Neurological observations:
Glasgow Coma Scale observation chart

Demonstrated by Siobhan McLernon, Senior Lecturer, London South Bank University, and Sandra Fairley, Clinical Nurse Specialist, Neurocritical Care, The National Hospital for Neurology and Neurosurgery, London

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Components of consciousness

Consciousness is a state of general awareness of oneself and the environment. It has two components, arousal and awareness, and these correspond to two brain structures, the reticular activating system and the cerebral cortex respectively. Consciousness depends on the interaction between the neurones in the reticular activating system in the brainstem and the neurones in the cerebral cortex. The content of consciousness is determined by the neurones in the cerebral cortex while the neurones in the reticular activating system are responsible for the primitive state of arousal.

Arousal
Simply being awake is a primitive state managed by the reticular activating system.

Awareness
Awareness is the more sophisticated part of consciousness, requiring an intact cerebral cortex to interpret the sensory input from the reticular activating system and respond accordingly.

The Glasgow Coma Scale

The Glasgow Coma Scale (GCS) is universally used to assess conscious level in the acute phase of brain injury and should be charted as a graph to enable easy identification of a change in the patient’s condition. It is more accurate in assessing altered levels of consciousness due to cerebral trauma than medical causes of coma. A complete chart for recording the GCS is reproduced on page 10.

Before the development of the GCS in 1974, level of consciousness was described in terms such as stupor, semi-coma and deep coma, but these terms were not clearly defined and there was a great deal of inconsistency when assessment was carried out by different observers. The GCS was designed to standardise observations using a simple system based on clearly definable criteria that could be reproduced objectively and reliably by a range of medical and nursing personnel (Teasdale & Jennett, 1974). Since then, the GCS has become an integral part of clinical practice (Teasdale et al., 2014a). Some 40 years after its initial development, Teasdale et al. (2014a) reviewed the application of the scale and proposed a new structured approach to its use, which has been incorporated into this procedure. Detailed information is also available at www.glasgowcomascale.org.

When using the acronym GCS, it is important not to confuse the Glasgow Coma Scale with the Glasgow Coma Score. The Glasgow Coma Score (the total sum of components) should only be used to summarise information about groups of patients, whereas the scale is applicable to the management of individual patients.

The scale defines conscious level in terms of three modes of behaviour: eye opening, verbal response and motor response. In each of these categories, it assesses the response generated by different stimuli, with the increasing stimulus required to elicit a response indicating a decrease in the level of cerebral functioning. Each response is also given a score—the minimum a patient can score is 3 and the maximum is 15. The best response is recorded in each category, so the GCS provides only a global assessment. It is important to separately monitor, report and communicate the ratings of the three behaviour categories, preferably in words (e.g., E—spontaneously) and, in some cases, in numbers (e.g., E4).

NAME: | TIME |
---|---|
Spontaneous 4 | |
To sound 3 | |
To pressure 2 | |
None 1 | |
Not testable NT | |
Oriented 5 | |
Confused 4 | |
Words 3 | |
Sounds 2 | |
None 1 | |
Not testable NT | |
Obey commands 6 | |
Localising 5 | |
Normal flexion 4 | |
Abnormal flexion 3 | |
Extension 2 | |
None 1 | |
Not testable NT | |

• 1 240
• 2 230
• 3 220
• 4 210
• 5 200

Do not undertake or attempt any procedure unless you are, or have supervision from, a properly trained, experienced and competent person. Always first explain the procedure to the patient and obtain their consent, in line with the policies of your employer or educational institution.
The GCS was designed for the acute phase of brain injury, when the patient’s condition may fluctuate and there is a risk of secondary complications. The scale is therefore an effective way to monitor trends in consciousness. It is not always an appropriate tool in chronic neurological conditions. Observations should be carried out as early as possible to establish a baseline (after resuscitation in severe cases) and their subsequent frequency should be adjusted to:

- A drop of one point requires escalation and review if it persists for 30 minutes (NICE, 2017).
- A drop of two points requires immediate escalation and review.
- A new drop on the GCS to 8 or below requires anaesthetic review with regard to airway management.

**Assessing consciousness**

- Consciousness cannot be measured directly. It can only be assessed by observing a person’s behaviour in response to different stimuli.
- The response the patient gives indicates the level at which the sensory information has been translated within the central nervous system.

**Frequency of observations**

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- The risk of complications;
- The patient’s condition;
- How much time has passed since injury/elective procedure;
- How much change is observed.

**Neurological observations must include:**

- Assessment of conscious level (GCS).
- Limb assessments.
- Pupil size and reaction to light.
- Vital signs.

