AIMS AND LEARNING OUTCOMES

The aim of this article is to develop the nurse's knowledge and understanding of neurological assessment and the assessment tool universally used to assess level of consciousness, the Glasgow Coma Scale. After reading the article you should be able to:

I Describe the importance of neurological assessment as part of a nursing assessment for patients with neurological conditions.
I Illustrate the need for an assessment tool.
I Describe the three parts of the Glasgow Coma Scale.
I Perform a neurological assessment on a patient using the GCS and other neurological data.

INTRODUCTION

Nursing care of patients is holistic and patient focused, and begins with an accurate patient assessment. This is vital for planning and implementing appropriate care to all patients, including those with a neurological condition.

Doctors and nurses carry out neurological assessments for different reasons. Doctors primarily use the neurological assessments to find the site of a central nervous system (CNS) problem, establish a diagnosis, or determine the course of treatment. Nurses, however, use the assessment to:

I Determine whether the patient has a neurological problem.
I Establish what impact the neurological condition has on the patient's independence and daily life.
I Establish a baseline assessment of the patient's neurological function.
I Determine any changes in the patient's neurological condition over a period of time.

A comprehensive neurological assessment is the responsibility of the doctor (Box 1). Apart from nurses working in the specialist field of neurosciences, a neurological assessment for nurses comprises an assessment of level of consciousness – but how do we define consciousness and how can we assess it?

WHAT IS CONSCIOUSNESS?

Consciousness is defined as a general awareness of oneself and the surrounding environment (Hickey 1997); it is a dynamic state and can, therefore, change. One prime example of a change in a person's conscious level is seen when a person wakes up from sleep. Consciousness is described as having two parts to it:

I Arousal or wakefulness – a function of the reticular activating system (RAS) located in the brainstem.
I Cognition – a function of the cerebral hemispheres.

Consciousness cannot be measured directly and can only be assessed by observing a person's behaviour in response to different stimuli. Assessment of consciousness is difficult because it can only be implied by an evaluation of the person's appearance and behaviour by another person (Hickey 1997).

Raised intracranial pressure

For a person who has an intracranial lesion, a deterioration in conscious level can denote raised intracranial pressure. Box 2 outlines the pathological causes of a decreased conscious level. Normal intracranial pressure is
Box 2. Pathological causes of decreased conscious level (Hickey 1997)

INCREASE IN BRAIN VOLUME
- Brain tumours
- Cerebral oedema from head injury
- Cerebral abscess

INCREASE IN CEREBRAL BLOOD VOLUME
- Extradural haematoma
- Subdural haematoma
- Subarachnoid haemorrhage
- Intracerebral haematoma

INCREASE IN CSF VOLUME
- Increase in amount of CSF – hydrocephalus

METABOLIC CAUSES
- Hepatic coma
- Electrolyte imbalance
- Uraemic coma
- Diabetic coma

DRUGS
- Sedatives – barbiturates, opiates
- Amphetamines – tricyclic antidepressants
- Steroids
- Salicylates
- Anticonvulsants

Box 3. Compensatory mechanisms

- Decrease in cerebrospinal fluid (CSF) volume by pushing the CSF out to the lumbar theca
- Decrease in cerebral blood volume
- Decrease in extracellular fluid in the brain

The skull is a rigid structure containing the brain, cerebrospinal fluid (CSF) and blood – all of which are incompressible. The volume of these constituents remains in a state of dynamic equilibrium (balance). However, if one of these constituents increases in volume, it will affect the volume of one of the others for the overall equilibrium to remain the same. If the volume of one of the three components continues to increase, the natural equilibrium will not be maintained and the intracranial pressure will begin to rise – the Monro Kellie hypothesis (Gardiner et al 1991).

When there is an expanding mass within the skull, the body starts compensatory mechanisms in an attempt to maintain the equilibrium (Box 3).

If the cause of the mass or lesion is not treated, the pressure within the skull rises above normal and is termed ‘raised intracranial pressure’. This increase in pressure can ultimately result in brain death.

The development of a tool for the assessment of conscious level is a tool that was developed so that doctors and nurses could easily assess consciousness and to:
- Standardise clinical observations of patients with impaired consciousness – for example, head injured patients.
- Monitor the progress of head injured patients and those undergoing intracranial surgery.
- Minimise variation and subjectivity in the clinical assessment of these patients.
- Provide a guide to estimate a patient’s prognosis.

