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Acquired brain injury: acute management

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Aim and intended learning outcomes

The aim of this article is to present a logical format for the care of patients with acquired brain injury in the high dependency and intensive care departments of district general hospitals. Acute and critical care are discussed with the expectation that the reader already has a knowledge base in these areas. This article may also be of value to nurses working in accident and emergency and other admissions units. After reading the article you should be able to:

- Describe acquired brain injury and identify the causes.
- Understand the basic structures and functions of the brain.
- Describe the investigations used in the diagnosis of brain injury.
- Undertake and give the rationale for using Glasgow Coma Scale and pupil reaction tests.
- Discuss the main aims of nursing care.
- Identify and prioritise patient care.
- Explain the importance of family support and collaborative care.

Introduction

Acquired brain injury is a non-degenerative brain injury that has occurred since birth through some outside physical force or chemical derangement. The term 'acquired brain injury' includes all traumatic brain injury either open or closed, and non-traumatic injuries such as those caused by stroke and other vascular accidents, tumours, infectious diseases, hypoxia, metabolic disorders – including liver and kidney disease and diabetic coma – and by toxic substance taken into the body by inhalation, injection or ingestion (UK Acquired Brain Injury Forum 2000).

Acquired brain injury can occur at any time and to anybody. Most patients have had a full and often rewarding life before the injury and the subsequent effects can be devastating. Statistics show that this kind of injury affects more young people than old, with the majority of patients in long-term rehabilitation being young males.

Considering the national shortage of specialist beds, it is highly likely that many of these patients will be nursed in intensive and critical care units in general hospitals where specialist neurosurgical advice is not readily available. While many patients make a good recovery, they are often left with some kind of physical or cognitive deficit. Although hospital treatment cannot change the initial insult, good nursing and medical care will limit and prevent secondary damage thus reducing the probability of long-term disability.

TIME OUT 1

Reflecting on your practice over the past year, consider how many patients you encountered who had the potential to develop a brain injury from their condition. If you have cared for a patient with a brain injury, reflect on the care he or she received. You may wish to make notes so that this information is easy to refer to later.

The brain

The brain is an extremely delicate organ, which is protected by the hard outer covering of the skull or cranial bones. Underneath the skull the brain has three soft outer coverings or membranes called

In brief

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Summary
Acquired brain injury is a non-degenerative brain injury that may affect anyone at any time. Patients with acquired brain injury are often critically ill and this injury can have a devastating and long-lasting effect on the patient's quality of life. Although hospital treatment cannot change the initial injury, good nursing care will help to limit and prevent secondary damage thus reducing the probability of long-term disability.

Key words
- Critically ill patients
- Head injuries
- Neurological disorders

These key words are based on subject headings from the British Nursing Index. This article has been subject to double-blind review.

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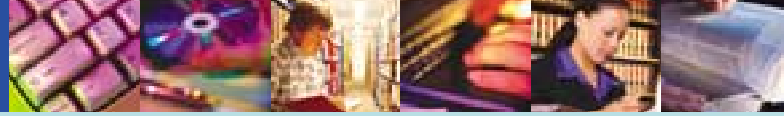


Figure 1. Meninges of the brain

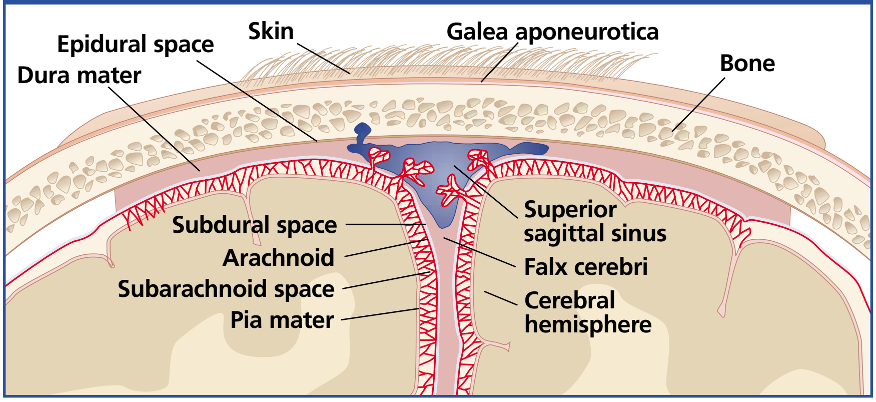


Figure 2. Ventricles of the brain (lateral view)

