Screening for Delirium in Acute Brain Injury

Jeffrey Singh MD FRCPC MSc
Toronto Western Hospital
Interdepartmental Division of Critical Care
University of Toronto
Disclosures

• I am the recipient of an unrestricted quality improvement grant from *Hospira*
  – Delirium screening
  – Sedative protocols
  – Early mobility

• Honoraria from Snell Medical
Objectives

• Explore challenges in screening for delirium in patients with brain injuries

• Rationale for why these patients may be similar to and different from other ICU patients

• Review preliminary data from our institution
What is Delirium?

• Delirium is a common clinical syndrome characterized by:
  
  Acute onset of Cognitive dysfunction with Inattention

Delirium: Pathophysiology

- Disruption of neurotransmitters
- Neuroinflammation
ICU Delirium is Common

• 20-80% of ICU patients develop delirium
  – Frequently unrecognized/misdiagnosed by clinicians
• Onset: ICU Day 2 (± 2)
• Duration: 4 (± 2) days
• 50% & 10% delirious at ICU & hospital discharge

Peterson et al., JAGS 2006;54:479-484.
Fan E et al., Crit Care Med 2008;94-99.
Incidence of Delirium in the ICU

Medical ICU: 66 - 90%
- Hyperactive 1%
- Hypoactive 35%
- Mixed 64%

Trauma ICU: 67%
- Hyperactive 2%
- Hypoactive 60%
- Mixed 6%

Sx ICU: 73%
- Hyperactive 1%
- Hypoactive 64%
- Mixed 9%

Ely, et al., JAMA 2001; 286: 2703-2710
Peterson, et al., JAGS 2003; P394
Pandharipande, et al., J Trauma 2008; 65:34-41
Why Do We Care About Delirium?

• Delirium is an independent predictor of:
  – Longer ICU stay
  – Longer hospital stay
  – Increased mortality
  • ICU
  • Hospital
  • 6-month
• 5x self extubation; >2x reintubation

Why We Need to Care About Delirium

BRAIN NOT CLEAR!

HELP
Delirium in Brain Injury

• ‘Acute confusional state’ has long been described following traumatic brain injury

• Fluctuations in arousal and cognition are expected following mild and severe TBI

• Is this all a problem with nosology / classification?
Post TBI Encephalopathy

Coma → Delirium → Amnesia → Dysexecutive Synd.
### Post TBI Cognitive Impairments

<table>
<thead>
<tr>
<th>PTE Stage</th>
<th>Key Neurobehavioral Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttraumatic Coma</td>
<td>Impaired arousal</td>
<td>A complete impairment of arousal (wakefulness) in which there is no response to sensory input and no spontaneous behavior (purposeful or non-purposeful).</td>
</tr>
<tr>
<td>Posttraumatic</td>
<td>Impaired attention</td>
<td>A state in which there is reduced clarity of awareness of the environment, as evidenced by a reduced ability to focus, sustain, or shift attention.</td>
</tr>
<tr>
<td>Delirium</td>
<td></td>
<td>• alterations of arousal, which may fluctuate over minutes, hours, or days;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• disturbances of sleep-wake cycle;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• motor restlessness;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• impairments of processing speed, working memory, episodic memory (including orientation), language/communication, and executive function;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• perceptual disturbances (i.e. hallucinations)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• emotional lability;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• verbally, physically, and/or sexually disinhibited behavior, agitation, and/or aggression.</td>
</tr>
</tbody>
</table>

Arciniegas, DB. *Psychiatr Ann.* 2011
Structural Brain Injury and Delirium

• Structural associations:
  – Loss of brain volume
  – Neuronal atrophy
  – Loss of white matter integrity

• Role of inflammation and neuronal loss

*Findings common to Medical-Surgical and TBI patients*
Brain Volumes and Delirium

