In 2010, 2.5 million people sustained a traumatic brain injury.
Estimated direct and indirect costs of TBI in 2010 was $76.5 billion
#1 cause is Falls in <4 yrs or >75 yrs
#1 fatalities due to TBI is MVA’s
Shaken baby syndrome is leading cause of child maltreatment deaths in the US
**Primary Injury Mechanisms—TBI**

- Most brain damage caused by acceleration-deceleration
- Diffuse axonal injury: Widespread stretching of axons caused by the rotation of the brain around its axis
- DAI may be seen on brain MRI
- www.medschool.lsuhsc.edu/physical_medicine/PPT/Agitation_Traumatic...

**Secondary TBI Injury Mechanisms**

- ICH (ex. SDH)
- Brain edema
- Oxidant injury
- Hypoxia secondary to cerebral perfusion pressure
- Excitotoxicity: Neuronal damage caused by accelerated release of excitatory neurotransmitters by injured neurons
- www.medschool.lsuhsc.edu/physical_medicine/PPT/Agitation_Traumatic...

**International Consensus Definition**

- “Concussion is a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.”
- Signoretti, PMR 2011

**Severity Grading**

<table>
<thead>
<tr>
<th>TBI</th>
<th>GCS</th>
<th>PTA</th>
<th>LOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>13–15</td>
<td>&lt;1 day</td>
<td>30 min</td>
</tr>
<tr>
<td>Moderate</td>
<td>9–12</td>
<td>&gt;1 - &lt;7 days</td>
<td>&gt;30min – &lt;24hrs</td>
</tr>
<tr>
<td>Severe</td>
<td>3–8</td>
<td>&gt;7 days</td>
<td>&gt;24 hrs</td>
</tr>
</tbody>
</table>
TBI patient issues

- Spasticity
- Heterotopic ossification
- Posttraumatic epilepsy
- Posttraumatic hydrocephalus
- Cranial nerve damage
- Sleep disorders
- Dysphagia
- DVT
- Skin breakdown
- Post traumatic amnesia/AGITATION

Definition of agitation in TBI

- “Subtype of delirium occurring during the period of post traumatic amnesia, characterized by excessive behaviors including some combination of aggression, disinhibition, akathisia, and emotional lability.”
  - A 1996 literature review featured in the Archives of PM&R by Sandel & Mysiw, 77:617-623
- “State of aggression during PTA. Occurs in the absence of other physical, medical or psychiatric cases. Manifested by intermittent or continuous verbal or physical behaviors.”
Etiology of agitation

- Brain trauma disrupts the catecholamine/neurotransmitter pathways: surges of norepinephrine and epinephrine have been documented in the plasma and CSF.
- TBI patients can also have hypothalamic dysfunction affecting temperature, blood pressure, etc.
- [www.ohsu.edu/xd/research/centers-institutes/neurology/...](www.ohsu.edu/xd/research/centers-institutes/neurology/...)

Diagnosing agitation

- A diagnosis of exclusion after medical and neurological conditions have been ruled out
- Must rule out metabolic derangement, hypothyroidism, infection/sepsis, hypoglycemia, hypoxemia (PE), medications such as anticholinergics
- Drug withdrawal (ex. Sedatives, hypnotics)
- [www.ohsu.edu/xd/research/centers-institutes/neurology/...](www.ohsu.edu/xd/research/centers-institutes/neurology/...)

Diagnosing agitation continued...

Neurologic complications such as seizures, hydrocephalus, IC mass lesions, and migraine are possibilities that must be investigated. Psychiatric conditions – mania, psychosis, anxiety, dementia, disrupted sleep/wake cycles....

PAIN – undiagnosed fractures
- Excessive stimulation, temp, restraints

AGITATED BEHAVIOR SCALE

<table>
<thead>
<tr>
<th>Patient Period of Observation:</th>
<th>a.m.</th>
<th>p.m.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observ. Environ. From:</td>
<td>a.m.</td>
<td>p.m.</td>
</tr>
<tr>
<td>Rater/Disc. To:</td>
<td>a.m.</td>
<td>p.m.</td>
</tr>
</tbody>
</table>

At the end of the observation period indicate whether the behavior described in each item was present and, if so, to what degree: slight, moderate or extreme. Use the following numerical values and criteria for your ratings.