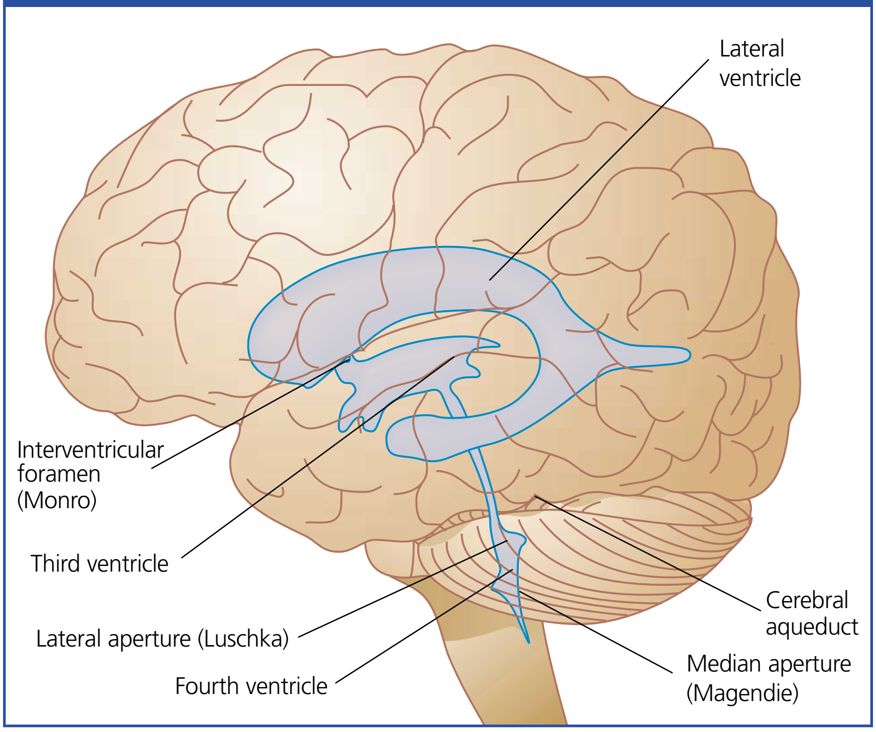


Figure 3. Circle of Willis arteries

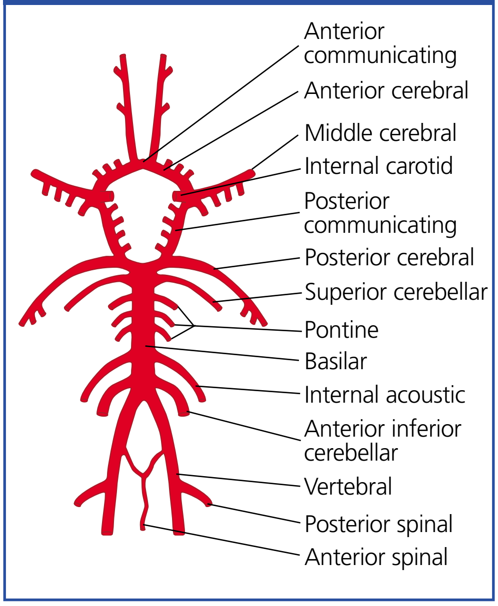
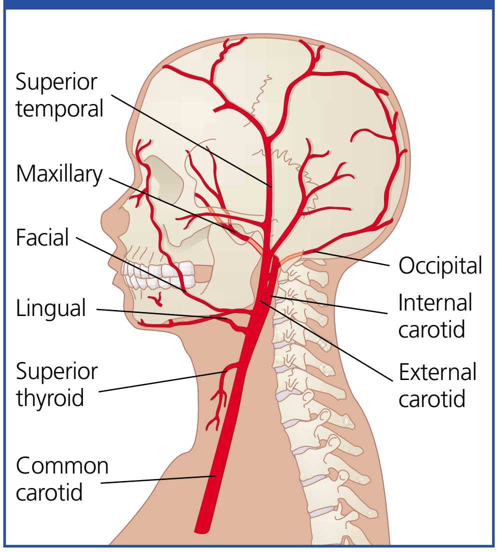


Figure 4. Main arteries of the head and neck



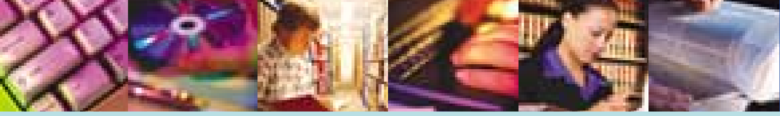
the meninges (Figure 1):

- Dura mater – the outer layer of meninges, consisting of two layers of dense fibrous tissue. The outer layer takes the place of the periosteum on the inner surface of the skull and the inner layer provides a protective covering to the brain. A potential space exists between the two layers of the dura mater except at the formation of sinuses where venous blood drains between the layers of dura.
- Arachnoid – the middle membrane comprising a delicate serous membrane that is separated from the dura by the subdural space and from the pia mater by the subarachnoid space. The arachnoid mater passes over the convolutions of the brain created by the cerebrum. The subarachnoid space contains cerebrospinal fluid (CSF).
- Pia mater – the inner membrane of fine connective tissue containing minute blood vessels that completely cover each convolution and fissure in the brain.

In the brain are four irregular shaped cavities called ventricles that contain CSF (Figure 2). The CSF continuously circulates and bathes the brain and nervous tissue via the subarachnoid space, the ventricles and the spinal cord. It is a medium for the exchange of nutrients and provides protection against chemical and physical injury by acting as a shock absorber and maintaining an ideal environment for neuronal functioning. Oxygen and nutrients are supplied to the brain mainly by blood vessels that form the cerebral arterial circle at the base of the brain called the Circle of Willis (Figures 3 and 4).

The brain is divided into two hemispheres and is joined in the middle. The right hemisphere controls the left hand side of the body and vice versa. Each hemisphere is further divided into four lobes (Figure 5) and each lobe has specific functional areas (Figures 6 and 7 and Box 1).