- Association between decrease brain volume and delirium

Brain Volumes and Delirium

Brain Volumes and Delirium

- Every 3 days increase in duration of delirium

2.4 cm³ difference in superior frontal lobe

1 cm³ = sugar cube
White Matter in ICU Delirium

- Loss of white matter tracts
  - At discharge
  - At 3 months
  - Worse cognitive scores at 12 months
White Matter in Stroke

- Loss of white matter tracts associated with cognitive deficits
White Matter in TBI

• Loss of white matter tracts and axonal injury associated with cognitive deficits in TBI
Delirium Assessment

CAM-ICU

1. Does patient have adequate arousal for CAM-ICU?
   Yes
   No

2. Acute Change or Fluctuating Mental Status:
   - Acute change from mental status baseline? OR
   - Has the patient’s mental status fluctuated during the past 24 hours?

3. Inattention:
   - Ask: Squeeze my hand when I say the letter ‘A’
   - Read the following sequence of letters:
     S A V E A H A A R T
   - ERRORS: No squeeze with ‘A’ & Squeeze on other letter other than ‘A’
   - If unable to complete —> Letters or Pictures

5. Disorganized Thinking:
   1. Will a stone float on water?
   2. Are there fish in the sea?
   3. Does one pound weigh more than two?
   4. Can you use a hammer to pound a nail?
   Or COMMANDS:
      “Hold up this many fingers” (Hold up 2 fingers)
      “Now do the same thing with the other hand” (Do NOT demonstrate) OR
      “Add one more finger” (If patient unable to move both arms)

ICDSC

TOTAL SCORE (0–8):

Level of consciousness:
A: No response
B: response to intense and repeated stimulation (loud voice and pain)
C: response to mild or moderate stimulation
D: normal wakefulness
E: exaggerated response to normal stimulation

Score:
none
1
1
0
1
1

SCORING SYSTEM:
1. Altered level of consciousness:
   A) No response or B) the need for vigorous stimulation in order to obtain any response signifies a severe alteration in the level of consciousness precluding evaluation. If there is coma (A) or stupor (B) most of the time period then a drowsy (-) is entered and there is no further evaluation during that period.
   D) Drowsiness or requirement of a mild to moderate stimulation for a response implies an altered level of consciousness and scores 1 point.
   E) Hyperactivity is rated as an abnormal level of consciousness and scores 1 point.

2. Disorientation: Any obvious mistake in time; place or person scores 1 point.
3. Hallucinations, delusions or psychosis: The unequivocal clinical manifestation of hallucinations or delusions probably due to hallucinations (e.g., trying to catch a non-existent object) or delusions. Gross impairments in reality testing. Any of these scores 1 point.
4. Psychomotor agitation or retardation: Hyperactivity requiring the use of additional sedatives or restraints in order to control potentially dangerous (e.g., pulling out IV lines, biting staff). Hypoactivity or clinically noticeable psychomotor slowing. Any of these scores 1 point.
5. Inappropriate speech or mood: Inappropriate, disorganized or incoherent speech. Inappropriate display of emotion related to events or situation. Any of these scores 1 point.
6. Sleep/wake cycle disturbance: Sleep less than 4 hours or waking frequently at night (do not consider wakefulness initiated by medical staff or loud environment). Sleeping during most of the day. Any of these scores 1 point.
7. Symptoms fluctuations: Fluctuation of the manifestation of any item or symptom over 24 hours (e.g. from one shift to another) scores 1 point.

If A or B do not complete patient evaluation for the period

Inattention
Disorientation - delusion – psychosis
Psychomotor agitation or retardation
Inappropriate speech or mood
Sleep/wake cycle disturbance
Symptom fluctuation

Jitendra Sharma MD, MPH, and Vanderbilt University, 2002
Confusion Assessment Method for the ICU (CAM-ICU)

**Feature 1:** Acute change or fluctuating course of mental status

And

**Feature 2:** Inattention

And

**Feature 3:** Altered level of consciousness

Or

**Feature 4:** Disorganized Thinking

---

DSM-IV
Ely EW et al., JAMA 2001;286:2703-2710.
CAM-ICU in Stroke Patients

- Validated CAM-ICU instrument in cohort of patients with acute stroke
- Findings:
  - CAM-ICU highly sensitive and specific in stroke patients
  - Similar characteristics in patients with altered LOC
  - High incidence of post-stroke delirium

Table 2. Criterion validity of the CAM-ICU reported as sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy.

