Coma Science Group – GIGA Consciousness

http://www.comascience.org/
OUTLINE

Introduction

• What is « consciousness »?
• Disorders of consciousness
• Behavioral scales

Coma Recovery Scale – Revised

• Presentation of 23 items and 6 subscales
• Brainstem reflexes
INTRODUCTION
Disorders of consciousness & behavioral scales
WHAT IS CONSCIOUSNESS?
Reducing consciousness to 2D

Consciousness ≠ global brain function

Laureys et al., Lancet Neurology, 2004
Two awareness networks

DISORDERS OF CONSCIOUSNESS

- Functional communication
- Command following
- MCS +
- Severe disabilities
- Moderate disabilities
- Professional reinsertion
- Independence
- Signs of consciousness (non reflex behaviors)
- Arousal (eye opening)
- VS/UWS
- MCS -
- Coma

Cognitive function

Behavioral diagnosis

Vanhaudenhuyse et al, Scholarpedia, 2009
Coma

- Eyes **always** closed
- Duration: > 1h
- Recovery from coma: few hours to 4 weeks
Unresponsive wakefulness syndrome (UWS) (vegetative state)

Laureys et al. BMC Medicine 2010, 8:68
http://www.biomedcentral.com/1741-7015/8/68

Unresponsive wakefulness syndrome: a new name for the vegetative state or apallic syndrome

Steven Laureys1, Gastone G Celesia2, Francois Cohadon3, Jan Lavrijsen4, José León-Carrión5, Walter G Sannita6,7, Leon Szably8, Erich Schmutzhard9, Klaus R von Wild10,11, Adam Zeman12, Giuliano Dolce13, the European Task Force on Disorders of Consciousness1
Unresponsive wakefulness syndrome (UWS)

- Eye opening and closure
- Absence of purposeful behaviors
- Absence of language
- Preserved hypothalamic and brainstem autonomic functions

- Eye opening
- Preserved sleep-wake cycles
- Clear signs of reproducible purposeful behaviors
- Emotionally contingent behaviors
- Challenge: fluctuation +++

MCS - vs MCS +

**MCS -**
- Oriented (contextualized) behaviors
- Visual pursuit or fixation
- Orientation to noxious stimulation
- Reaching for objects
- Contingent behaviors (emotional)

**MCS +**
- Following simple commands
- Intentional communication
- Intelligible verbalization

Bruno et al., *J Neurol*, 2011; Bruno et al., *J Neurol*, 2012
Emergence from minimally conscious state (EMCS)

- Functional communication AND/OR
- Functional object use
- The same item must be observed on 2 consecutive assessments

Giacino et al., Neurology, 2002
Locked-in syndrome (LIS)

- Impaired motor function but preserved consciousness
- Preserved cognitive abilities
- Aphonia
- Anarthria
- Quadriplegia or quadriparesis
- Communication with vertical eyes movements and/or with blinking
- Partial LIS is possible

American Congress of Rehabilitation Medicine, *Arch Phys Med Rehab*, 1995
BEHAVIORAL SCALES
Why is it important to assess consciousness?

- Misdiagnosis ~ 40%
- Standardized neurobehavioral assessment > clinical consensus!
- Prognostic, therapeutic and ethical implications
  - Prognosis/outcome depending on diagnosis, etiology, age and time since injury
  - MCS patients are more likely to perceive pain

Schnakers et al., BMC Neurology, 2008; Stender et al., Lancet Neurology, 2014
Why is it important to assess consciousness?

**Prognosis (non traumatic)**
- VS/UWS
  - %100
  - MCS
  - deceased
  - unresponsive

- MCS
  - %100
  - deceased
  - Recovery

**Treatment**

**Ethics**
- It is acceptable to stop treatment in a chronic...
- I would like to be kept alive if I were in a chronic...