Blood, CSF and brain tissue all exert pressure in the skull (Hickey 1997), and together they make up the



Box 1. Functional bodies in the brain

Body	Area of control
Basal nuclei	Skeletal muscle tone
Thalamus	Sensory input from skin, viscera and sense organs, which are then transmitted to the cerebrum
Hypothalamus	Output of hormones from the anterior pituitary and the autonomic nervous system, that is, thirst, hunger, body temperature, heart and blood vessels, flight or fight mechanisms
Midbrain	A relay station for ascending and descending nerve cells from the cerebrum and pons varolii
Pons varolii	Relay station for cranial nerves
Medulla oblongata	Autonomic reflex activity – the cardiac centre, respiratory centre, vasomotor centre, vomiting, coughing, sneezing and swallowing
Cerebellum	Co-ordination of voluntary muscular movement, posture, balance and equilibrium and proprioception occurring below the level of consciousness
Cerebral cortex	Memory, intelligence, thinking, conscience, learning, reasoning, morality, sensory perception and the initiation of voluntary muscle control

(Ross and Wilson 1990)

intracranial pressure (ICP). This is represented in Figure 8. An increase in pressure in any of these three components will increase the ICP. Should this occur, blood and CSF will leave the cerebral circulation to maintain homeostasis. This is called autoregulation (Figure 9). However, as pressure in the brain rises, the brain is unable to regulate itself and the brain tissues become damaged due to a lack of blood supply and oxygenation (Hanley 1997). The brain requires a cerebral blood flow of at least 50-100ml at a perfusion pressure of 60mmHg to maintain optimal oxygenation (Alan 1986). When cerebral blood flow falls to levels below 30-100ml, the patient will begin to lose consciousness and may exhibit symptoms such as seizures (Germon *et al* 1994). Once pressures rise above a certain level, the only outlet is down the spinal column. This is known as coning and occurs when brain tissue begins to exit the brain enclosure through the foramen magnum and into the spinal column (Sharr 1984). This is a fatal condition (Hudak *et al* 1998).

Cerebral blood flow (CBF) and cerebral perfusion pressure (CPP – the pressure required to provide an adequate CBF) are directly related to mean arterial pressure (MAP) and ICP. The following equation represents this:

$$CPP = MAP - ICP$$

The management of head injured patients should aim to maintain optimal pressures in the brain to prevent any secondary damage – primary damage being that which occurred at the initial injury (Matta and Menon 1997, Odell 1996). Secondary damage is primarily a result of hypoxia and for this reason management is aimed at maintaining adequate CPP.

