

REHABILITATION IN ACUTE TRAUMA CARE

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2017



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



**Australasian Faculty
of Rehabilitation
Medicine**



The Royal Australasian
College of Physicians

PMR

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

UROLOGY MANAGEMENT-PREVENT DAMAGE, ACHIEVE FUNCTIONAL CONTINENCE

► 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

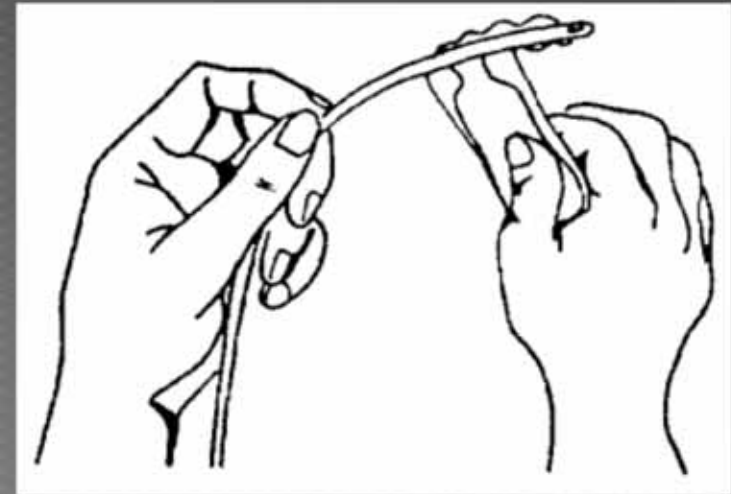
- Achievable goal
- May be neglected in young children
- May not have been continent prior to injury
- CIC participation should be treated as a milestone

Generao Journal of Urology 2004
Samson Phys Med Rehabil Clin N Am
2007



BENEFITS OF CIC

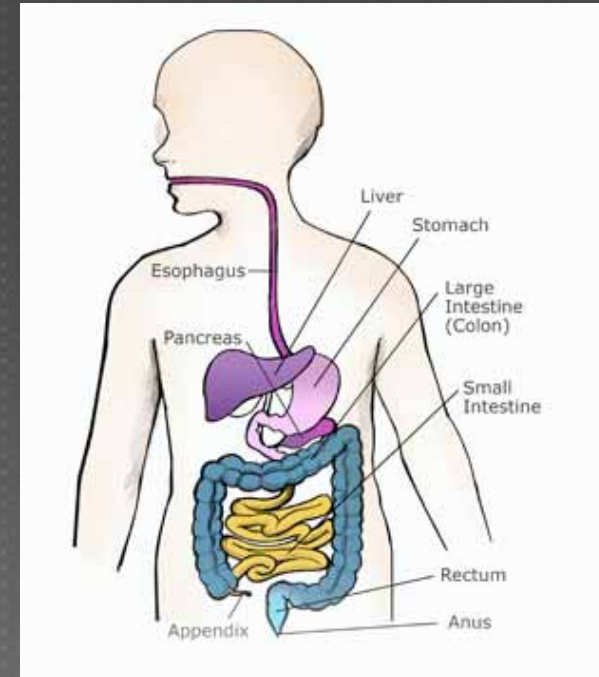
- ▶ High risk renal damage with cervical spine injuries
- ▶ CIC and Anticholinergics prevent
 - ▶ Hydronephrosis
 - ▶ Scarring
 - ▶ Reflux
 - Trabeculation