THE GLASGOW COMA SCALE

The Glasgow Coma Scale (GCS) was developed in 1974 by Jennett and Teasdale. It has been modified and in its present form is widely used throughout the world as a standard assessment of a patient’s level of consciousness. The main advantages of using the Glasgow Coma Scale are that (Aucken and Crawford 1998):
- It provides a standardised, consistent assessment of conscious level.
- It is a reliable tool for assessment of conscious level.
- It can be used by different observers and still produce a consistent assessment, irrespective of the observer’s status (Juarez and Lyons 1995).
- It is a valid assessment that can be repeated to provide a series of assessments which can be used to evaluate any changes in a patient’s condition.

- It is documented in the form of a graphic scale which allows quick and easy evaluation of trends in a patient’s condition.
- Once the observer is familiar with the score, it is quick to use.
- It is not restrictive and can be used on patients who are fully mobile or bed bound.
- It eases communication between doctors and nurses.

The GCS describes level of consciousness by assessing a patient’s ability to perform three activities:
- Eye opening.
- Motor response.
- Verbal response.

It assesses the two aspects of consciousness: arousal – being aware of the environment; and cognition – demonstrating an understanding of what the observer has said through an ability to perform tasks.

Each activity is given a score; a patient can get a total score from three to 15. The worst score is three – even patients who are brain stem dead score three – and the best is 15 (Table 1). Any reduction in score is seen as a deterioration in conscious level and should be brought to the attention of senior nursing staff and medical staff.

A patient who has a score of eight or less is considered to be in a deep coma (Aucken and Crawford 1998, Hickey 1997).

Eye response Assessment of eye opening shows that arousal mechanisms located in the brain stem are functioning (Jennett and Teasdale 1974, Lower 1992). The best response is to have eyes open spontaneously and scores four. If patients have their eyes closed, their state of arousal can be assessed by the degree of stimulation needed to get them to open their eyes. If patients open their eyes in response to speech, they score three. A verbal stimulus may be normal, repeated, or even loud. The most recognisable verbal stimulus is a person’s name. If patients do not open their eyes to verbal stimulation, they are becoming more unconscious and assessment of eye opening continues in response to a central painful stimulus.

A central stimulus can be applied in three ways:
- Trapezius squeeze – by using the thumb and two fingers, two inches of the trapezius muscle where the head meets the shoulder are held and twisted.
- Supraorbital pressure – by running a finger along the supraorbital margin – the bony ridge along the top of the eye – a notch or grove can be felt. If pressure is applied here, it causes pain in the form of a headache. If a patient has facial
fractures, it is not recommended to apply supraorbital pressure. Using supraorbital pressure as a painful stimulus may also make the patient grimace and lead to closing the eye rather than eye opening. It may be more useful to use the trapezium squeeze or peripheral pain.

II Sternal rub – grinding the centre of the sternum using the knuckles of a clenched fist which causes pain.

Eye opening to painful stimulus scores two. The worst response is no response to both verbal and painful stimulus which scores only one (Table 2). If there is damage to the occulomotor nerve from trauma with a head injury or during intracranial surgery, the patient may not be physically able to open his or her eye. The occulomotor nerve is responsible for movement of the eyelid and causes the eye to open. A patient who is unable to open an eye due to damage to this nerve is said to have ptosis.

Verbal response Verbal response assesses consciousness by determining whether a person is aware of him- or herself and the environment. It involves the second aspect of consciousness – cognition. This includes:

Table 1. The Glasgow Coma Scale

<table>
<thead>
<tr>
<th>EYE OPENING SCORES 1-4</th>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Spontaneously</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>To speech</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>To pain</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>No response</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>VERBAL RESPONSE SCORES 1-5</th>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Orientated</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Confused</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Inappropriate words</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Incomprehensible sounds</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>No response</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BEST MOTOR RESPONSE SCORES 1-6</th>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Obeys commands</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Localises to pain</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Flexes and withdraws from pain</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Abnormal flexion</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Extension</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>No response</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Eye response

<table>
<thead>
<tr>
<th>EYE OPENING</th>
<th>SCORE</th>
<th>CRITERIA FOR SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spontaneously</td>
<td>4</td>
<td>Eyes open without the need of a stimulus</td>
</tr>
<tr>
<td>To speech</td>
<td>3</td>
<td>Eyes open to verbal stimulation (normal, raised, or repeated)</td>
</tr>
<tr>
<td>To Pain</td>
<td>2</td>
<td>Eyes open to central pain only</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>No eye opening to verbal or painful stimulus</td>
</tr>
</tbody>
</table>

Now do Time Out 3

Try the three different methods of making a central painful stimulus on yourself and a willing volunteer. Evaluate which one produces the most painful stimulus for you and your volunteer.