Figure 5. Lobes of the brain

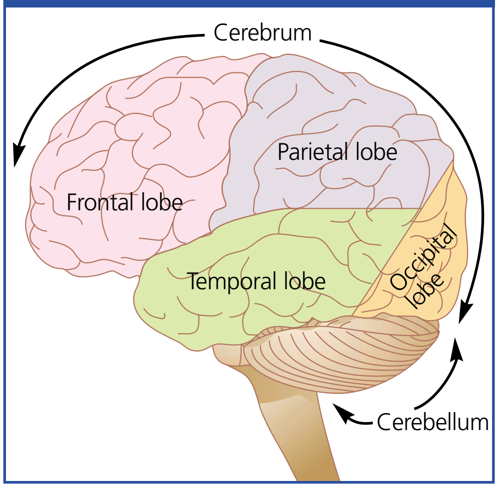


Figure 6. Functional areas of cerebral cortex

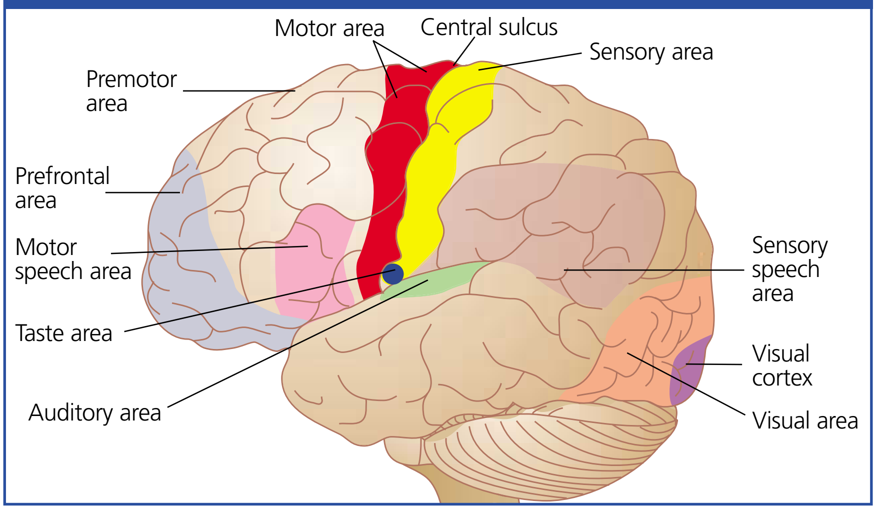


Figure 7. Somatotopic organisation of the cerebrum

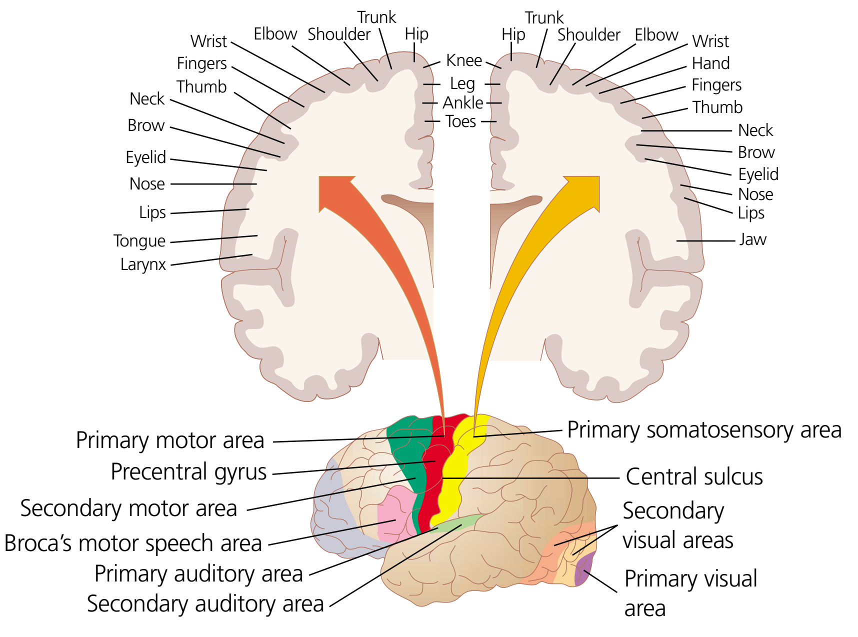


Figure 8. Components of intracranial pressure

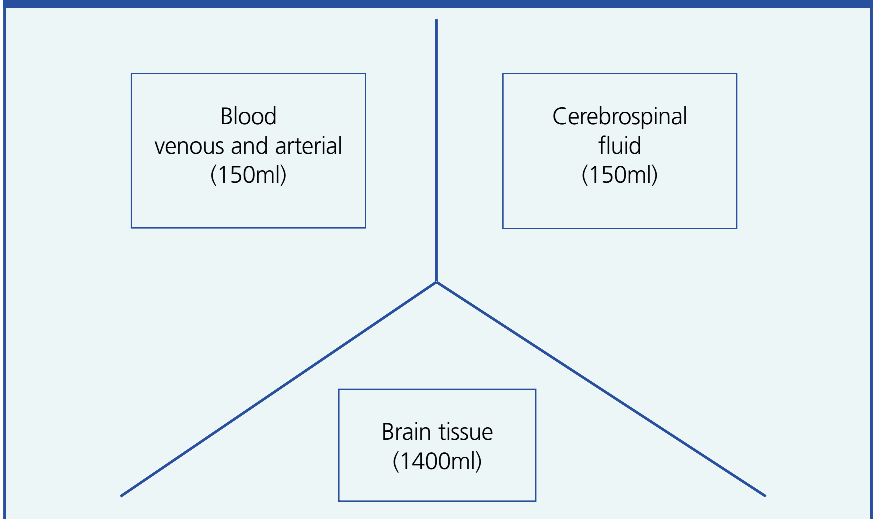
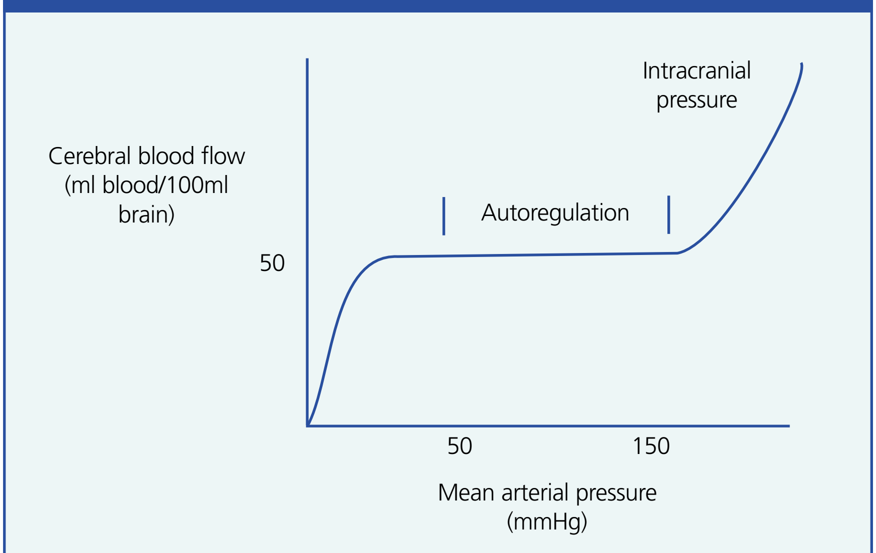


Figure 9. Autoregulation of the brain



Box 2. Glasgow Coma Scale

1. Eye opening:
   - Score 4 Spontaneously
   - 3 In response to voice
   - 2 In response to pain
   - 1 No response
   - C = eye closed or swollen
2. Best verbal response
   - Score 5 Orientated
   - 4 Confused
   - 3 Inappropriate speech
   - 2 Incomprehensible speech
   - 1 No response
   - T = intubated or tracheostomy
3. Best motor response
   - Score 6 Obey commands
   - 5 Localises to pain
   - 4 Flexes to pain
   - 3 Abnormal flexion
   - 2 Abnormal extension
   - 1 No response
   - S = sedated patient

Lowest possible score = 3
Highest possible score = 15

TIME OUT 2

Identify the normal range for ICP and consider how the following activities contribute to raising the ICP:

- Coughing
- Shouting
- Sneezing
- Shivering
- Defecating
- Exercise

You may wish to consult a textbook to assist you in this task.

Neurological observations

Neurological observations allow nurses to make an initial assessment of the patient's health status. They also provide a baseline for comparison of further observations plus immediate evidence of any deterioration in the patient's condition. Observation of the neurologically impaired patient should provide information on five critical areas:

- Level of consciousness.
- Pupillary activity.
- Motor function.
- Sensory function.
- Vital signs.