1 = absent: the behavior is not present.
2 = present to a slight degree: the behavior is present but does not prevent the conduct of other, contextually appropriate behavior. (The individual may redirect spontaneously, or the continuation of the agitated behavior does not disrupt appropriate behavior.)
3 = present to a moderate degree: the individual needs to be redirected from an agitated to an appropriate behavior, but benefits from such cueing.
4 = present to an extreme degree: the individual is not able to engage in appropriate behavior due to the interference of the agitated behavior, even when external cueing or redirection is provided.

DO NOT LEAVE BLANKS:
1. Short attention span, easy distractibility, inability to concentrate.
2. Impulsive, impatient, low tolerance for pain or frustration.
3. Uncooperative, resistant to care, demanding.
4. Violent and/or threatening violence toward people or property.
5. Explosive and/or unpredictable anger.
6. Rocking, rubbing, moaning or other self-stimulating behavior.
7. Pulling at tubes, restraints, etc.
8. Wandering from treatment areas.
9. Restlessness, pacing, excessive movement.
10. Repetitive behaviors, motor and/or verbal.
11. Rapid, loud or excessive talking.
12. Sudden changes of mood.
13. Easily initiated or excessive crying and/or laughter.
14. Self-abusiveness, physical and/or verbal.

Total Score
Ohio State Agitation Behavior Scale

- For clinical purposes, we consider any scores (Total or converted subscale) 21 or below to be within normal limits; from 22 through 28 to indicate mild occurrence; 29 through 35 to indicate moderate; and more than 35 to be severe.
- http://tbims.org/combi/abs/

Tests suggested to evaluate the agitated patient

- CMP, Thyroid function, CBC with differential, UA, B12/folate, tox screen, Brain CT/MRI, EEG, XR (see if occult fractures/heterotopic ossification causing pain)
- www.medschool.lsuhsc.edu/physical_medicine/PPT/Agitation_Traumatic...

Rancho Los Amigos Scale of Cognitive Functioning

- Developed at the California Hospital of the same name
- Rancho I: No response to any stimulation; appears to be sleeping
- Rancho II: Generalized Response
- Rancho III: Localized response

Rancho Los Amigos scale (continued)

- **RANCHO IV: Confused, Agitated, may be aggressive
- Rancho V: Confused, Inappropriate, nonagitated
- Rancho VI: Confused, appropriate
- Rancho VII: Automatic, appropriate
- Ranch VIII: Purposeful, appropriate
Management

- Environment
- Educate Staff and Family
- Behavior
- Medication

Environmental Management

- FIRST REDUCE STIMULI—light, noise, distractions
- Patient should have a limited number of visitors at a time
- EVERYONE should speak in a low volume, one at a time

Environmental Management

- To reduce patient confusion:
  - Consistent schedule and staffing
  - Don’t move patient to another room
  - Reorient person frequently

Environmental Management

- AVOID RESTRAINTS IF AT ALL POSSIBLE
- Padded hand mittens if necessary
- Soft lap belt in the wheelchair
- Heavy, stable wheelchair that will not tip over
- Limit lines/tubes, cover (abdominal binder)
- Timed voiding for toileting
Behavioral Strategies

- Tolerate patient’s restlessness as much as possible (ex. Allow patient to pace if ambulatory)
- Mobile patients may need a closed unit or sensor unit for their safety
- Remove lines tubes ASAP
- Consider Craig bed or Vail bed

Medications – sleep

- Consider trazodone or other TCA to establish more normal sleep wake cycles.
- Limit caffeine

Medication – Restlessness/Akathisia

- Increase therapy/activity
- Frequent ambulation
- Beta-blockers
- Dopaminergic neurostimulants – Amantadine, Bromocriptine

Medication – Hyperandrenergic State

- Beta-blocker
- Titrate until heart rate and/or blood pressure controlled. As patient recovers hyperandrenergic state recedes and medication can be reduced/discontinued.
Medication–Episodic Behavior Dyscontrol/Mood Lability

- Anticonvulsants/Mood Stabilizers
- Tegretol, Valproate
- SSRI’s
- +/- Atypical antipsychotics