Orientation – the awareness of oneself and the environment. For patients to be orientated, they must be able to tell the observer who they are, where they are, what day it is – the day, date, month and year – and why they are where they are (Jennett and Teasdale 1974, Aucken and Crawford 1998). Some patients may have been in hospital for a few days, or have been unconscious when first admitted to hospital, and may not be able to accurately recall the exact day and date. A patient who is orientated will score five.

Confusion – where a patient may be able to hold a conversation with the observer but cannot accurately answer the observer’s questions. This category is sometimes referred to as ‘sentences’, which is a more specific assessment used by neurocentres. A patient who talks in sentences, is confused but not orientated, and will score four.

Inappropriate speech or words – a patient only replies in words which may be said at random. This kind of verbal response may take the form of shouting and swearing. In this case the patient will score three.

Incomprehensible speech or sounds – here patients are less aware of their environment and their verbal response is in the form of incomprehensible sounds. The observer may now have to use both a painful and verbal stimulus to get a response. If patients respond with only sounds, they score two.

No response – if there is no verbal response to both verbal and painful stimulus, the patient will score one. However, if there is any damage to the speech centres in the brain, the patient may be awake and alert but cannot talk. Damage can result from trauma from a head injury or can occur during surgery for an intracranial lesion such as a haematoma or a brain tumour. The speech centres are located in the frontal and parietal lobes of the dominant hemisphere. For all right-handed people, and 75 per cent of
None 1 No response to a central painful stimulus

Obeying commands 6 Follows and acts out commands, for example, lift up your arm

Localises 5 Purposeful movement to remove a noxious central stimulus

Withdrawing from pain or normal flexion 4 Flexes the arm at the elbow without wrist rotation in response to a central painful stimulus

Abnormal flexion 3 Flexes arm at the elbow with rotation of the wrist with resulting spastic posture in response to a central painful stimulus

Extension 2 Extends arm at the elbow with inward rotation of the arm in response to a central painful stimulus

None 1 No response to a central painful stimulus

Assessment of motor response
Obeying commands is the best response and scores 6. It shows that patients are aware of their environment, have understood the observer’s instructions, and are able to carry them out. Examples of possible commands are ‘lift up your arms’ or ‘hold up your thumb’. If patients are asked to ‘squeeze my hands’, they must also be asked to release their grip, because some patients with a brain injury can show an involuntary grip response when something is placed in the palm of their hand. This grip response does not mean that patients have understood what has been asked of them, rather it is a primitive reflex which is also present in newborn babies and patients with dementia (Lindsay et al 1991).

If patients do not respond by following commands, the next part of the assessment involves assessing their response to a painful stimulus (Table 3).

What is a painful stimulus? In their original article, Jennett and Teasdale (1974) suggested using a peripheral stimulus first, to see what response the patient produces, and then to use a central painful stimulus to see if the patient localises towards the source of the pain. They suggested pressing on the fingernail bed as a peripheral stimulus, however pressure directly applied to the nailbed can cause trauma and is no longer recommended. A peripheral stimulus may only involve a spinal reflex and does not involve cerebral function. It can result in patients pulling their finger away from the source of the pain, but only a central painful stimulus can show if patients localise to the pain (Hickey 1997). (Refer to the section on Eye Opening for the types of central painful stimulus).

Localising to pain This is a response to a central painful stimulus which involves the patient’s brain receiving sensory information. It involves the higher centres of the brain, the cerebral hemispheres or cerebrum, in the process of feeling pain. The brain then tells the body to do something about removing the source of the pain – usually a motor response such as moving an arm towards the source of the pain in order to remove it and stop the pain from continuing. In practical assessment terms, this means that patients must bring their hand up beyond the level of their chin in response to a central painful stimulus.

The best methods of applying a central painful stimulus to see if a patient localises are the trapezius squeeze and a supraorbital pressure. It can be difficult to distinguish between localising and flexing to pain with a sternal rub, bearing in mind that a true localising response must show the patient bringing his or her arm up to chin level which may not completely happen if using the sternal rub.

Dysphasia
Dysphasia is divided into: ‘receptive dysphasia’, an inability to understand the spoken word, which is due to damage to the Wernicke’s speech centre that is responsible for comprehension of speech; and ‘expressive dysphasia’, an inability to put thoughts into words, due to damage of the Broca’s speech centre – in this case patients can understand what has been said to them, but cannot reply with the right words. Expressive and receptive dysphasia can occur together or separately.

When a patient is found to be dysphasic on assessment, a ‘D’ is placed against the appropriate verbal response. It is important to remember that fully conscious people can be dysphasic. Box 4 provides additional information that can be used in the documentation of a GCS.