- VS
- MCS


**Consciousness | Disorders of consciousness | Behavioral scales | Conclusion**
Glasgow Coma Scale (GCS)

Especially useful in acute settings
3 subscales:
- E: Eyes opening (awakening)
- M: Motor ( consciousness)
- V: Verbal ( consciousness)

Total score = addition of subscales → /15

Short
Most well-known
Easy to administer
Most studied for its prognostic value
Allows recovery monitoring

Addition of subscales masks heterogeneity
Depends on the experience
Fluctuant inter-rater reliability
Scoring of patients with ocular trauma, tracheotomy or ventilatory support
No operational definition

Glasgow Coma Scale (GCS)

Teasdale & Jennett, The Lancet, 1974; Laureys et al., The Lancet Neurology, 2014; Schnakers & Majerus, 2011 (Book: Coma et états de conscience altérée)
Wessex Head Injury Matrix (WHIM)

6 components:
- Communication
- Attention
- Social behavior
- Concentration
- Visual awareness
- Cognition (memory & spatio-temporal orientation)

Hierarchical sequence
Based on longitudinal observation of recovery in 88 coma patients
Precise operational definition for each item
Score = most advanced behavior
Useful to assess MCS behaviors

Unproven reliability
Diagnostic sensitivity < other standardized scales

Shiel & al., Clin Rehab, 2000; Schnakers & Majerus, 2011 (Book: Coma et états de conscience altérée)
Wessex Head Injury Matrix (WHIM)

### Wessex Head Injury Matrix (62 Items)

Adaptation française avec l’autorisation de A. Shiel, auteur, en collaboration par:
S. Majerus, & M. Van der Linden, Service de Neuropsychologie, Université de Liège (Belgique);
A. Fontaine, A.C. Tissier, N. Marier, & P. Azouvi, Hôpital R. Poincaré, Garches (France).

Commencez à l’item 1. Mettez une barre pour tout item observé et une croix pour tout comportement non-observé. Arrêtez la cotation après 10 croix consécutives. Le rang du comportement le plus avancé constitue le score.

<table>
<thead>
<tr>
<th>No</th>
<th>COMPORTEMENTS OBSERVES</th>
<th>DEFINITIONS OPERATIONNELLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ouverture brève des yeux</td>
<td>Moins de 30 secondes</td>
</tr>
<tr>
<td>2</td>
<td>Ouverture prolongée des yeux</td>
<td>Plus de 30 secondes</td>
</tr>
<tr>
<td>3</td>
<td>Les yeux sont ouverts et bougent mais ne se fixent pas sur une personne ou un objet</td>
<td>Les yeux bougent de manière aléatoire, sans signe de poursuite et ils ne s'arrêtent pas sur un objet ou une personne.</td>
</tr>
<tr>
<td>4</td>
<td>Attention momentanément captée par un stimulus dominant</td>
<td>Momentanément = 2 secondes ou plus; stimulus dominant = bruyant/grand/vivement coloré/douleur/entraînant un changement identifiable du comportement bien que momentané, p.ex. agité &gt; calme, yeux fermés &gt; ouverts, immobile &gt; mouvements, etc.</td>
</tr>
<tr>
<td>5</td>
<td>Regarde brièvement une personne</td>
<td>Le regard se déplace sans but à travers la chambre. Jusqu’un objet ou une personne est remarqué; les yeux se fixent sur celui-ci. Brèvement = momentanément-impression qu’il regarde quelqu’un ou quelque chose.</td>
</tr>
<tr>
<td>6</td>
<td>Vocalisation volontaire, pour exprimer ses sensations</td>
<td>Gémissements comme pour exprimer un malaise, soit spontanément soit lors de manipulations passives des membres contractés, d'injections ou de prises de sang.</td>
</tr>
</tbody>
</table>

Shiel & al., Clin Rehab, 2000; Schnakers & Majerus, 2011 (Book: Coma et états de conscience altérée)
Full Outline of Unresponsiveness scale (FOUR)

4 subscales:
- Motor responses
- Ocular responses
- Brainstem reflexes
- Respiration

Total score /16

Good inter-rater reliability
No assessment of verbal functions
Same weight for each subscale
Diagnosis of brain death
Follow recovery of autonomous functions
Visual pursuit
Neurological progression of UWS patients
Assessment of cognitive functions
Detection of LIS
Fast administration

Not suited for rehabilitation setting

Full Outline of Unresponsiveness scale (FOUR)

