Since the Glasgow Coma Scale was introduced in 1974, it has become the most common method of describing a patient’s level of consciousness. However, despite its almost universal use, there remain a number of misunderstandings, particularly regarding the appropriate situations in which to use the Glasgow Coma Score rather than the Scale, and also in the correct way to elicit and record the motor responses. This article, aimed at non-neurosurgeons, addresses these problems, and provides a reference for those wishing to learn or teach the Glasgow Coma Scale and Score.

The GC Scale (Table 1) provided a relatively simple and reliable measure of conscious level. Studies showed good (i.e. low) inter-observer variability amongst medical and nursing staff once they had been trained. The GC Scale went on to be accepted and used by most Neurosurgical Units in the English speaking world, and most of Europe. However, its use has not been without its problems and critics. For example, Wiese criticised the 1976 modification of the motor response without “an explanation and clarifying change of name”. Bassi and Marion suggested the inter-observer variability was poor (although in their studies the GC Score was assessed (see below) not the GC Scale). Other authors have sought to modify the way the responses, particularly the motor responses, are elicited and described, presumably due to dissatisfaction with the original descriptions. Also, a number of other Coma Scores have been devised, including the Glasgow—Liege Scale, the Full Outline of UnResponsiveness (FOUR) Score, the Reaction Level Scale, the Innsbruck Coma Scale, and the Maryland Coma Scale, all of which have been summarised by Laureys. However, none appear to have gained widespread acceptance outside their area of origin. The author’s experience of teaching the GC Scale over a 30-year period suggests that many of the perceived problems with the GC Scale and Score arise from a poor understanding of how the Scale, particularly the Motor Responses, should be applied. Once such misunderstandings have been overcome, most clinicians find that the GC Scale is accurate and reliable, and just as quick as other methods of assessing responsiveness.

Other reviews of the GC Scale have been published, including the comprehensive review by Matis and Birbilis. Matis describes the origins of the GC Scale, its use in the assessment of reduced consciousness from all causes, not just...
trauma, the problems inherent in using the GC Scale in ventilated patients, and the statistical implications of the different weightings applied to each of the three components; he also describes the Paediatric Coma Scale.

Many descriptions of the GC Scale will also be found in textbooks, guidelines, and on internet sites. However, few of these describe accurately and in detail how each of the responses should be elicited and recorded; virtually none explain the importance of distinguishing between the GC Score and the GC Scale in clinical use.

This article aims to provide a detailed and practical account of the GC Scale and Score for a general (non-neurosurgical) audience, and to act as a reference for those wishing to learn or teach the GC Scale.

### The GC Scale

The three aspects of consciousness are reckoned to be arousal, awareness, and activity, and the GC Scale uses a description in words to describe these components as Eye Opening, Verbal Response, and Motor Response respectively. The GC Score (see below) is the numerical equivalent of the GC Scale. It is important to understand that the GC Scale (description in words) should be used to describe individual patients in a clinical situation, whereas the GC Score (a number) was designed for research and audit purposes.

When using the GC Scale, all three components are recorded separately. However, with a little experience it is often easy to assess two or three components at the same time, thus increasing efficiency. For example, if a patient does not open his eyes, or speak, or obey commands on initial approach, whether he then eye opens to pain, or makes incomprehensible sounds in response to pain, can be assessed when pain is applied to test the motor response; there is no need to apply pain three times.

When assessing responses the clinician should “start at the top” and work down. So, for example, a good effort should be made to see if the patient obeys commands before applying pain to test for a localising response.

### Eye opening

There is rarely any difficulty in assessing Eye Opening. If the patient does not have spontaneous eye opening on approach, speaking in a loud voice whilst gently shaking him will determine if they eye open to speech. (If they do, then obviously the verbal response, and whether they obey commands, will be assessed at the same time.)

If there is no eye opening to speech, pain is applied, either by squeezing the ear lobe or by pinching the upper inner fold of the trapezius muscle, or if these fail, by pressure to the finger tip (see below – testing motor response). Applying pressure to the supraorbital ridge is not the best way to test for eye opening, as this can cause a reflex screwing up of the eyelids. In the case records the responses are written as:

- EO Spont;
- EO Speech;
- EO Pain;
- EO None.

If it is not possible to test for eye opening because of, for example, swelling of the eyelids, this is recorded on the observation chart as “C”, not “None” (Fig. 1), and in the case record the full reason is given.

### Verbal response

If the patient appears drowsy or unresponsive, some effort may be required to get him to answer questions. The best verbal response, “Orientated”, requires the patient to be orientated to time, place and person, and so this requires the patient to answer at least three questions accurately. A “Confused” response requires the patient to be able to speak in phrases or sentences, but to be disorientated in at least one of time, place or person. In milder injuries there may be some advantage in grading the degree of orientation – i.e.: time, place, person (x3), place and person (x2), person (x1). This can be written long-hand in the case records, but anything less than “Orientated x3” would be recorded on the coma chart as “Confused”.