Generao, *Journal of Urology* 2004

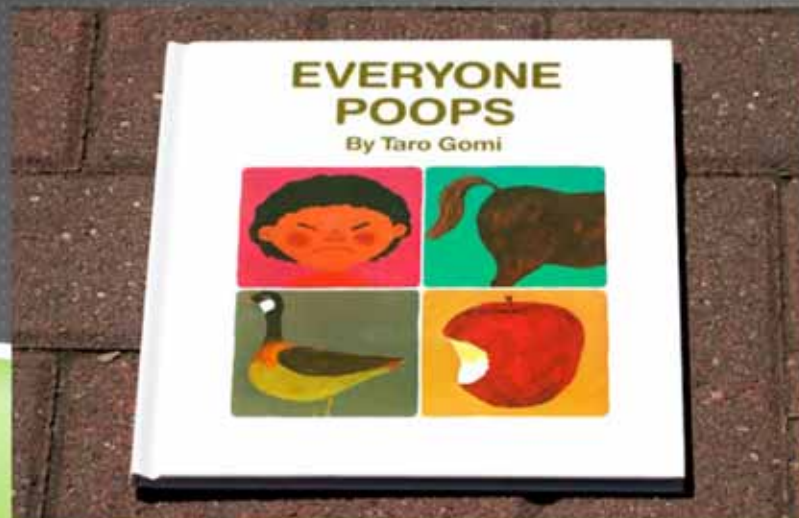
GI COMPLICATIONS SCI

- ▶ 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

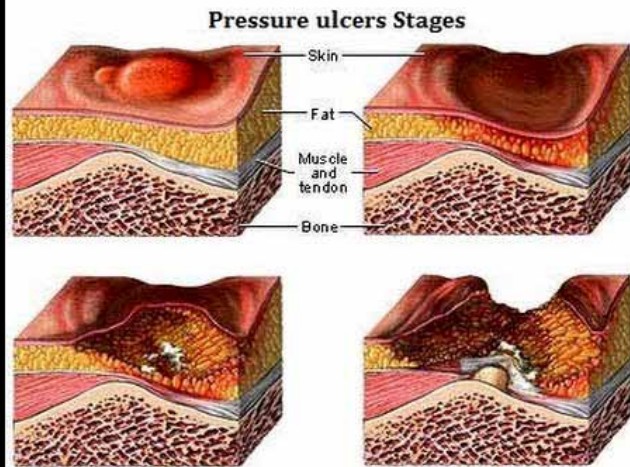
- ▶ Attitude
- ▶ Equipment
- ▶ Functional skill acquisition
- ▶ >80% require oral and/or rectal med regimen
- ▶ Surgical options