Monitoring the vital signs should, similar to any critically ill patient, include assessment of peripheral perfusion, arterial blood pressure – MAP should be documented separately – heart rate and rhythm, central venous pressure, temperature and respiratory function/pattern. In addition, the following observations should be made of patients with acquired head injury:

The Glasgow Coma Scale (GCS) Unlike sedation scoring systems, the GCS is not designed to show how sedated a patient is, but to ascertain how well the brain is functioning by obtaining specific information about it (Jennet and Teasdale 1981). The GCS has been found to be reliable and fairly easy to use (Addison and Crawford 1999) and while there is controversy about its translation (Lowry 1999), it is used in most neurological centres in Europe (Box 2). National guidelines being developed indicate that the GCS should be used to assess all brain-injured patients (NICE 2003). It is suggested that during the handover of shifts when nurses have been doing neurological observations that the nurse finishing and the one coming on should go through the next set of GCS observations together so that the one coming on can see how the results have been interpreted previously (Grant *et al* 1990).

The regularity with which observations should be undertaken is determined by the severity of the patient's condition. The GCS allows assessment of neurological status and encourages early identification of changes. Observations should be carried out regularly, allowing the nurse to notice changes immediately (Lindsay 1984, 1986). Two to four hourly observations will not identify early changes, therefore observations should be undertaken every 30 minutes for two hours or until the patient stabilises or the GCS reaches 15. After this, observations should be taken every hour for four hours returning to half hourly should the patient's condition deteriorate. If the patient remains stable on hourly GCS for four hours then it can be reduced to two hourly for the remainder of the stay (NICE 2003).

Documentation of observations should be thorough and in keeping with current professional guidelines (NMC 2002a). A fall of two points in the GCS is significant and medical staff should be informed immediately. The GCS is broken down into three categories each providing information about responses in higher centres of the brain (Box 2):

Eye opening – This gives an indication of the activity of the arousal systems in the brain. Eye opening may be spontaneous, or occur in response to speech, pain or not occur at all. Some pre-existing conditions may prevent eye opening, such as bruising and swelling, and this should be documented, because this is not an indication of a falling level of consciousness.

Verbal response – This provides information about the speech and cognitive centres situated in the frontal lobe of the brain that allows assessment of how aware the patient is of him or herself in the environment (Plum and Posner 1980). The patient may have some pre-existing conditions that do not allow him or her to speak and this should be documented. For example, the patient may have dysphasia from a previous cerebrovascular accident, be unable to speak following intubation or English may not be his or her first language and therefore comprehension may be difficult.

Motor response – The patient's best motor response should be documented. A note should be made of the power in each limb and how purposeful any movement is. The most common mistake in the evaluation of this response is to say the patient is able to obey commands after squeezing someone's hand. Gripping is a reflex action and is well documented as an innate ability of babies soon after birth and also in the severely demented (Atkinson *et al* 1990). Patients should be able to grip and release in response to command.

Painful stimuli Pain stimuli should only be applied when the patient shows no response to verbal commands. Ethical considerations should be made when painful stimuli are used to obtain a response from the patient (Rush 1997). Care should be taken not to mark or bruise the patient and it is not permissible to stick pins or needles into a patient. The least amount of pressure should be used to gain a response and only two techniques are recommended:

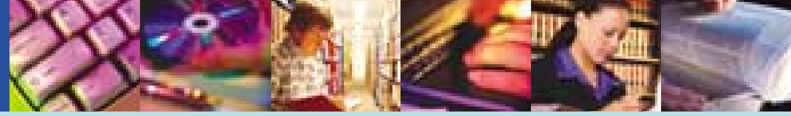
- Sub-orbital pressure (gentle pressure on the orbital bone, medial to the nose, just below the inner aspect of the eyebrow) or jaw-margin pressure (gentle pressure at the angle of the jaw, just below the ear where the mandible joins the maxillary bones) – produces a true response to pain and allows appropriate representation of localisation.
- Trapezium squeeze (gentle squeeze of the trapezius muscle which lies across the top of the shoulder at the base of the neck) – may be used in the presence of facial injuries (Ellis and Cavanagh 1992).

Other methods of pain stimulation are not recommended because they elicit peripheral reflex responses only and do not allow the representation of true localisation. Damage to any part of the motor pathways can affect the ability to move. Any response from lower limbs should be ignored because these are spinal reflexes. This phenomenon has been shown to persist even after brain-stem death has been certified.

TIME OUT 3

Discuss with colleagues the different types of painful stimuli you have seen being used in practice, for example, sternal rub and nail-bed pressure. Think about the ethical implications of applying inappropriate painful stimuli to brain-injured patients.

Pupil reaction tests Examination of the pupils and their reaction to light is one of the most important neurological observations to make of head-injured patients (Becker and Stevens 1988) (Box 3). The GCS may not be an appropriate test to use on patients who are sedated and ventilated, but the pupil reaction test indicates much about the patient's neurological status. Impaired pupillary accommodation suggests there is damage to the midbrain due to excessive pressure exerted on it (Shah 1999, Shell 1980). This may be because of swelling or a haematoma in another area of the brain. Pupil constriction and



Box 3. Guidelines for pupil reaction test

Equipment needed: pen torch

Procedure: Inform the patient that you are going to look into their eyes with a torch whether conscious or not and explain procedure.
Rationale: Sense of hearing may not be impaired. Aids in the reduction of anxiety. Ensures, as far as possible, that the patient consents to, and understands, the procedure.

Procedure: Darken the room if necessary.
Rationale: Enables better view of the eye and reaction to light stimulus.

Procedure: Wash hands.
Rationale: Prevents contamination of the eye with infection.