Eye Opening
Eye openingramer opening to indicate the presence of an endotracheal tube or a tracheostomy tube

Reflexes
Extension 2 Extends arm at the elbow with inward rotation

Abnormal flexion 3 Flexes arm at the elbow without wrist rotation

Withdrawing from pain or normal flexion 4 Flexes the arm at the elbow with rotation of the wrist

Localising to pain

Dysphasia

Verbal response assess two aspects of cerebral function:

- Comprehension or understanding of what has been said – reception of speech.
- Ability to express thoughts into words – expression of speech.

Any damage to the speech centres of the brain can result in an inability to speak – dysphasia. Dysphasia is divided into: ‘receptive dysphasia’, an inability to understand the spoken word, which is due to damage to the Wernicke’s speech centre that is responsible for comprehension of speech; and ‘expressive dysphasia’, an inability to put thoughts into words, due to damage of the Broca’s speech centre – in this case patients can understand what has been said to them, but cannot reply with the right words. Expressive and receptive dysphasia can occur together or separately.

The speech centres are located in the dominant hemisphere of the brain. Damage can be due to direct damage to the speech centre from trauma, as a result of surgery or brain swelling in that area. A patient who has a brain tumour in the left frontal lobe of the brain which is close to the speech centre may be expressively dysphasic. It may be only temporary if it is due to swelling around the tumour. Consequently, a tumour in the left parietal lobe may cause the patient to be receptively dysphasic.

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Table 3. Motor response

<table>
<thead>
<tr>
<th>MOTOR RESPONSE (best arm response)</th>
<th>SCORE</th>
<th>CRITERIA FOR SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obeying commands</td>
<td>6</td>
<td>Follows and acts out commands, for example, lift up your arm</td>
</tr>
<tr>
<td>Localises</td>
<td>5</td>
<td>Purposeful movement to remove a noxious central stimulus</td>
</tr>
<tr>
<td>Withdrawing from pain or normal flexion</td>
<td>4</td>
<td>Flexes the arm at the elbow without wrist rotation in response to a central painful stimulus</td>
</tr>
<tr>
<td>Abnormal flexion</td>
<td>3</td>
<td>Flexes arm at the elbow with rotation of the wrist with resulting spastic posture in response to a central painful stimulus</td>
</tr>
<tr>
<td>Extension</td>
<td>2</td>
<td>Extends arm at the elbow with inward rotation of the arm in response to a central painful stimulus</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
<td>No response to a central painful stimulus</td>
</tr>
</tbody>
</table>

Box 4. Additional notes used in documentation of the Glasgow Coma Score

C – Used in eye-opening to denote closed eye, or if the patient is unable to open an eye due to swelling, nerve palsy or eye dressing

T – Used in verbal response to indicate the presence of an endotracheal tube or a tracheostomy tube

# – Used in motor response to indicate inability to assess due to arm or leg fractures

P – Used in eye-opening and motor response to indicate the presence of pharmacological paralysis

D – Used in verbal response to indicate the patient’s dysphasia
For the assessment of motor response, the ‘best arm response’ is used, as a response in the legs is both inconsistent and inaccurate and may only be a spinal reflex. Patients who have been diagnosed as being ‘brain dead’ can still flex their legs to a peripheral painful stimulus. This is only a spinal reflex (Jennett and Teasdale 1974). If patients have damage to the dominant hemisphere from trauma or a haematoma, they may not be able to understand what has been said to them because of damage of the speech centres, in particular, the centre responsible for comprehension of speech.

Localising to pain gives the patient a score of five. It is worth remembering that continually squeezing the trapezius muscle or applying supraorbital pressure can cause tissue damage and bruising. Inflicting a painful stimulus may not always be needed, as the patient may find objects such as nasogastric tubes and oxygen masks irritating, and may localise spontaneously to such sources of irritation.

Withdrawal from pain If a central painful stimulus is applied, patients may flex or bend their arm towards the source of the pain, but do not actually localise or try to remove the source of the pain. As mentioned above, this can result in patients pulling their finger away from the source of the pain, for example, withdrawing from pain if a peripheral painful stimulus is applied. It can also occur if a central stimulus is applied: patients flex or bend their arm towards the source of the pain but do not actually localise or try to remove the source of the pain – they do not manage to get their arm up to chin level or to the point where the painful stimulus is coming from. Specialist neurocentres use the term ‘flexion to pain’ and not ‘withdrawing to pain’. Withdrawing from pain or flexion to pain will give a patient a score of four.