**CHECK!**

- For factors interfering with communication, ability to respond and other injuries.

**OBSERVE!**

- Eye opening, content of speech and movements of right and left sides.

**STIMULATE!**

- Sound: spoken or shouted request. Physical: Pressure on finger tip, trapezius or supraorbital notch.

**RATE!**

- Rate the patient’s response according to the highest response observed.

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Eye opening

Spontaneous: score 4
Criterion: Observed before you approach the patient or speak to them.

Eyes open to sound: score 3
Criterion: After spoken or shouted request (e.g., call the patient’s name).

Eyes open in response to pressure: score 2
Criterion: Apply pressure to the finger tip using a pen or a pencil. Apply pressure with increasing intensity (up to 10 seconds) until you have applied the maximum stimulus. Apply pressure to the distal part of the nail, and vary the finger that is used, in order to minimise the potential for harm (Teasdale et al., 2014b). (Note: do not apply a central stimulus to the supraorbital nerve when assessing eye opening, as this will cause grimacing and eye closure.)

None: score 1
Criterion: No eye opening at any time, in the absence of any interfering factor. Ensure that the pressure stimulus is adequate.

Not testable: score NT
Criterion: If the patient’s eyes are closed due to a local factor such as swelling, write NT (Not Testable) here.

Eye opening looks at the arousal mechanisms and control of the eyes in the brainstem. Even when brain damage is severe, all patients who survive will eventually open their eyes (usually within 2–4 weeks). Spontaneous eye opening merely indicates that the arousal mechanisms in the brain stem are active but does not necessarily mean that the patient is aware.

Verbal response

Orientated: score 5
Criterion: Knows name, place, month. The patient should know who they are, where they are (e.g. in hospital or other specific location) and the month and/or year. If the patient answers one or more component wrongly then record them as confused.

Confused: score 4
Criterion: Not orientated but the patient’s communication is coherent.

Words: score 3
Criterion: Utters occasional words rather than sentences. (These are often abusive words elicited by noxious stimuli, rather than spontaneous.)

Sounds: score 2
Criterion: Only moans/groans.

None: score 1
Criterion: No audible response, in the absence of any interfering factor.

Not testable: score NT
(If there are factors that interfere with communication—e.g., the patient has an endotracheal tube or tracheostomy—write NT (Not Testable) here.)

Verbal response assesses two elements of cerebral functioning: comprehension and transmission of sensory input, and the ability to articulate a reply. An orientated response shows a high degree of integration within the nervous system. Although this section indicates “best verbal response”, the patient with an endotracheal tube or tracheostomy may be able to communicate by a means other than voice to indicate that they are orientated (e.g., by mouthing words or by writing) and should be documented as such.
Motor response

In patients who have suffered traumatic brain injury, motor response is the most important prognostic aspect of the GCS. In this category, the record of the patient’s best response indicates the functional state of the brain as a whole. You should record only the responses of the upper limbs, as these are more reliable than lower limb responses, which could be due to spinal reflexes.

In a patient who does not obey commands, and makes no response to fingertip pressure, you will need to assess their motor response by applying a central stimulus. Teasdale et al. (2014a) recommend using a stimulus at the trapezius and the supraorbital sites, in a standard sequence of graded intensity.

The interpretation of motor responses in people not obeying commands takes into account information from finger tip pressure and stimuli applied to the trapezius/supraorbital sites, and, in practice, the sequence will usually be in that order, as pressure on the finger tip will already have been used when eye opening does not occur spontaneously or to sound.

Obeying commands: score 6

First stimulus: trapezius pinch

First apply the trapezius pinch. Place your hand over the patient’s shoulder and press your fingers into the muscle above the shoulder blade. Apply pressure with increasing intensity for up to 10 seconds until you are sure that the response you observe is the patient’s best response.

Second stimulus: supraorbital notch

If there is no localising response to the trapezius pinch (see page 5), apply pressure to the supraorbital notch. Place your hand on the patient’s forehead with your thumb over the upper rim of the orbit. Feel for the notch in the supraorbital margin. Apply pressure with increasing intensity for up to 10 seconds until you observe the best response. Do not rate the patient as having an absence of response until you have applied the maximum stimulus.

Patient does not obey commands

Obeying commands: Criterion: The patient successfully performs a two-step action such as, “Can you grasp and release my fingers with your hand?” or, “Open your mouth and stick out your tongue”.

In a patient who does not obey commands, a peripheral stimulus alone is inadequate to assess the motor component, and an additional central stimulus is needed.