<table>
<thead>
<tr>
<th>Group Total Assessments</th>
<th>All 1003</th>
<th>Richmond Agitation and Sedation Scale &lt;0 240</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CAM-ICU Positive</td>
<td>CAM-ICU Negative</td>
</tr>
<tr>
<td>Diagnostic and Statistical Manual of Mental Disorders positive</td>
<td>225 (true-positive)</td>
<td>60 (false-negative)</td>
</tr>
<tr>
<td>Diagnostic and Statistical Manual of Mental Disorders negative</td>
<td>12 (false-positive)</td>
<td>706 (true-negative)</td>
</tr>
</tbody>
</table>

- **Sensitivity (95% CI)**
  - CAM-ICU: 76.0 (54.9–90.6)
  - Richmond Agitation and Sedation Scale: 85.0 (62.1–96.8)

- **Specificity (95% CI)**
  - CAM-ICU: 98.1 (93.2–99.8)
  - Richmond Agitation and Sedation Scale: 97.1 (85.1–99.9)

- **Positive predictive value (95% CI)**
  - CAM-ICU: 90.5 (69.6–98.8)
  - Richmond Agitation and Sedation Scale: 94.4 (88.3–97.9)

- **Negative predictive value (95% CI)**
  - CAM-ICU: 94.4 (88.3–97.9)
  - Richmond Agitation and Sedation Scale: 91.9 (78.1–98.3)

- **Overall accuracy (95% CI)**
  - CAM-ICU: 93.8 (88.2–97.3)
  - Richmond Agitation and Sedation Scale: 92.7 (82.4–98.0)
Delirium After TBI

- 97 patients TBI at Vanderbilt TICU
  - Mild traumatic brain injury
  - Continuous $O_2$ saturation data

- Hypothesis: hypoxia related to delirium and long-term cognitive impairment

Does Hypoxia Affect Intensive Care Unit Delirium or Long-Term Cognitive Impairment After Multiple Trauma Without Intracranial Hemorrhage?

Oscar D. Guillamondegui, MD, MPH, Justin E. Richards, MD, E. Wesley Ely, MD, MPH, James C. Jackson, PsyD, Kristin Archer-Swygart, PhD, DPT, Patrick R. Norris, PhD, and William T. Obremskey, MD, MPH

Guillamondegui OD et al. J Trauma. 2011
Delirium After TBI

- Delirium common after TBI
  - 57% CAM-ICU positive
- 37/61 (61%) had cognitive impairment at 12 months
- Hypoxemia NOT associated with ICU delirium or long-term outcomes

Does Hypoxia Affect Intensive Care Unit Delirium or Long-Term Cognitive Impairment After Multiple Trauma Without Intracranial Hemorrhage?

Oscar D. Guillamondegui, MD, MPH, Justin E. Richards, MD, E. Wesley Ely, MD, MPH, James C. Jackson, PsyD, Kristin Archer-Swygert, PhD, DPT, Patrick R. Norris, PhD, and William T. Obremskey, MD, MPH
Our Experience at TWH

• Part of a larger multifaceted quality improvement project
  – Delirium screening
  – Sedation stewardship
  – Coordination of SAT/SBT
  – Early Mobility
Toronto Western Hospital

- Part of UHN
- 236 beds
- 26 bed MSNICU
  - 45% neuroscience
- Specialty Programs
  - Neurosurgery / Spine
  - Neurology / Stroke
  - Ortho / Hand
  - Bariatric
  - Ophthalmology
Study Cohort

- Cohort assembled from 2 consecutive audit periods following training in CAM-ICU