Goetz J Spinal Cord Med 1998

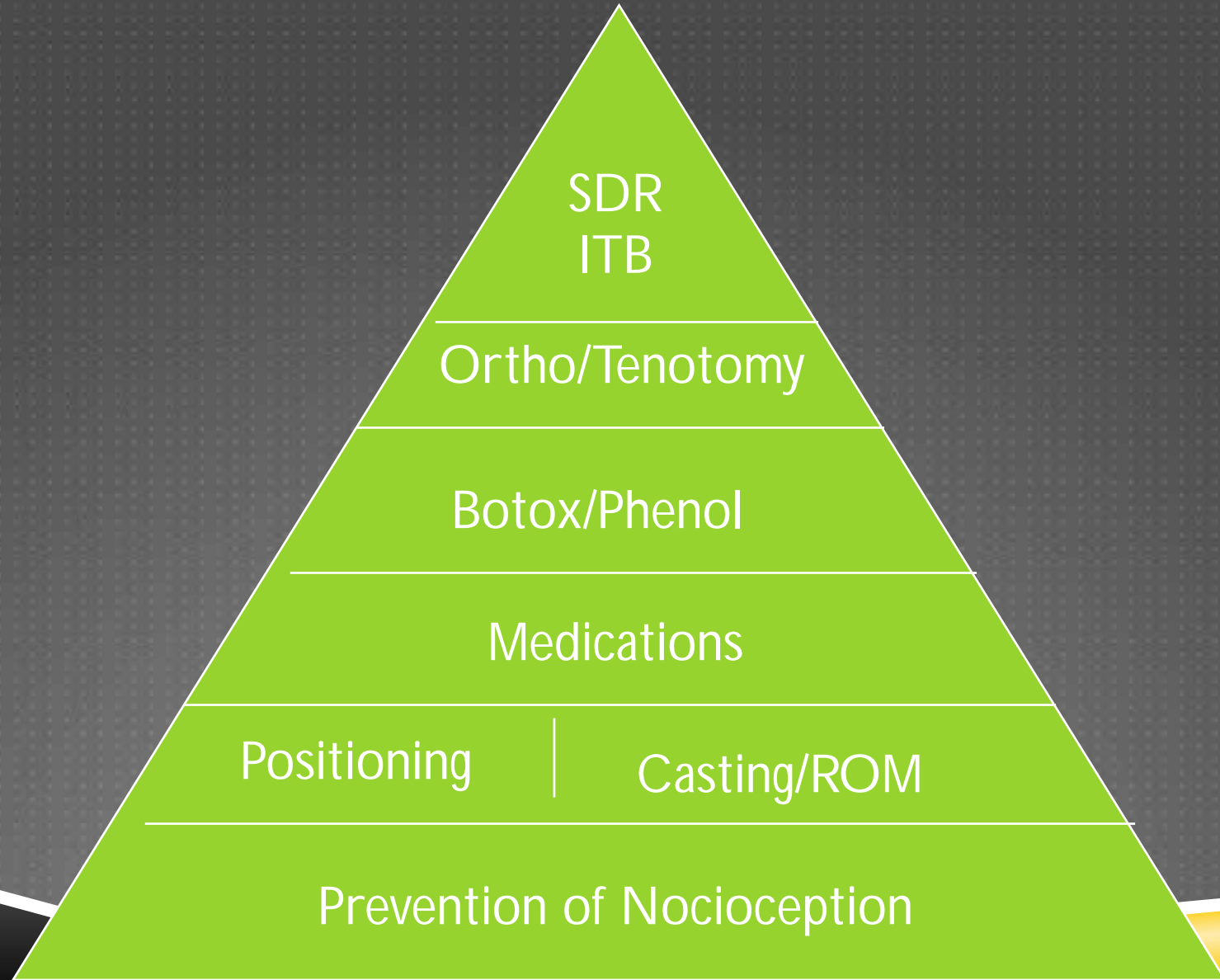
SKIN-INCIDENCE OF DECUBITI

- ▶ 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



AUTONOMIC DYSREFLEXIA

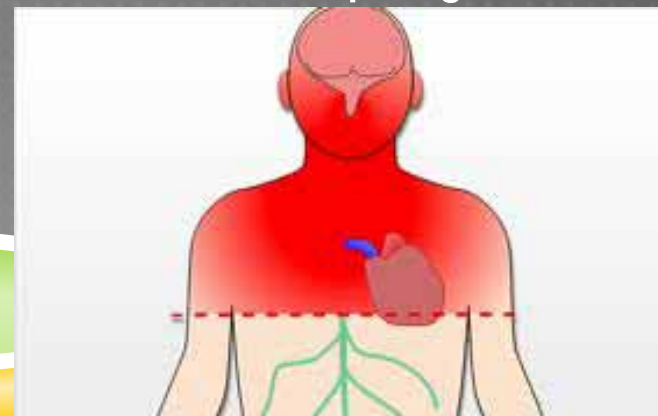
- ▶ T6 and above
- ▶ Noxious stim below level of injury
- ▶ Vasconstriction below/