This stimulus should not be used in patients with known or suspected facial injuries/swelling adjacent to the supraorbital notch.
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**Neurological observations: Glasgow Coma Scale observation chart**

**Localising: score 5**

Localising: Criterion: If the patient responds by bringing the hand above the clavicle in an attempt to move the stimulus away, this is called localising. If the upper limb does not reach above the clavicle but does flex, then the patient is flexing either normally or abnormally (see right and below). In clinical practice, the assessment of these non-localising responses is based on a combination of both peripheral and central stimuli.

**Normal flexion: score 4**

Normal flexion: Criterion: In normal flexion the elbow bends and the arm moves rapidly away from the body and away from the stimulus.

**Abnormal flexion: score 3**

Abnormal flexion: Criterion: The elbow bends slowly and the arm comes across the body (abnormal flexion may be accompanied by a spastic flexion of the wrist).

**Extension: score 2**

Extension: Criterion: The patient extends the arm at the elbow (i.e., straightens the elbow).

**None: score 1**

None: Criterion: No movement in arms or legs, in the absence of any limiting factors. You must ensure that the stimulus is adequate.

**Not testable: score NT**

Not testable: If the patient is paralysed or there are other limiting factors, write NT (Not Testable) on the chart.
Pupillary response to light is dependent upon intact afferent (optic nerve) and efferent (oculomotor nerve) function transmitting the light impulse from the retina to the midbrain and thence to the pupillary musculature. A dilating pupil indicates an expanding lesion on the same side (ipsilateral) (see above right), since the oculomotor nerve does not decussate; this is an important localising sign. Pupillary pathways are relatively resistant to metabolic insult and, therefore, the presence or absence of the light reflex is the single most important sign that has the potential to distinguish structural from metabolic coma.

Pupil size is measured in millimetres and is estimated using the scale of pupil sizes printed on the neurological assessment chart.

Pupils should be assessed for size, shape, equality and reaction to light.
- Bilaterally fixed and dilated pupils in a patient whose motor response is flexion or localising suggests the recent occurrence of a seizure (or homatropine eye drops).
- Muscle relaxants do not affect pupil reaction and in the patient who is paralysed and sedated for ventilation it is the only clinical sign of raised intracranial pressure (ICP) that can be tested. Since pupil abnormalities are a late sign of intracranial complications, these patients require ICP monitoring.
- Damage to the cervical cord or brachial plexus can cause inequality of the pupils.

Limb responses
- A difference in responsiveness in one limb, compared to the other, indicates focal brain damage. Hemiparesis or hemiplegia usually occurs in the limbs on the opposite side to the lesion (due to decussation of nerve fibres in the medulla).

Tentorial herniation (Kernohan’s notch)
- However, hemiparesis or hemiplegia may also affect the limbs on the same side as the lesion, due to pressure on the contralateral hemisphere. This false localising sign is called Kernohan’s notch syndrome.
Assessing arm responses (a)

Hold one of the patient's arms at the wrist and ask them to pull their arm towards their shoulder against resistance (you should pull in the opposite direction).

(b)

Then ask them to push your hand away, while you provide a force in the opposite direction. If the patient has a weakness, they will not be able to resist your movement.

Mild weakness in one arm (a)

A mild weakness may be difficult to identify. Ask the patient to raise both arms above their head and shut their eyes. If they have normal power, the patient will be able to hold their arms in the air.

(b)

If there is a mild weakness of one arm, it will exhibit a 'drift', by slowly moving downwards.

Assessing leg responses (a)

Ask the patient if they can raise their leg off the bed and hold it there. If they can, but the nurse can push it back down to the bed, a mild weakness is indicated. If the patient can move some muscles within the limb but is not able to raise it against gravity, severe weakness is indicated.

(b)

Apply a downward pressure to the patient's ankle with your hand and ask them to raise their leg. It should not be possible to overcome the patient's movement.
Temperature regulation may be disrupted due to damage to the hypothalamus, which contains the temperature-regulating centre. In the acute phase of brain injury, hyperthermia should be treated since it will exacerbate cerebral ischaemia and adversely affect outcome.

Respiratory complications can occur in the acute stage following cerebral insult. It is important to observe the patient for any breathing difficulties, and to note any changes in the patient’s baseline rate and pattern of respiration.

In a normal (uninjured) brain, a fall in blood pressure does not cause a drop in cerebral perfusion pressure since autoregulation results in cerebral vasodilation to protect brain tissue. However, following cerebral insult, when autoregulation may be impaired, hypotension may lead to brain ischaemia. Hypotension (defined as a systolic blood pressure <90 mmHg) has been identified as the predominant factor in secondary brain injury and has the highest correlation with morbidity and mortality.