Eye response
- 4 = Eyelids open or opened, tracking or blinking to command
- 3 = Eyelids open but not tracking
- 2 = Eyelids closed but open to loud voice
- 1 = Eyelids closed but open to pain
- 0 = Eyelids remain closed with pain

Motor response
- 4 = Thumbs-up, fist or peace sign
- 3 = Localising to pain
- 2 = Flexion response to pain
- 1 = Extension response to pain
- 0 = No response to pain, or generalised myoclonus status

Brainstem reflexes
- 4 = Pupil and corneal reflexes present
- 3 = One pupil wide and fixed
- 2 = Pupil or corneal reflexes absent
- 1 = Pupil and corneal reflexes absent
- 0 = Absent pupil, corneal and cough reflex

Respiration
- 4 = Not intubated, regular breathing pattern
- 3 = Not intubated, Cheyne–Stokes breathing pattern
- 2 = Not intubated, irregular breathing
- 1 = Breathes above ventilator rate
- 0 = Breathes at ventilator rate or apnoea

Coma Recovery Scale – Revised (CRS-R)

23 items assessing:

- Auditory perception
- Visual perception
- Motor abilities
- Oro-motor abilities
- Communication
- Arousal

+ Brainstem reflexes and contingent behaviors

Standardized & validated
Most sensitive to identify MCS behaviors (2002)
Precise operational definition for each item
Hierarchisation of items
Observation of spontaneous movements
Complex functions (communication/functional use of objects)
Diagnosis based on quality of observed behaviors

Best to use but:
Total score does not permit to identify diagnosis (subscales)
Long to administer

**Coma Recovery Scale – Revised (CRS-R)**

<table>
<thead>
<tr>
<th>Patient:</th>
<th>Date:</th>
</tr>
</thead>
</table>

### Auditory Function Scale
- 4: Consistent Movement to Command *
- 3: Reproducible Movement to Command *
- 2: Localization to Sound
- 1: Auditory Startle
- 0: None

### Visual Function Scale
- 5: Object Recognition *
- 4: Object Localization: Reaching *
- 3: Visual Pursuit *
- 2: Fixation *
- 1: Visual Startle
- 0: None

### Oromotor/Verbal Function Scale
- 3: Intelligible Verbalization *
- 2: Vocalization/Oral Movement
- 1: Oral Reflexive Movement
- 0: None

### Communication Scale
- 2: Functional: Accurate †
- 1: Non-Functional: Intentional *
- 0: None

### Motor Function Scale
- 6: Functional Object Use †
- 5: Automatic Motor Response *
- 4: Object Manipulation *
- 3: Localization to Noxious Stimulation *
- 2: Flexion Withdrawal
- 1: Abnormal Posturing
- 0: None/Flaccid

### Arousal Scale
- 3: Attention
- 2: Eye Opening w/o Stimulation
- 1: Eye Opening with Stimulation
- 0: Unarousable

### Total Score

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Why the CRS-R?

- Guidelines of administration & scoring procedures
- Excellent content validity & test-retest reliability
- Standardized administration and scoring
- Most sensitive scale to detect MCS

N.B.

Identification of possible confounding factors (deafness, aphasia, blindness) when improbable scoring occurs

When using only one CRS-R assessment ~ 34% chance of false negatives
→ Perform at least 5 assessments!

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But...

- Difficult to use and to be repeated in daily care
- Requirement of concentration +++

Development of short CRS-R = the SECONDS (Simplified Evaluation of CONsciousness Disorders)

- Use of most frequent signs of consciousness:
  - Observation
  - Command-following
  - Communication
  - Visual pursuit
  - Visual fixation
  - Localization to pain
  - Arousal
  - Oriented behaviors
- Difficult to use and to be repeated in daily care
- Requirement of concentration

- Development of short CRS-R: Simplified Evaluation of CONsciousness Disorders
  - Use of most frequent signs:
    - Observation
    - Command-following
    - Communication
    - Visual pursuit
    - Visual fixation
    - Localization to pain
    - Arousal
    - Oriented behaviors
Consciousness ≠ responsiveness

Any questions?

THANK YOU!