Vasodilation above level of injury
- ▶ Increased vagal tone
 - ▶ Bradycardia
- ▶ Symptoms
 - ▶ Headache
 - ▶ Sweating above level
 - ▶ Flushing
 - ▶ Nasal congestion

▶ Acute Management

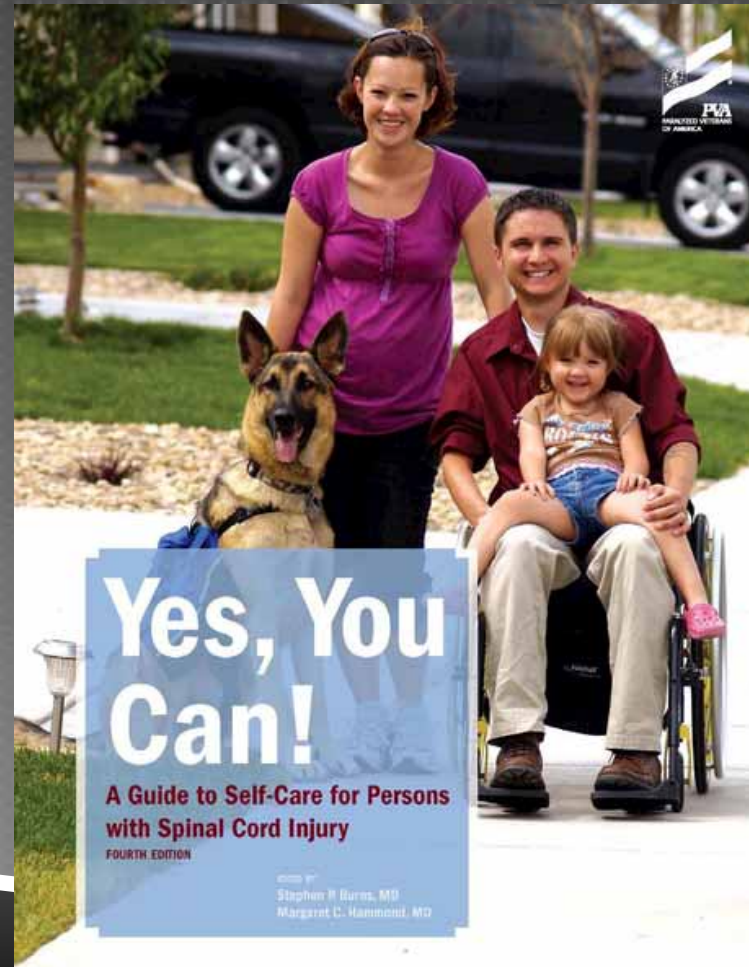
- ▶ Drain bladder
- ▶ Sit up
- ▶ Treat discomfort
- ▶ Nifedipine/
Nitroglycerine
paste