Medications – other

- Anxious/Fearful: environmental (family)
  - Buspirone
  - SSRI’s/TCA’s
  - Trazodone

Paranoid/Suspicious: family
- Atypical antipsychotics – Risperdal, Seroquel

Cochrane Review 2008

- Fleminger, Greenwood, Oliver. Prescription drug use for managing agitation and aggression in people with acquired brain injury. 16 July 2008 online
- No firm evidence that medications are effective.
- Weak evidence, small RCT beta blockers can improve aggression, but need high doses/SE
- Other classes, no reasonable size RCT’s
- Acedotal evidence antipsychotics, mood stabilizers, antidepressants may be helpful.

Antipsychotics

- Ex. Haldol: The typical agents, in both human and animal studies, have been shown to cause a decline in cognitive performance (verbal ability, memory, learning, attention, spatial ability.....once the medication was stopped, cognition improved)
  Stanislav et al, Brain Injury 1997, p335–41
Beta Blockers

- Two placebo-controlled, blinded studies with propanolol showed decreased agitation in patients with TBI.
- Also helps to control tachycardia and hypertension found in many TBI patients

Brooke et al., Arch Phys Med Rehabil 73, Oct 1992, 917-921

Dopamine agonists (amantadine, bromocriptine), SSRIs, methyphenidate, and TCA's have not been shown to control agitation successfully, but do improve alertness/initiation

Medication

Long term sequelae of TBI

- Problems with cognition (thinking, memory, reasoning) and behavioral or mental health (depression, anxiety, personality changes, aggression, acting out and social inappropriateness)

Long-term sequelae

- Seizures: Increased risk 17–95x in severe, up to 6.6x in mod and 1.5x in mild
- Dementia (DAT): HR of 2.32 in mod, 4.51 in severe
- Parkinsons: associated with mod, severe TBI, clear link with boxers
- Language and communication difficulties: Aphasia, dysarthria, dysphagia, prosodic dysfn
- Hypopituitarism, GH def: mod, severe TBI
- Heterotopic Ossification: incidence 7–76% more common in severe, esp with autonomic dysregulation

Long-term sequelae

- 3 year post injury prospective study found improvements in home integration, social integration and productivity that continued throughout the 3 years.
- Clinical determinants of TBI severity like GCS, CT abnormalities, hypoxia, hypotension or hypothermia predict short term outcome, but not long term.

Pediatric Population


- Of 4 groups infant, preschool, middle childhood and late childhood: middle childhood (7–9yrs) had lower IQ scores across all domains, infant and preschool gps performed below the late childhood gp on nonverbal and processing speeds domains
**Resources**

- Brainline.org – for lay and professionals
- [http://ocamp.org](http://ocamp.org): Oregon Concussion Awareness and Management Program

**Sideline Assessment & Beyond**

- SCAT 2
- ImPACT testing in community – The Center 541–382–3344, Desert Orthopedics 541–388–2333

**Objectives**

- Review of rehab interventions
  - Physical Therapy
  - Occupational Therapy
  - Speech Therapy
- Best practices for TBI management
  - Acute
  - Rehab
  - Outpatient / post discharge

**Rehab Interventions: PT**

- Mobility
- Gross motor
- CGT with family
Oral Care
- Brushing after each meal and cleaning dentures daily, (and weekly professional oral care) significantly reduces aspiration pneumonia in geriatric population.

(van der Maarel-Wiernink, 2013)

Best Practices – Acute

- Coma Recovery Scale (CRS–R)

http://www.tbims.org/combi/crs/CRS%20for.pdf
Best Practices – Acute

- Cognitive challenges affecting communication
  - Attention / Memory
  - Mental processing speed
  - Initiation
  - Anasognosia (lack awareness of deficits)
  - Executive functions / Problem solving
  - Personality / Lability / Affect

Best Practices – Acute/Rehab

- Rancho IV–V
  - Barriers
    - Safety Awareness/problem solving
    - Initiation
    - Sequencing
    - Easily agitated
  - Strategies
    - Orientation / Introduction
    - Functional activities
    - Low stim
    - Consistency in schedule

