Clinical Assessment

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Disorders of consciousness

<table>
<thead>
<tr>
<th>Scale</th>
<th>Free access</th>
<th>Guidelines of administration &amp; scoring procedures</th>
<th>Content validity (i.e., enclosing diagnostic criteria)</th>
<th>Internal consistency</th>
<th>Inter-rater reliability</th>
<th>Test-retest reliability</th>
<th>Diagnostic validity</th>
<th>Outcome prediction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coma Recovery Scale-Revised (CRS-R, [45])</td>
<td>Yes</td>
<td>Present</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
<td>Excellent</td>
<td>Unproven</td>
<td>Unproven</td>
</tr>
<tr>
<td>Sensory Stimulation Assessment Measure (SSAM, [46])</td>
<td>Yes</td>
<td>Present</td>
<td>Good</td>
<td>Unproven</td>
<td>Unproven</td>
<td>Unproven</td>
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<tr>
<td>Wessex Head Injury Matrix (WHIM, [47])</td>
<td>No</td>
<td>Present</td>
<td>Good</td>
<td>Unproven</td>
<td>Unproven</td>
<td>Unproven</td>
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<tr>
<td>Western Neuro Sensory Stimulation Profile (WNSSP, [48])</td>
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<td>Present</td>
<td>Good</td>
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<td>Sensory Modality Assessment and Rehabilitation Technique (SMART, [49])</td>
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<td>Present</td>
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<tr>
<td>Disorders of Consciousness (DOC, [50])</td>
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<td>Present</td>
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<tr>
<td>Coma Near Coma (CNC, [51])</td>
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<td>Present</td>
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<tr>
<td>Full Outline of Unresponsiveness scale (FOUR, [52])</td>
<td>Yes</td>
<td>Absent</td>
<td>Poor</td>
<td>Excellent</td>
<td>Good</td>
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<tr>
<td>Comprehensive Level of Consciousness Scale (CLOCS, [53])</td>
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<td>Absent</td>
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<tr>
<td>Innsbruck Coma Scale (INNS, [54])</td>
<td>Yes</td>
<td>Absent</td>
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<tr>
<td>Glasgow Liège Scale (GLS, [55])</td>
<td>Yes</td>
<td>Absent</td>
<td>Poor</td>
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<tr>
<td>Loewenstein Communication Scale (LOEW, [56])</td>
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<td>Absent</td>
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<tr>
<td>Reaction Level Scale (RLS85, [57])</td>
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<td>Unproven</td>
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GCS, GLS or FOUR?

n=60

GCS: 29 diagnosed “vegetative”/unresponsive
FOUR: 24 PVS/UWS

Schnakers et al, Annals of Neurology, 2006

n=146

131 intubated (74%)

Inter-rater reliability
- GCS (κ 0.65), GLS (κ 0.66), FOUR (κ 0.75)

Outcome prediction
- GCS ≈ GLS ≈ FOUR

GCS: 71 diagnosed “vegetative”/unresponsive
FOUR: identified 8 MCS-
(eye tracking - 11%)

Bruno et al, Neurocritical Care, 2011
Diagnostic error

n=103 post-comatose patients

- 45 clinical consensus diagnosis ‘vegetative state’
- 18 signs of awareness (Coma Recovery Scale-Revised)

40% potential misdiagnosis

Schnakers et al, BMC Neurology 2009
<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnosis</th>
<th>Etiology</th>
<th>Date of Onset</th>
<th>Date of Admission</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<table>
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<th>3</th>
<th>4</th>
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</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

**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

**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

**AROUSAL SCALE**

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

**TOTAL SCORE**

<table>
<thead>
<tr>
<th>Score</th>
<th>Derotes emergence from MCS</th>
<th>Derotes MCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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</table>

**SELF-STUDY DVD OFFER**

COMA RECOVERY SCALE - REVISED: GUIDELINES FOR ADMINISTRATION AND SCORING

 coma@chu.ulg.ac.be
Auditory function

4- Consistent mvt to command

Choose at least 1 object-related and 1 non-object related command from the Command Following Protocol. The type of command chosen (eye, limb, oral) should be based on patient's physical capacity and should be of low spontaneous frequency. If time permits, more than one type of command from each category may be used. The command should be repeated once during the 10 second response interval.

3- Reproducible mvt to command

3 clearly discernible responses occur over the 4 trials on any one of the object or non-object related commands.

2- Localization to sound

Standing behind the patient and out of view, present an auditory stimulus (eg. voice, noise) from the right side for 5 seconds. Perform a second trial presenting the auditory stimulus from the left side. Repeat above procedure for a total of 4 trials, 2 on each side.

Head and/or eyes orient toward the location of the stimulus on both trials in at least one direction. This item is scored when there is clear evidence of head and/or eye movement. It is not dependent on the degree or duration of movement.

1- Auditory startle

Present a loud noise directly above the patient's head and out of view. Administer 4 trials.

Eyelid flutter or blink occurs immediately following the stimulus on at least 2 trials.
5—Object recognition

Object-related eye or limbs movement commands

3/4 clearly discernible responses

4—Object localization: reaching

The patient is asked to touch an object with his/her arm or leg, 4 trials (2 left, 2 right presentations).

Movement must occur in the correct direction on 3/4 trials.