Hypertension may be associated with a rise in intracranial pressure. It is part of the Cushing’s response—rising blood pressure with a widening pulse pressure, bradycardia and decreasing respirations. This response, which is seldom seen in patients, and is a late response, is invariably preceded by a drop in the score of the GCS.

Changes on the electrocardiogram may occur in the acute stage following cerebral insult as a result of catecholamine release (the transient “sympathetic storm”). These can include peaked P waves, prolonged QT interval, heightened T waves and ST-segment elevation or depression and general cardiac arrhythmias.
Case history (a)

John Smith, a 35-year-old man, has been admitted to A&E following an accident at work in which he was hit on the front of the head by a large steel pipe. Work colleagues reported to the ambulance crew that he lost consciousness for a few seconds. On arrival in A&E, he is opening his eyes spontaneously, is orientated and is able to obey commands. He complains of headache and has two episodes of vomiting.

When his GCS score drops 3 (E1 V1 M1) he is taken to CT scan which shows a large left frontal extradural haematoma.

Consider the following in relation to Mr Smith’s acute management:

- Frequency of observations.
- Triggers for CT scan.
- Triggers for urgent medical review.
- GCS trigger for intubation and ventilation.
- Significance of drop in GCS score, pupillary changes and development of limb deficit (check your answers in NICE, 2017).

Case history (b)

Margaret Jones, a 55-year-old woman, is admitted to A&E after her husband found her collapsed at home. Mr Jones gives a history of his wife waking early in the morning and complaining of headache and nausea. A short time later he found her collapsed in the bathroom.

On arrival in A&E she is opening her eyes to speech, confused but able to obey commands. A CT scan is ordered when her neurological assessment deteriorates to opening her eyes only to pain, making incomprehensible sounds, and flexing to pain. The CT scan shows diffuse subarachnoid haemorrhage with intraventricular extension and enlargement of temporal horns, suggesting a degree of hydrocephalus.

Consider the following in relation to Mrs Jones’ acute management:

- Frequency of observations.
- Deterioration in GCS score from secondary complications.
- Trigger for intubation and ventilation.
- Significance of deteriorating GCS score, pupillary signs and development of limb deficit.
# Neurological observations: Glasgow Coma Scale observation chart

**NEUROLOGICAL OBSERVATION CHART**

<table>
<thead>
<tr>
<th>RECORD No.</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye opening (E)</td>
<td></td>
</tr>
<tr>
<td>Spontaneous 4</td>
<td></td>
</tr>
<tr>
<td>To sound 3</td>
<td></td>
</tr>
<tr>
<td>To pressure 2</td>
<td></td>
</tr>
<tr>
<td>None 1</td>
<td></td>
</tr>
<tr>
<td>Not testable NT</td>
<td></td>
</tr>
<tr>
<td>Oriented 5</td>
<td></td>
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<tr>
<td>Confused 4</td>
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<tr>
<td>Words 3</td>
<td></td>
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<tr>
<td>Sounds 2</td>
<td></td>
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<tr>
<td>None 1</td>
<td></td>
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<tr>
<td>Not testable NT</td>
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<tr>
<td>Obeys commands 6</td>
<td></td>
</tr>
<tr>
<td>Localising 5</td>
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<tr>
<td>Normal flexion 4</td>
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<tr>
<td>Abnormal flexion 3</td>
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<tr>
<td>Extension 2</td>
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<tr>
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<tr>
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<table>
<thead>
<tr>
<th>PUPILS</th>
<th>Size</th>
<th>Reaction</th>
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<tbody>
<tr>
<td>Left</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td></td>
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</table>

| Blood pressure and Pulse rate | |
|-------------------------------| |
| 240 |
| 230 |
| 220 |
| 210 |
| 200 |
| 190 |
| 180 |
| 170 |
| 160 |
| 150 |
| 140 |
| 130 |
| 120 |
| 110 |
| 100 |
| 90  |
| 80  |
| 70  |
| 60  |
| 50  |
| 40  |
| 30  |
| 20  |
| 10  |

| Temperature °C | |
|----------------| |
| + reacts       | |
| - no reaction  | |
| c eye closed   | |

<table>
<thead>
<tr>
<th>LIMB MOVEMENT</th>
<th>Arms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal power</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild weakness</td>
<td></td>
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<tr>
<td>Severe weakness</td>
<td></td>
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</tr>
<tr>
<td>Spastic flexion</td>
<td></td>
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</tr>
<tr>
<td>Extension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Limb</th>
<th>Normal power</th>
<th>Mild weakness</th>
<th>Severe weakness</th>
<th>Extension</th>
<th>No response</th>
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