The next worse response after “Confusion” is “Inappropriate Words”. Almost always these will be swear words or other expletives, often in response to stimulation such as pain.

If no recognisable words are uttered, but the patient cries, groans, screams, or makes any other kind of noise, this is recorded as “Incomprehensible Sounds”. Usually such sounds are produced when pain is applied. If there are no sounds, even when pain is applied, the verbal response is “None”. In the case records the response is written as:

- VR Orient;
- VR Conf;
- VR Words;
- VR Sounds;
- VR None.

It can sometimes be difficult to distinguish confusion from dysphasia and, if the patient is cooperative enough, formal
tests for expressive or receptive dysphasia (naming objects, carrying out complex commands) may be tried. If a patient appears bright and alert but has difficulty speaking, they are more likely to be dysphasic than confused, especially if they have a right sided weakness, or evidence of left hemisphere damage on the CT scan. On the observation chart, dysphasia is recorded as “DYS”, written vertically (Fig. 1). If the patient has a tracheostomy or is intubated, this is recorded on the chart as “T”, not “None” (Fig. 1).

Motor response

The motor response (MR) is the most important of the three responses as it carries the greatest prognostic significance, but is also the response that causes the most difficulties in assessment. Numerous variations of both the description of the motor responses and the methods of eliciting them have appeared in the literature, adding to the confusion.

Jennett and Teasdale in their original description in 1974 listed five motor responses, namely:

Obey commands;
Localises pain;
Flexion to pain;
Extension to pain;
None

A second paper in 1976 included a further response of “Spastic (or Abnormal) Flexion”, and the authors have been criticised for making this change without adequate explanation. The reasons for this response being considered somewhat differently are given below.

The term “Best” MR is used to describe the conscious level, “Best” referring to the response in the best limb, not the best response over a period of time. This implies that both upper limbs need to be assessed in the event of there being a difference between the two sides. For example, if the patient is flexing on the right but extending on the left, their conscious level is “Flexing” (the “Best” MR); the extensor response on the right is an important focal, or localising, sign, which is useful clinically, but is recorded separately under limb responses (Fig. 1). The word “Best” also refers to the best level of response shown in the better limb at the time of assessment. Occasionally, determined testing during a single examination will produce a higher response, or a mixed response, and the best response is the one taken to represent the conscious level.

In Jennett and Teasdale’s original paper, it was suggested that pain be applied in several ways during any single assessment to gauge the MR. Experience has shown that the best way to learn and teach the MR is to follow the sequence described below. The end result is the same, the point being that there are standard ways of eliciting each of the responses to pain.
Obeys commands

This should always be tested for before applying pain, even if the patient initially appears comatose, or is on a ventilator. If the patient has a cervical injury, it is even more important to test carefully for this response.

Assuming the patient can use both upper limbs, the most efficient way to test for obeying commands is to ask the patient to raise both arms, and hold them elevated. In this way, any weakness of one upper limb should be evident (an important focal sign). However, obeying any kind of command will suffice, as long as the observer is sure that the movement carried out by the patient is not simply a reflex action.

Localises pain

If the patient does not obey commands, test next for a localising response. This is done by applying pressure to the supraorbital ridge, sufficient to produce significant pain. If positive, the patient will raise one hand to the site of stimulation. By convention, if the hand gets above the clavicle, this is classed as a localising response.

Some clinicians prefer not to apply supraorbital pressure, and in the case of significant periorbital injury it would not be appropriate anyway. A suitable alternative is pinching the upper inner border of the trapezius muscle (the Mr Spock death grip). Applying pain to the sternum, or indeed anywhere below the clavicle, is not appropriate, for obvious reasons.

The patient will almost always use one arm preferentially to localise the pain. To test the other arm, hold the “preferred” arm firmly down on the bed, and apply pain again. After attempting to move the pinned limb, the patient will then move the other arm if able to do so.

If the patient localises with both arms as described, there is no need to test any further for the motor response.

Flexion to pain and extension to pain

These responses are tested by applying pressure with a pen or pencil to the fingernail bed (Fig. 2). (Concern has been raised by some that this can damage the nail, causing it to fall off later, although the author has never seen this. Therefore, pressure on the side of the terminal interphalangeal joint is an alternative.) The arm is rested on the body with about 30–40° of elbow flexion as the stimulus is applied. A good flexion response is characterised by flexion of the elbow, often accompanied by lifting the elbow clear of the body. An extension response is shown by extension of the elbow, usually accompanied by pronation of the forearm.

Both upper limbs are tested in the same way, and any asymmetry of response noted (although the “Best” response will be recorded as the Coma Scale).

If there is no movement of the upper limb in response to nail bed pressure, record “No Motor Response”.

If a patient is deteriorating with raised intracranial pressure, the time at which he starts extending to pain, or progresses to no MR, usually correlates with the development of brain herniation and the pupil(s) becoming fixed and dilated. Progression to apnoea and death is not too far away.