3—Pursuit eye movements

Move mirror 45° to the right, left, upper and lower directions. 2 trials in every direction (manually open eyes if necessary).

Eyes must follow the mirror for 45° without loss of fixation on 2 occasions in any direction.

2—Fixation

Present a brightly coloured object in front of the patient’s face and then rapidly move to upper, lower, right and left visual fields for a total of 4 trials (manually open eyes if necessary).

Eyes change from initial fixation point and then fixate on the new target location for more than 2 s. At least 2 fixations.

1—Visual startle

Quickly move a finger 1 inch in front of the patient’s eye, while avoiding contact with the eyelashes or inadvertent production of a breeze (manually open eyes if necessary). 4 trials per eye.

Blink promptly following presentation of visual threat on at least 2 trials with either eye.
Visual fixation = reflex
Eye tracking: use a mirror!

Vanhaudenhuyse et al., JNNP 2008

Assessed without a mirror: 29% VS
Motor function

6- Functional object use
Select 2 common objects (e.g. comb, cup). Place one of the objects in the patient's hand and instruct the patient to "Show me how to use a [name object]." Next, place the second object in the patient's hand and restate the same instruction. Movements executed are generally compatible with both object's specific function (e.g. comb is placed on or near the head) on all 4 trials administered.

5- Automatic motor response
Observe for automatic motor behaviors such as nose scratching, grasping bedrail that occur spontaneously during the examination. At least 2 episodes of automatic motor behavior are observed within the session and each episode can be clearly differentiated from a reflexive response.

4- Object manipulation
Place a baseball size ball on the dorsal surface of one of the patient's hands. Roll the ball across the index finger and thumb without touching the undersurface of the hand or fingers. While moving the ball, instruct the patient to, "Take the ball." The following criteria must be met on 3 of the 4 trials administered:
1. The wrist must rotate and the fingers should extend as the object is moved along the dorsal surface of the hand; and 2. The object must be grasped and held for a minimum of 5 seconds. The object cannot be held by means of a grasp reflex or increased finger flexor tone.

3- Localization to Noxious stimulation
Extend all four extremities. Apply pressure to the finger or toe of an extremity (use best extremity on each side of the body) for a minimum of 5 seconds (i.e. squeeze the finger or toe between your thumb and index finger). Administer 2 trials on each side for a total of 4 trials. The non-stimulated limb must locate and make contact with the stimulated body part at the point of stimulation on at least 2 of the four trials.

2- Flexion withdrawal
There is isolated flexion withdrawal of at least one limb. The limb must move away from the point of stimulation. If quality of response is uncertain, the trial may be repeated.

1- Abnormal posturing
Slow, stereotyped flexion or extension of the upper and/or lower extremities occurs immediately after the stimulus is applied.
Oromotor/Verbal function

3- Intelligible verbalisation
1. Tell patient "I would like to hear your voice." This should be followed by an attempt to directly elicit speech using the verbal prompts shown below. At least one prompt should be selected from the Aural Set and at least one from the Visual Set.
2. A maximum of 3 trials should be administered for each prompt chosen from the Aural and Visual Sets. Prompts should be administered at 15 second intervals.

1. Each verbalization must consist of at least 1 consonant-vowel-consonant (C-V-C) triad. For example, "ma" would not be acceptable, but "mom" would. Make sure objects chosen have a C-V-C sequence;
2. Two different words must be documented by the examiner to ensure that a repetitive word-like sound is not mistaken for a word. Words need not be appropriate or accurate for the context, but must be fully intelligible;
3. Words produced by writing or alphabet board are acceptable.

2- Vocalisation/oral movement

Observe for non-reflexive oral movements, spontaneous vocalizations or vocalizations that occur during administration of vocalization commands (see page 5).

Present tongue blade between patient's lips and/or teeth

At least one episode of non-reflexive oral movement and/or vocalization occurs spontaneously or in response to application of sensory stimulation.

There is clamping of jaws, tongue pumping, or chewing movement following introduction of tongue blade into mouth.

1- Oral reflexive movement
Communication

2-Functional accurate
Administer the 6 Situational Orientation questions from the Communication Assessment Protocol (page 12). The examiner may use the Visual set, Auditory set or both sets, if appropriate.

Clearly discernible and accurate responses occur on all 6 of the Visual or Auditory Situational Orientation questions from the Communication Assessment Protocol (see page 12).

1- Non functional/intentional

A clearly discernible communicative response* (e.g. head nods/shakes, thumbs up) must occur within 10 seconds on at least 2 of the 6 Situational Orientation questions (irrespective of accuracy).
Arousal

3-Attention

Observe consistency of behavioral responses following verbal or gestural prompts.

There are no more than 3 occasions across the length of the evaluation in which the patient fails to respond to a verbal prompt.

2- Eye opening w/o stimulation

Observe status of the eyelids across length of assessment.

Eyes remain open across the length of the examination without the need for tactile, pressure or noxious stimulation.

2- Eye opening with stimulation

Tactile, pressure or noxious stimulation must be applied at least once during the examination in order for the patient to sustain eye opening (the length of time the eyes remain open may vary and is not considered in the scoring).
New knowledge, new scales

- **FOUR**
  - Visual subscale → LIS detection

- **CRS-R**
  - MCS criteria
  - Better diagnosis sensitivity

- Eye tracking → use a mirror!

- Ambiguous signs of consciousness: e.g. visual fixation