<table>
<thead>
<tr>
<th></th>
<th>Acute Brain Injury N=65</th>
<th>Medical-Surgical / Spine N=147</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>58 (48-73)</td>
<td>67 (51-78)</td>
</tr>
<tr>
<td>Gender, Male N (%)</td>
<td>35 (54%)</td>
<td>92 (63%)</td>
</tr>
<tr>
<td>APACHE II, Median (IQR)</td>
<td>17 (14-21)</td>
<td>24 (20-27)</td>
</tr>
<tr>
<td>Admission GCS*, Median (IQR)</td>
<td>13 (5-13)</td>
<td>13 (10-14)</td>
</tr>
<tr>
<td>ICU Length of Stay, Median (IQR)</td>
<td>5 (3-8)</td>
<td>5 (2-11)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial Hemorrhage (ICH/SDH/SAH)</td>
<td>33 (51%)</td>
</tr>
<tr>
<td>Post Craniotomy</td>
<td>13 (20%)</td>
</tr>
<tr>
<td>Seizures / Status Epilepticus</td>
<td>4 (6%)</td>
</tr>
<tr>
<td>Other Neurologic</td>
<td>15 (23%)</td>
</tr>
</tbody>
</table>
Challenges in Assessment

• Decreased arousal in non-sedated brain injured patients
• Inability to differentiate decreased arousal and neurocognitive failure from:
  – Acquired structural brain injury
  – Pre-existing cognitive dysfunction / deficits
  – Delirium
Challenges in Assessment

- Inability to differentiate changes and fluctuations in arousal and neurocognitive function due to:
  - Evolution of structural brain injuries
  - New brain injuries (delayed ischemia, etc.)
  - Delirium
## Coma and Delirium

<table>
<thead>
<tr>
<th></th>
<th>Acute Brain Injury N=65</th>
<th>Medical-Surgical / Spine N=147</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Arousal</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAS, Median (IQR)</td>
<td>3 (2-4)</td>
<td>4 (2-4)</td>
</tr>
<tr>
<td>Proportion comatose observations, N(%)</td>
<td>84 (34%)</td>
<td>149 (28%)</td>
</tr>
<tr>
<td>Number of days of coma</td>
<td>2 (1-4)</td>
<td>4 (2-6)</td>
</tr>
<tr>
<td><strong>CAM-ICU Assessments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAM-ICU observations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>41 (14%)</td>
<td>62 (10%)</td>
</tr>
<tr>
<td>Negative</td>
<td>70 (24%)</td>
<td>252 (41%)</td>
</tr>
<tr>
<td>Unable to Assess</td>
<td>179 (62%)</td>
<td>306 (49%)</td>
</tr>
<tr>
<td>Admissions with at least one CAM-ICU + observation N(%)</td>
<td>23 (35%)</td>
<td>30 (20%)</td>
</tr>
<tr>
<td>Duration of Delirium, median (IQR)</td>
<td>2 (1-3)</td>
<td>2 (1-3)</td>
</tr>
<tr>
<td>Days Free of Delirium and Coma, Median (IQR)</td>
<td>1 (0-2)</td>
<td>1 (0-3)</td>
</tr>
<tr>
<td>Proportion of days free of delirium or coma, %, [95% CI]</td>
<td>30% [20-39]</td>
<td>46% [36-56]</td>
</tr>
</tbody>
</table>
Cam-ICU Assessments

• 36 / 65 were not able to be assessed on the first ICU day
  – Coma (SAS 1 or 2) (70%)
  – Inability to follow any instructions / aphasia

• 21 (58%) of these were subsequently able to be assessed
  – 15 (71%) were delirious for at least one day
Unable to Assess Due to Coma
Final Thoughts / Questions

• Assessing delirium in patients with acute brain injuries is challenging
• Is it really delirium? Does it matter?
• Do interventions translate across populations?
• We are on the cusp of something great!
jeff.singh@uhn.ca