Procedure: Hold both eyes open and note size, shape and equality of the pupils.
Rationale: To assess the size, shape and equality of the pupils as an indication of brain damage. Normal pupils are spherical, usually central and range in diameter from 1.5-6.0mm.

Procedure: Hold one eye open, moving the light shining from the pen torch towards and across the eye from the side. This should cause the eye to constrict quickly.
Rationale: To assess pupil reaction to light. A normal reaction indicates no lesion or pressure on the third cranial nerve or brain-stem regulating pupil reaction.

Procedure: Hold both eyelids open, shining the light in the same manner into the same eye. The pupil into which the light is NOT shone should also constrict equally.
Rationale: To assess consensual light reflex. Prompt, equal constriction in the opposite eye indicates intact connections between areas that control constriction.

Procedure: Record unusual eye movements.
Rationale: To assess cranial nerve damage.

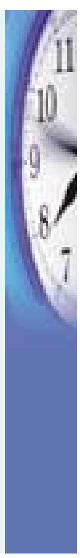
Procedure: Repeat tests on the opposite eye.
Rationale: To assess equality of reaction and ensure all areas are functioning correctly. Differing reactions indicate damage to the side of the brain that controls the eye being tested. The left side of the brain controls the left eye and the right side controls the right eye.

(Mallet and Pritchard 1992)

dilation is controlled by the third cranial nerve (the oculomotor nerve), which arises in the midbrain and runs through the centre of the brain. Pressure on this nerve will produce unequal or non-reacting large pupils. In the majority of cases both eyes work together, therefore a reaction seen in one eye should be identical in the other.

TIME OUT 4

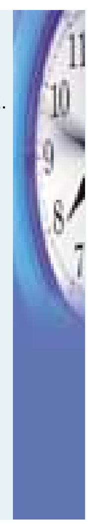
Jane is in her late 20s. She was found unconscious in the street and brought into A&E by the police. She has since regained a level of consciousness, but is unable to give a coherent history. Some bruising and swelling are evident around her right eye and temple. Having been stable for some hours with a GCS of 13, Jane suddenly becomes unresponsive to verbal stimulation and her breathing has become slow and obviously laboured. There is an audible snoring on inspiration and she begins to vomit. What would your first considerations be and what further observations would you make? See Box 4 for suggested answer.



The essence and most important factor in any medical and nursing diagnosis is a detailed clinical history. Certain factors are of paramount importance in both treatment and prognosis (Box 5). Obtaining images of the brain using various techniques gives clarity to specific regions and helps in obtaining an exact diagnosis. These techniques are listed in Box 6.

TIME OUT 5

Consider a patient you may have encountered with a neurological deficit. Using the information and accompanying illustrations try to deduce the areas of brain that were affected to produce such a deficit. Compare your results to any computed tomography (CT) scan or magnetic resonance imaging (MRI) results that are available on the chosen patient. How has the neurological deficit affected the patient's lifestyle? What lifestyle changes or adaptations has he or she had to make since the injury?



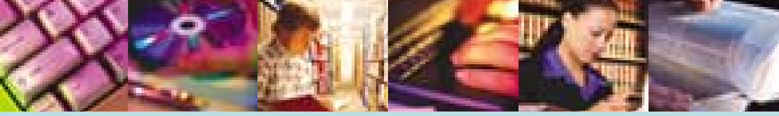
Box 4. Suggested answer to Time Out 4

When considering Time Out 4 you should have identified that the immediate action would be to maintain a patent airway as there is a risk of aspiration through vomiting, and that the condition has changed and therefore pupil reaction and GCS should be reassessed.

Box 5. Clinical factors

- The patient's age
- Mode of onset
- Duration of symptoms
- Family history
- Previous medical history

(Jones and Tomson 1998)



Box 6. Investigative methods for diagnosis of acquired brain injury

Tool	Method
Computed tomography (CT) scan	This is the use of a computer to take pictures of slices of the brain. X-rays are fired at different angles of the brain and picked up by receivers. The images obtained are analysed by the computer producing a series of pictures through the skull and brain. Dye (contrast) may be injected into a vein to highlight areas when more information is required. This method is useful in demonstrating the presence of tumours, cerebrovascular accident and bleeding. It is a painless procedure, requiring the patient to lie in the scanner, with the head extremely still. Therefore, the patient needs to be co-operative or otherwise sedated.
Magnetic resonance imaging (MRI)	A large, powerful magnet circles the patient's skull. Atoms in the brain orientate themselves around the magnetic field. Radio waves are then fired at the patient causing hydrogen atoms to resonate. As the atoms return to a resting state they give off radio waves that are picked up by receivers and analysed by a computer giving a detailed picture of the brain. This technique can detect subtle changes and abnormalities in the brain which are undetectable by CT scan.
Angiography	This method of investigation is used in the diagnosis and treatment of aneurysms. A dye is injected into a vein and radiography tracks its progress through the intricate mesh of arteries in the brain. Abnormal arteries are easily highlighted on X-ray.
Electroencephalography (EEG)	This is a recording of the electrical impulses occurring in the brain. Similar to ECG monitoring of the heart, the patient has electrodes placed around the skull that amplify and magnify the tiny electrical impulses from the brain and record them onto paper in seconds of time. It is a harmless and painless investigation and is useful in the diagnosis of epilepsy and in monitoring deeply comatose patients. A normal pattern will show a waveform every tenth of a second. This slows down during sleep and speeds up when the patient is awake and alert. EEG monitoring can be performed by telemetry.

