation
- Neuroendocrine function
- Sleep/wake regulation
- Memory
- Complex sensory gating
- Emotional and social regulation
- Motivation
RANCHO LOS AMIGOS SCALE

I  No Response
II  Generalized Response
III  Localized response
IV  Confused, agitated
V  Confused inappropriate
VI  Confused appropriate
VII  Automatic Appropriate
VIII  Purposeful, appropriate
PAROXYSMAL AUTONOMIC INSTABILITY AND DYSTONIA - P.A.I.D.

- Patients with severe BI in low response state
- Starts in ICU and may persist weeks to months
- Intermittent
- Diagnosis of exclusion

A.K.A.
- Neurostorming
- Midbrain syndrome
- Hypothalamic instability
- Central fever
PATHOPHYSIOLOGY

- Dysfunction of autonomic centers in the thalamus and hypothalamus and their cortical and subcortical connections
- Release of controls
- Sympatho-excitatory center activation
- Cortically induced catecholamine release
- Thermoregulatory dysfunction
- Hypermetabolic state
- Blockage of inhibitory signals from midbrain to pontine and vestibular nuclei → dystonia
P.A.I.D. CRITERIA

- At least 1 cycle per day for >3 days
- +/- Triggered
- Constellation of:
  - Tachycardia
  - Tachypnea
  - Hyperthermia
  - Agitation
  - Hypertension
  - Diaphoresis
  - Dystonic posturing
MIMICS-WHAT IT ISN’T

- Pain
- ↑ ICP
- Central fever
- Sepsis
- Subclinical seizure
- Agitation
- Withdrawal
- Autonomic dysreflexia
- Neuroleptic malignant syndrome
- Malignant hyperthermia
INTERVENTION FOR P.A.I.D.

- Recognize it
- Eliminate triggers
- Pharmacologic management
  - Target symptoms
  - Safest options
  - Meds that address multiple symptoms simultaneously
PHARMACOLOGIC OPTIONS

- **Bromocriptine** - Dopamine agonists - DA withdrawal causes NMS
- **Propranolol** - Nonselective β-adrenergic blockade - address HTN
- **Clonidine** - A2 adrenergic agonist - treat sympathetic signs
- **Ativan** - Benzodiazepines - anxiolytic, muscle relaxant
- **Dantrolene** - Direct muscle relaxant, reduce somato-sympathetic spinal reflexes
- **Baclofen** - Centrally acting muscle relaxant GABA analogue
- **ITB** - w/intractable spasticity and storming
- **Morphine** - Opioids - receptors found in brain cardiovascular nuclei, cardiovascular system cause analgesia, ↓ RR ↓ HR ↓ BP

Blackman Arch of Neurology 2004
P.A.I.D./AUTONOMIC DYSREGULATION

- P.A.I.D. - acute phenomenon in low level of response population - 8-13% severe TBI in ICU population
- Can persist weeks to months. May continue >1 yr.
- Duration is longest in anoxic injuries
- Autonomic dysregulation can persist and occur in patients with higher levels of function - 5% acute rehab
  - Triggered by nociceptive stimuli
  - 5y post injury, triggered by injection

Baguley Am J. of PM&R 2009
NEUROBEHAVIORAL INTERVENTION IN THE ICU

- Environmental
- Pharmacologic
- Short term benefits
  - Decreased need for sedation
  - Improved participation in therapy
- Long term benefits?

[Image of a child in an ICU setting]
EVALUATION OF NEUROBEHAVIORAL STATUS IN PICU

- Pre-injury factors
  - Psychiatric
  - Developmental
  - Substance abuse
- Progression through RLA stages
- Temporal relationships between medical and behavioral events
- Patient perception of threat
- Medication effects
- EEG - evaluate for subclinical seizures
- Assess cognition and emergence from PTA
COMMON NEUROBEHAVIORAL ISSUES

- Impairments in
  - Arousal
  - Cognition-memory and processing speed
  - Impulse control
  - Behavioral regulation-agitation

- Executive dysfunction becomes apparent as delirium improves
NEUROBEHAVIORAL INTERVENTION

- Attention to medical issues
- Environmental modifications
- Avoid psychotropic side effects of medications when possible
- Treat pain
- Re-orient
- Consistency

- Limit perceived threat
- Regulate sleep/wake environment
- Physiologic feeding rhythms
- Errorless learning-proactive provision of correct information
- Coma stim

Arcinegas Crit Care Clinics 2008
**NEURO-TRANSMITTERS**

- **Serotonin**
  - Mood
- **Acetylcholine**
  - Attention
  - Arousal
  - Memory
  - New learning acquisition and retention
- **Dopamine**
  - Memory
  - Learning
  - Motivation
- **Norepinephrine**
  - Attention
  - Arousal
- **GABA**
  - Inhibitory neurotransmitter
- **Glutamate**
  - Learning
  - Memory long term
DECREASED AROUSAL, ATTENTION, PROCESSING

- Augmentation of catecholamine, dopaminergic function
  - Ritalin
    - processing speed
    - high level attention
  - Bromocriptine
  - Sinemet

- Greater recovery from early VS and MCS
- Amantadine
  - Fatigue
  - Distractibility
  - Arousal
  - Orientation
  - Initiation
  - Purposeful movement
  - Attention
  - Concentration
  - Sequencing and processing time

Spritzer The Neurol 2015
Patrick Brain Inj. 2003
Green Am J PM&R 2004
Meythler J Head Trauma Rehab 2002
AGITATION

- Types
  - Social
  - Predatory (purposeful acts)
  - Defensive - most like TBI agitation

- Animal models
  - Damage to
    - Hypothalamus
    - periaqueductal gray
    - limbic structure damage
  - Confrontational situations
    - ↑DA ↓serotonin

Lombard Am J. PM&R 2005
AGITATION MANAGEMENT

- **Environmental and behavioral intervention**
  - Calm, reassuring, predictable, limit perception of threat

- **Pharmacotherapy**
  - Address dysregulation of dopaminergic and cholinergic function
  - More evidence for normalizing dopaminergic function
  - Typical and atypical antipsychotics
  - Sedating medications
**TYPICAL ANTIPSYCHOTICS**

- Typical D2 receptor blockade side effects
  - Cognitive impairment
  - Extrapyramidal symptoms
- Haldol at 10mg/day 80% of striatal D2 receptors are occupied↑SE
- Animal studies suggest long term cognitive compromise from high dose long term use
- Clinical studies showed increased duration of PTA

Kline Critical Care Med 2007
Rao Arch Phys Med Rehabil 1985
Free Exp Neurol 2017
Combination therapy can be necessary and effective
Early clinical studies are promising
Atypicals-Act at various sites
- Serotonin
- Dopamine
- $\alpha_1$ adrenergic
- Muscarinic
- Histamine-1 receptors

Elovic J Head Trauma Rehabil 2008
REHABILITATION COURSE FOR TBI

- Provide a period of intensive intervention:
  - Promote functional recovery of skills
  - Family education

- Support re-entry into community and family:
  - Skill development
  - Education of key people to provide a supportive environment

- Provide long term support:
  - Understand needs
  - Identify strengths
  - Address specific deficits
SUMMARY

- Many opportunities for partnership of Rehabilitation and Acute/Critical care providers
- Improved acute critical care process
- Efficient, effective rehabilitation intervention
- Improved patient and family support
- Improved understanding of long term outcomes of acute/critical care interventions with cooperative research efforts