▶ Prevention

- ▶ Effective bowel and
bladder program



EDUCATION



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 MOSF
 - ▶ Can start as early as 2 days
- ▶ Ventilated >7days
 - ▶ 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



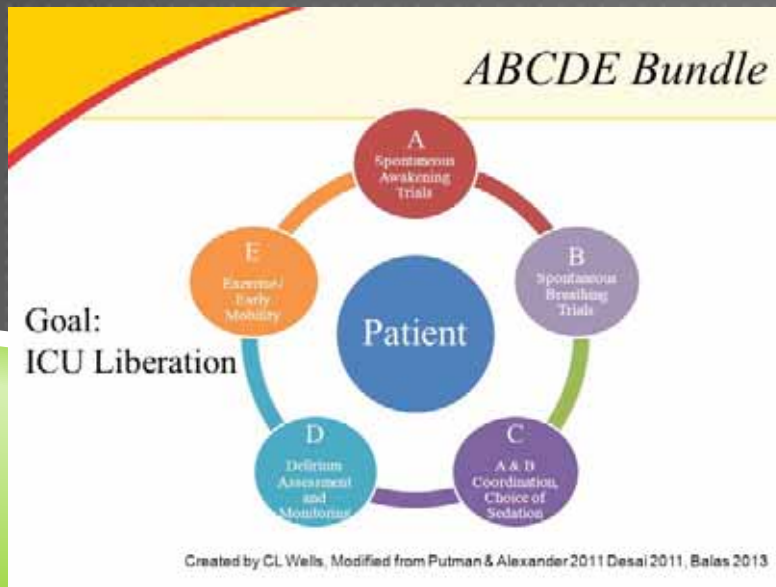
Schweickert *Lancet* 2009

Needham, *Arch Phys Med Rehabil* 2010

ABCDE 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



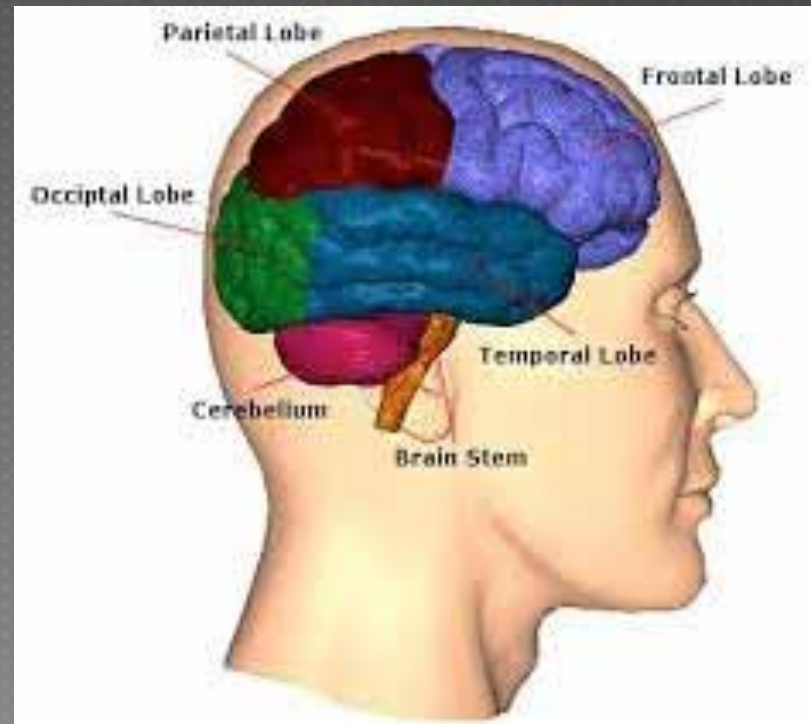
FAMILY EDUCATION

- ▶ 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



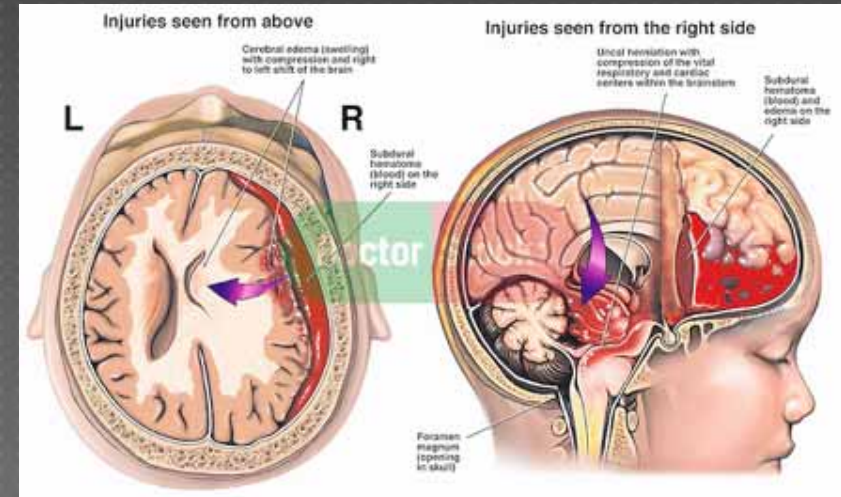
TBI COMMONLY INJURED AREAS

- ▶ Areas of vulnerability
 - ▶ Frontal lobes
 - ▶ Temporal lobes
 - ▶ Midbrain
 - ▶ White matter connections