Abnormal flexion In the past, abnormal flexion was known as ‘decorticate movement’. It is an abnormal response and indicates severe cerebral damage and an interruption of nerve pathways from the brain’s cortex to the spine. It indicates that the usual nerve pathways are not functioning normally (Hickey 1997). In practical assessment terms, patients will flex or bend the arm at the elbow and rotate the wrist, resulting in a spastic posture in response to a central painful stimulus. Patients who only respond with abnormal flexion to pain score only three and may indicate a deteriorating prognosis.

Extending to pain This response was previously known as ‘decerebrate movement’. This response is also an abnormal response and emanates from the brainstem. It shows that patients are not able to send information to and from the cerebrum due to damage to the brain stem. Damage can result from trauma from head injury or infarction of brain tissue due to severe hypoxia – this might occur in patients who have had a subarachnoid haemorrhage. It is a serious sign and has an extremely poor prognosis. In response to a central painful stimulus, patients will extend or straighten an arm at the elbow, or may rotate the arm inwards. Patient will score two with this response.

No response to central pain This is the worst response and scores one. Patients who are ‘brain dead’ will score one, but it is important to assess them holistically, as an absence of a motor response may be due to paralysis from a high cervical spinal injury or a lack of complete reversal following chemical muscular paralysis.

Assessment of pupillary response Assessment of pupil size and response to light is not actually part of the Glasgow Coma Scale, but it is a vital addition to the assessment. A change in a patient’s pupil response to light and size indicates raised intracranial pressure and compression of the cranial nerve that controls pupil constriction. Assessment of the pupils looks at the function of two cranial nerves.

Assessment of the pupil can be carried out in both conscious and unconscious patients. It is important to remember when assessing the pupils, that patients may already have pre-existing irregularities with their pupils which are normal for them, for example cataracts, a previous eye injury or blindness in one eye. Assessment of the pupil involves:

- Looking at the size of both pupils – this is the size of the resting pupil, that is before light is shone into the eye. Size varies normally with time of day. The average size is 2 to 5mm (Fig. 1).
- Looking at the shape of the pupil – normally pupils are round. Abnormal shapes are oval or irregular, and can indicate brain damage.
- Looking to see if both pupils are equal in size – if one pupil becomes larger than the other (dilates), this is a serious sign of raised intracranial pressure, causing constriction of the occulomotor nerve. It is important to include this as some drugs, such as atropine, dilate the pupil; opiates, such as morphine, constrict the pupil.
- Looking to see if both pupils react to light –

**Fig. 1. Pupil millimetre diameter guide**

<table>
<thead>
<tr>
<th>Number</th>
<th>Diameter Guide</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>○</td>
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<tr>
<td>2</td>
<td>●</td>
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<tr>
<td>3</td>
<td>●</td>
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<td>4</td>
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<td>6</td>
<td>●</td>
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<tr>
<td>7</td>
<td>●</td>
</tr>
<tr>
<td>8</td>
<td>●</td>
</tr>
</tbody>
</table>
there should be a consensual reaction where both eyes constrict as the light is shone into one eye. The reaction is recorded as:
- Brisk reaction = +
- No reaction = −
- Some reaction = sl (or sluggish).

A pupil that does not react to light is termed a non-reacting pupil. Damage can result from tumours of the cerebellum and brainstem or haemorrhages from hypertensive and subarachnoid bleeds. Cerebellar and brainstem tumours in adults are often metastatic. Changes in respiration, in terms of rate and pattern of breathing, can give a good idea of the function of the brain stem. This is due to respiration being controlled by four different centres in two different parts of the brain stem. Cheyne stoke breathing and apnoea are due to a sudden and massive rise in intracranial pressure. A good example of this is seen with a large subarachnoid haemorrhage. Raised intracranial pressure can cause the most dramatic changes in vital signs.

As intracranial pressure rises, the brain becomes hypoxic and ischaemic. The body responds by increasing the arterial blood pressure in an attempt to perfuse the brain. As a result, patients become bradycardic, their respiratory rate decreases and the pattern can change – this is known as the ‘Cushing’s reflex’. This happens very late on after the patient’s conscious level has deteriorated (Hickey 1997). Alterations in temperature may be due to damage to the hypothalamus, the thermoregulating centre of the brain. Incorporating vital signs into the neurological assessment of a patient can provide essential additional information. Changes in respiration, in terms of rate and pattern of breathing, can give a good idea of the function of the brain stem. This is due to respiration being controlled by four different centres in two different parts of the brain stem. Cheyne stoke breathing and apnoea are due to a sudden and massive rise in intracranial pressure. A good example of this is seen with a large subarachnoid haemorrhage. Raised intracranial pressure can cause the most dramatic changes in vital signs.

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