Best Practices – Acute / Rehab

- Rancho IV–V
  - Interventions
    - PT
    - Mobility
    - OT
    - Cognition / Attention
    - ADL's
    - Vision
    - SLP
    - Language / Cognition / Memory
    - Speech
    - Dysphagia

Best Practices – Acute/Rehab

- Rancho IV–V
  - Dysphagia Management
    - MBSS = Gold standard for swallow
    - Tracheostomies complicate progress
    - Exercises are effective

Rancho IV–V
- Dysphasia and Tracheostomies
  - Patients with trachs more likely to aspirate (Ding and Logmann, 2005)
  - Not sure trachs “cause” dysphagia
  - Blue dye tests: 30% of aspiration undetected
  - Inflated cuff does not prevent aspiration!

Silent aspiration video
http://www.youtube.com/watch?v=1sFNMk87558

Rancho VI–VIII
- Barriers
  - Awareness of deficits
  - Distractable
  - Executive function deficits
- Strategies
  - Schedule
  - Orientation
  - Structured environment

SLP Barriers
- Frustrating when communication is severely impaired
- Cognitive impairment can be very challenging to accept
- Expectations: perspective makes a difference
Best Practices – Rehab/Outpatient

- Rancho VI–VIII
  - Interventions
    - PT
      - Gait, Balance, Vestibular
    - OT
      - ADLs/IADLs
      - Vision
      - Cognition
    - SLP
      - Compensatory memory strategies
      - Encourage metacognitive skills, executive functions
      - Home evals
      - Community outings

Inpatient and Outpatient Rehab

- Vestibular trained therapists
- Neurologic Certified Specialists
- Geriatric Certified Specialists
- Vision trained therapists

Vestibular rehab

- 400,000–500,000 Americans suffer serious head injuries annually. A majority of these individuals complain of dizziness for up to five years following the injury, and many are disabled by this symptom."


- “Patients after mild and moderate TBI were followed up for 5 years post–injury. At 5 years, 20% of the ‘minor’ head injury group and 47% of the ‘moderate’ head injury group remained dizzy. There was no mention of concurrent rehabilitation. . .”

Frenzel lenses

Outpatient OT

- Transition to home, school, work environment
- Link with community resources
- Visual perceptual screening and functional interventions
  - Dynavision: http://www.youtube.com/watch?feature=player_embedded&v=kUhoyhCSIkg

St Charles Driving Program
- Must have a valid ODL and MD prescription
  - (541) 706-7725
- Vision Screening
Outpatient SLP

- Neuromuscular Electrical Stimulation for Dysphagia
- Secure and train a communication device: http://www.youtube.com/watch?v=Ad9EGRp60Pc
- Address the “walking wounded’s” needs: https://www.youtube.com/watch?v=hvLYuz8i9Kk

Local Support Groups

- “Moving Ahead” for survivors and their family/caregivers.
  - 1st and 3rd Thursday every month 5:30–7pm.
  - 2525 NE Twin Knolls Dr. Suite 150.
  - 541–388–8103 X 205
- Brain injury support group
  - 2nd Saturday of each month
  - 11–12:30 in the SCMC RCR
  - Contact Dave Accornero
  - 541–382–9451

Community Resources

- St. Charles OP
  - (541) 706–7725
- Volunteers in Action
  - (541) 548–7018
- LINC
  - (541) 475–4446
  - lincmadras.org
- Opportunity Foundation
  - (541) 389–0129
  - ofco.com
- Abilitree
  - (541) 388–8103
  - abilitree.org
- Residential Assistance Program (RAP)
  - (541) 388–3060
  - residentialassistanceprogram.org
- Full Access
  - (541) 284–5070
  - fullaccess.org
- The ARC of Central Oregon
  - (541) 390–4436
  - arcoregon.org
- Therapeutic Recreation through Bend Parks and Rec
  - (541) 389–7275
  - bendparksandrec.org
- Oregon Adaptive Sports
  - (541) 306–4774
  - oregonadapativesports.org
- Vocational Rehab
  - (541) 388–6336
- The Center Foundation
  - 541–382–3344

Multidisciplinary Concussion Management Clinic

- Starting in September 2014 at the Center
- St. Charles Neuropsych, COPA Neuropsych, St. Charles PT, OT, ST, SW
- Pediatric and adult