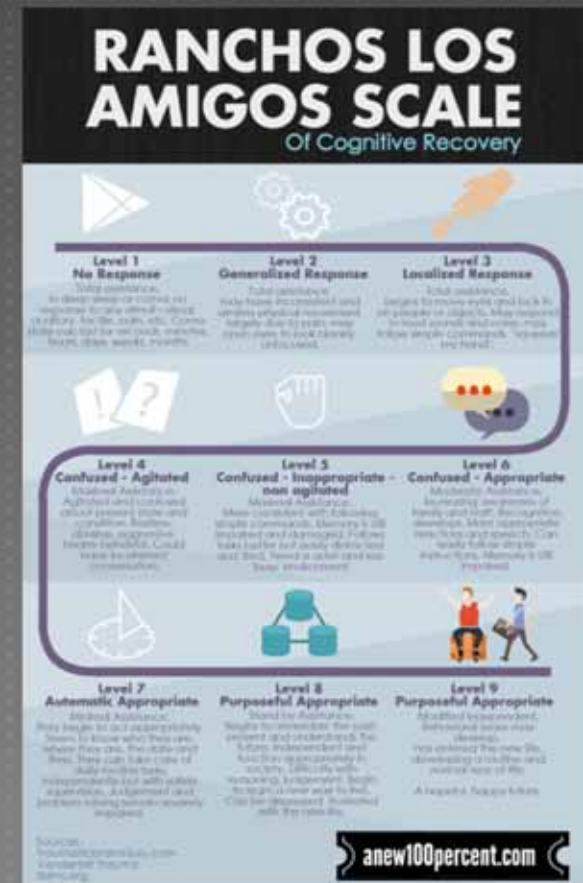
FUNCTIONS OF VULNERABLE AREAS

- ▶ 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



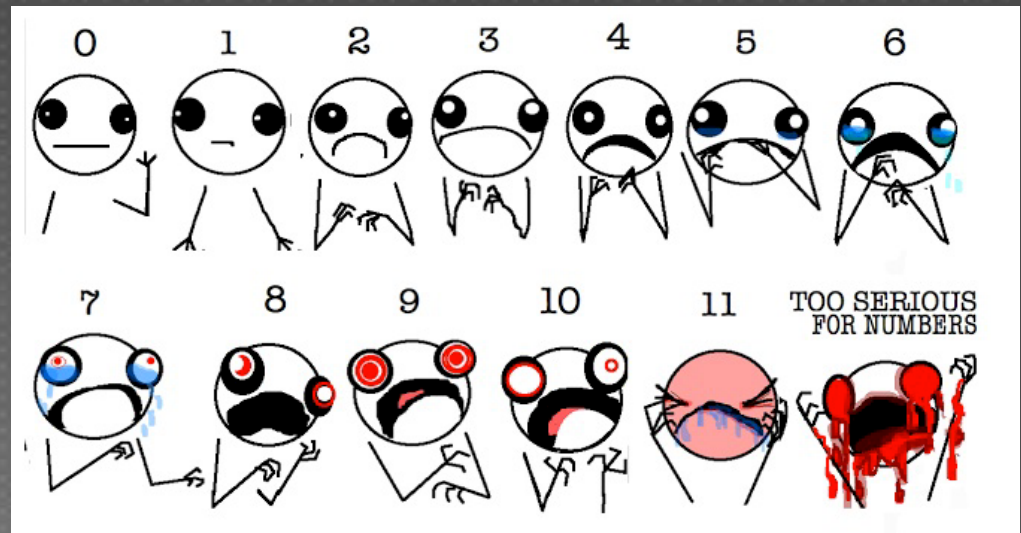
P.A.I.D. CRITERIA

- ▶ At least 1 cycle per day for >3 days
- ▶ +/- Triggered
- ▶ Constellation of:
 - ▶ Tachycardia
 - ▶ Tachypnea
 - ▶ Hyperthermia
 - ▶ Agitation
 - ▶ Hypertension
 - ▶ Diaphoresis
 - ▶ Dystonic posturing