However, a patient may give no MR because of high cervical cord injury, brachial plexus or other severe limb injury, or due to the effects of alcohol or other drugs, but in all these situations the pupils are likely to be reactive to light. In other words, if the pupils are reactive, look for other reasons for an apparent no MR.

Abnormal (or spastic) flexion

The response of spastic flexion sits between “flexion” and “extension” in the Coma Scale. It is not a commonly-observed response, and, if a patient with increasing intracranial pressure deteriorates from obeying to localising to flexing, their next worse response will usually be extending; they will not normally exhibit spastic flexion between flexing and extending.

Abnormal flexion seems to be correlated with damage to the basal ganglia of the brain, and is often associated with a severely disabled outcome. It is a response that is easier to recognise than to describe. Nevertheless, the definition is:

Abnormal flexion (spastic flexion) is present if there is either:

1) Preceding extension movement in arms or
2) Extension in leg or
3) Two of these:
   i. Stereotyped flexion posture;
   ii. Extreme wrist flexion;
   iii. Adduction of arm;
   iv. Fingers flexed over thumbs.

In Glasgow, the response of abnormal flexion is not included in the section of the observation chart for the Coma Scale, but can be recorded under the individual limb responses (Fig. 1). It is a response that usually only affects one side anyway, and is therefore often more useful as a focal sign than as a measure of conscious level. If there is doubt whether a response is (normal) flexion or spastic flexion, it is best to record “Flexion”.

Other terms used

It should be noted that phrases such as “reacts to pain”, “responds to pain”, and “withdraws to pain” are not part of the
Glasgow Coma Scale (although the term “withdrawal” was used once by authors from Glasgow to describe the difference between flexion and abnormal flexion). The inclusion of such terms in variations of the GC Scale is common, but causes confusion, particularly when the terms are not defined. Likewise the words “decerebrate” or “decorticar” are not in the GC Scale and are best avoided, implying as they do a “specific physioanatomical correlation” for which there is no evidence.1

The GC Score

Most readers will be aware that it is possible to ascribe a numerical value to each of the responses of the GC Scale (Table 1). The sum of each of the three numbers allocated to the three responses gives the total GC Score. The numerical value for the motor response depends on whether the response of spastic flexion is included in the list of motor responses, which in turn determines whether the highest GC Score is 14 or 15.

The GC Score was devised to allow the information about head injured patients to be stored and analysed on a computer. The GC Score was not intended to be used to describe individual patients in a clinical situation, but rather to be used for research, comparison of series of head injured patients, the development of guidelines, audit, and so on. It may indeed be helpful on occasions to calculate the GC Score for individual patients if the Score is required for other prognostic indices, such as the Acute Physiology and Chronic Health Evaluation (APACHE) Score. However, in these situations, the description of the patient in the case notes and during handovers or referrals should always be in words (the GC Scale), not numbers (the GC Score).

Nevertheless, despite pleas from the Glasgow group,12–16 many clinicians still use the GC Score in everyday clinical practice. Therefore, it is perhaps worth emphasising that there are at least five reasons why the GC Score is not appropriate to describe individual patients in a clinical situation:

1) It is frequently the case that the GC Score cannot be calculated because one or more individual components of the Score are not measurable. For example, if the eyes are closed by severe swelling, the eye opening cannot be assessed; if the patient has severe lower facial injuries, or is intubated, or has a tracheostomy, the verbal response cannot be assessed. To try to compose a Score in these situations is unhelpful and misleading.

2) There are frequent mistakes in calculating the Score. Many clinicians will admit in private that they use the GC Score as a kind of analogue scale, and make a “guestimate” as to where the patient sits within the range. Use of the Score rather than the Scale encourages this sloppy clinical practice, and is perhaps one reason why some studies suggest poor inter-observer variability.8,9

3) Using the GC Score rather than the GC Scale leads to loss of useful information. For example, if a patient is described as “GC Score = 10”, this might mean that the patient obeys commands, opens eyes to speech, and has no verbal response; or, the patient may be localising to pain, eye opening to pain, and speaking inappropriate words. Thus the same GC Score can represent significantly different clinical situations, which would clearly be described better by using words, not a number.

4) To calculate the GC Score (if it is done properly) takes more time than simply stating each individual response.

5) There is variation in practice regarding whether spastic flexion is included in the motor response, which in turn can lead confusion as to whether a 14- or 15-point Score is being used. This can be overcome by using the denominator, but it is better, surely, to describe the motor response in simple, well-defined words.

Summary

The Glasgow Coma Scale remains the most commonly used method of assessing conscious level, and, once learnt, is easy, quick, and reliable to use. Of the three components of the GC Scale, the motor response is the most important. Problems of communication and inter-observer variability arise when clinicians substitute non-standard, undefined, terms to describe different motor responses, and when the GC Score is used rather than the GC Scale.

The GC Score is useful for research, audit, prognostic calculations, and other types of data collection that require digitising and grouping of clinical information. The GC Score is best avoided for everyday clinical use.

Conflict of interest

The author has no conflict of interest arising from the preparation or publication of this article.

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REFERENCES