(Walker and Shorvon 1996)

Nursing and clinical interventions

Much of the nurse's role in caring for brain-injured patients is concerned with monitoring and observation. Nurses have become expert in the early recognition of illness, yet this is an area of knowledge often overlooked in the quest to learn new techniques (Benner 1984). Benner identifies the role of administering and monitoring therapeutic regimens as a key area of nursing practice. It is vital that the nurse is able to identify changes in the patient's condition and knows the appropriate steps to take if the condition deteriorates. It is therefore important that the nurse understands the aims of managing brain-injured patients in the critical care environment, which are to prevent or reduce the risk of secondary injury occurring (that is, any injury subsequent to the primary injury, such as hypoxia or bleeding).

Ventilation and oxygenation Oxygen saturation should be monitored continually using pulse oximetery, and oxygen therapy should be administered as appropriate to maintain saturations above 98 per cent (Hall 1997). A patient who is maintaining an airway and breathing spontaneously is in a potentially dangerous position because conditions can change rapidly. Respiratory rate, depth and rhythm should be noted and any changes reported. Decreasing levels of consciousness may prevent adequate airway maintenance and increase the risk of aspiration. Noisy, snoring and harsh breath sounds may be a sign that the airway is being compromised. Patients with a GCS of less than eight should be considered for intubation to protect the airway (RCUK 2000).

In the past, hyperventilation was thought to be beneficial because it caused vasoconstriction of cerebral vessels thus reducing blood supply to the brain (Gerraci and Gerraci 1996). However, it is now out of favour for this reason, because vasoconstriction prevents adequate perfusion and oxygenation (Iacono 2000). Actively removing carbon dioxide from the blood has been shown to significantly reduce CPP, resulting in severe hypoxaemia, ischaemia and cell death (Iacono 2000). Current practice recommends maintaining normal values of blood oxygen and carbon dioxide.

Cardiovascular status Current practice is aimed at maintaining adequate CPP to overcome a raised ICP. Hypotension can have a detrimental effect on patient outcome due to the associated fall in CPP (Chesnut *et al* 1993). A CPP of 60-70 mmHg is required to provide an adequate CBF, and the blood pressure should reflect this (Germon *et al* 1994). In areas where ICP is not directly monitored, MAP should be maintained above 80-90mmHg (Alan 1986), to maintain adequate CPP.

Blood pressure may be manipulated with inotropes in patients who are adequately hydrated. In the critical care setting, prescriptions for inotropic support are often written in such a way that allows the nurse to use his or her clinical judgement to titrate inotropic administration against patient response. The nurse will consider the aim of management and other factors such as fluid balance, heart rate and rhythm and peripheral perfusion to make decisions regarding drug administration. This requires close patient monitoring and careful consideration of the NMC (2002b) guidelines on drug administration.

Hydration and nutrition The risk of choking and aspiration is greatly increased in patients with a reduced level of consciousness. Therefore oral intake should be monitored closely and the patient's ability to cough and swallow assessed. Intravenous therapy may be necessary until full diet and nutrition is achieved. Current management is aimed at providing adequate hydration with an equal balance being achieved between fluid input and output (Smith 1994). Hourly measurement of urine output and fluid intake combined with an assessment of skin turgor, peripheral temperature, capillary refill, oral mucosa, blood pressure, pulse and central venous pressure are the best indicators of fluid status. The findings should be documented and any changes should be identified and reported (NMC 2002a).

Isotonic solutions are the fluid of choice for intravenous therapy in brain-injured patients because these fluids have the same osmolarity as plasma. Adequate hydration helps to maintain CPP, as blood pressure is more stable in well hydrated patients. Dextrose solutions are not recommended because of the relationship between hyperglycaemia and neuropathy, and also because glucose is easily converted to lactate in hypoxic states producing an acidosis. They also increase cerebral oedema and ischaemia by increasing the osmotic pressure (North and Reilly 1994). Hypoglycaemia starves the cells of the energy required for metabolism, which compounds the problem of brain injury. Blood glucose levels should be monitored closely and every effort made to maintain normoglycaemia.

Providing nutritional substance is vital. Studies show that brain injury induces hypercatabolism. Adequate nutrition will help to prevent infection and muscle wasting and provide the necessary nutrients for tissue repair and recovery. Dietetic advice should be sought on the most appropriate diet prescription considering the patient's high energy requirements.

If normal oral intake is not possible, the nasogastric route of administration is preferred to parenteral feeding. This encourages normal gut peristalsis, prevents development of corrosion in the gut lining, discourages translocation of bacteria and uses absorption systems appropriate to human anatomy (Lee *et al* 1990, Rennie 1993). Good mouth care is essential in patients who are not eating or drinking. Teeth should be cleaned with a soft toothbrush to prevent decay and mouthwash helps the oral mucosa to remain moist.

Immobility, sedation, the use of opiate-based drugs and a reduced fluid and nutritional intake all contribute to reduced digestion and bowel movements. Constipation will not only cause discomfort, but will also increase intra-abdominal pressure causing an inadvertent rise in ICP. Commencing a diet or a feeding regimen as early as possible will help to regulate bowel habits, however, an aperient may also be required. A record should be kept of all bowel movements.

Sedation Therapeutic sedation may be indicated where there has been severe damage to the brain and the ICP is difficult to control. Sedation has proved effective in controlling ICP in the initial week following insult (Odell 1996). The best results have been achieved when the patient is kept in a deeply comatose state (BRCTSG 1986, Grande *et al* 1997). However, deep sedation using an anaesthetic agent reduces the efficacy of neurological observations and means the patient will require artificial ventilation; therefore sedation should not be prolonged. The drug of choice for sedation should have a short half-life so it is eliminated rapidly from the body on discontinuation, thus avoiding prolonged sedation.