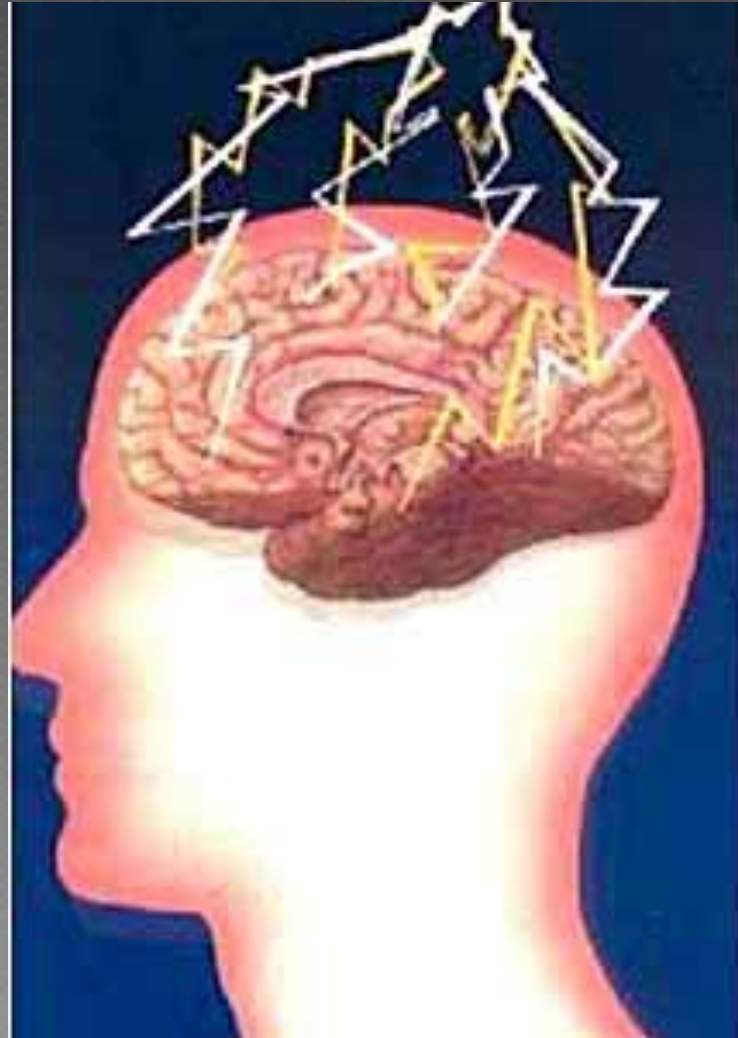
MIMICS-WHAT IT ISN'T

- ▶ 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

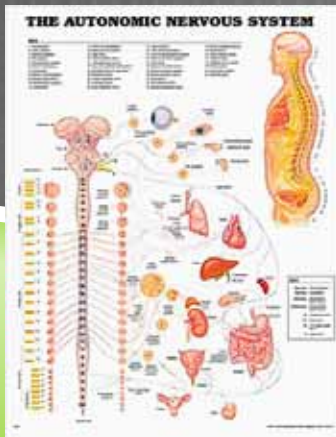
- ▶ **Bromocriptine**-Dopamine agonists- DA withdrawal causes NMS
- ▶ **Propranolol**-Nonselective β -adrenergic blockade-address HTN
- ▶ **Clonidine**-A2 adrenergic agonist-treat sympathetic signs
- ▶ **Ativan**- Benzodiazepines- anxiolytic, muscle relaxant
- ▶ **Dantrolene**-direct muscle relaxant, 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, \downarrow RR \downarrow HR \downarrow 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 >1yr.
- ▶ Duration is longest in anoxic injuries
- ▶ Autonomic dysregulation can persist and occur in patients with higher levels of function-5% acute rehab
 - ▶ Triggered by nocieptive stimuli
 - ▶ 5y post injury, triggered by injection



Baguley *Am. J. of PM&R* 2009

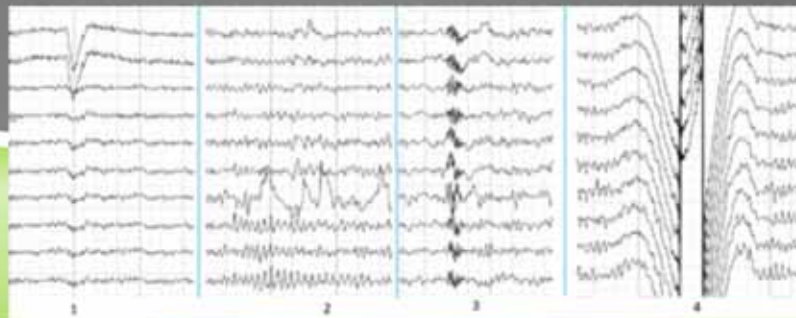
NEUROBEHAVIORAL INTERVENTION IN THE ICU

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



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

- ▶ Amantadine

- ▶ Fatigue
 - ▶ Distractibility
 - ▶ Arousal
 - ▶ Orientation
 - ▶ Initiation
 - ▶ Purposeful movement
 - ▶ Attention
 - ▶ Concentration
 - ▶ Sequencing and processing time

- ▶ Greater recovery from early VS and MCS

Spritzer *The Neurol* 2015

Giacino, *N Engl J Med* 2012

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

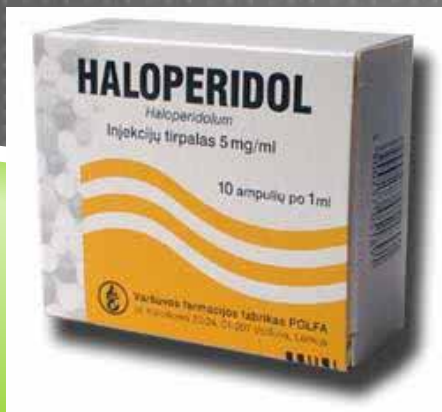
AGITATION MANAGEMENT

- ▶ 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

ATYPICAL ANTIPSYCHOTICS

- ▶ Combination therapy can be necessary and effective
- ▶ Early clinical studies are promising
- ▶ Atypicals-Act at various sites
 - ▶ Serotonin
 - ▶ Dopamine
 - ▶ α 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