Many sedative drugs cause dramatic vasodilation and therefore hypotension. This is best avoided with adequate hydration and may be counteracted by the use of inotropes. Nurses should be aware of the powerful effects of these drugs and should monitor the patient closely using a recognised sedation score (Beggan *et al* 2000, Finfers *et al* 1999), to ensure the management goal is being achieved.

It is not acceptable to administer muscle relaxants as a method of sedation (Ramsay 1993), although, if necessary, bolus doses may be administered before interventions when the patient is well sedated. Adequate and appropriate sedation often removes the need to administer these drugs.

Temperature control Research has shown that hypothermia can reduce mortality and permanent disablement by up to 60 per cent in the brain-injured patient (Hirayama *et al* 1995, Ishikura *et al* 1998, Marion *et al* 1997, Signorini 2001). It is suggested that each 1ºF rise in core temperature is associated with a 7 per cent increase in cerebral metabolism (Howe 1983). While extremely low temperatures have been associated with cardiac instability and bleeding, recent studies are in favour of maintaining temperatures between 32 and 34ºC, with caution. While conscious patients may find these temperatures intolerable, they should be encouraged to remain cool and remove blankets. Pyrexia should be treated with tepid sponging and/or water blankets (Polderman *et al* 2002, Shakell 1996).

Patient positioning Correct positioning of head-injured patients is an important aspect of nursing care and can dramatically improve ICP control. Correct positioning reduces the incidence of painful muscle contractures. Research recommends that head-injured patients should be positioned with the head elevated (Rosner and Coley 1986). Some studies suggest a head-up tilt of 30º to allow cerebral drainage (Feldman *et al* 1992). Some authors advocate higher positions suggesting the best position is the highest that is possible without adversely affecting the patient's blood pressure (Chudley 1994, Simmons 1997). Limbs and joints should be supported for comfort and spinal alignment maintained where possible. Neck rotation and head flexion increase ICP because drainage of fluid from the brain is impeded. For the same reason, endotracheal tubes should not be tied tightly around the face and neck (Sullivan 2000). Patients with moderate to severe brain injury are at high risk of developing pressure ulcers (Anthony and Barnes 1998), and pressure-relieving mattresses should be used.

While these recommendations are specific to brain-injured patients, these patients will often have other complications that require alternative intervention. A holistic approach should be adopted to overall patient care.

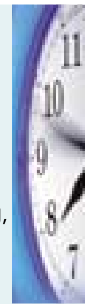
Delivery of care

The delivery of nursing care should be designed to meet the needs of the individual patient. Research and clinical practice have shown that episodes of care lasting longer than 15 minutes produce more than a transient rise in ICP and, therefore, should be avoided. ICP should be allowed to settle to its baseline recording before implementing further nursing interventions (Bruya 1981, Chudley 1994, Rising 1993). Predictable treatments can be planned into the patient's day considering these facts. The patient should not be disturbed unnecessarily and all treatments should be assessed to provide optimum comfort.

Research supports the theory that relatives – when a good relationship is evident – should be actively encouraged to become involved in patient care because ICP is considerably reduced in the presence of familiar voices and touch (Odell 1996, Schinner *et al* 1995, Treloar *et al* 1991). The House of Commons Health Select Committee (2001) and the Department of Health (2001) promote the involvement of families in recovery and rehabilitation in their reports on head injury rehabilitation.

TIME OUT 6

Refer back to the patient you considered in Time Out 1. How does the guidance given in this article compare to the care the patient received in your clinical area? Using the information provided in this article and an accepted model of nursing, write a retrospective care plan for the patient you have identified.



Collaborative care

The care of patients with acquired brain injury requires the co-ordination of many specialties and resources. It is important that members of the interdisciplinary team are able to function together to provide a seamless service for patients. Documentation is the key to effective communication and integrative care planning may be an option for patients with acquired brain injury. Recent reports from the House of Commons Health Select Committee (2001) and the Department of Health (2001) make various recommendations for an improved service for patients with brain injury. These include the development of clear care pathways and joint collaboration with community-based groups involved in long-term rehabilitation, for example, Headway. Many hospitals around the country are already developing care pathways for brain injury and although their use is limited at present many can be accessed via the internet at: www.nelh.nhs.uk/carepathways/

Rehabilitation and discharge should be considered at the earliest possible time. There are a number of different agencies involved in the rehabilitation of brain-injured patients and it is beneficial if these agencies can be included in patient care at an early stage because they also provide considerable support to families and carers. These agencies, for example, Headway, provide valuable information on future care and rehabilitation, and can also assist in co-ordinating the patient's discharge into the community.

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TIME OUT 7

Review the communication and documentation strategies in your area of work. Write down the advantages and disadvantages of these methods and consider ways in which they could be improved.

Conclusion

Acquired brain injury is a condition that may affect anyone at any time. It is not specific to any race or group of people and has devastating effects on the patient and his or her family. The effects of brain injury can grossly impede a person's ability to function in his or her environment, resulting in physical and social dependence requiring long-term rehabilitation. Effective care in the acute stages of injury reduces mortality and morbidity, increasing the chances of successful reintegration into community living.

A good understanding of the functions of the brain and accurate neurological observations by the nurse aid early identification of the condition, allowing the prompt implementation of care that will limit secondary damage. A variety of diagnostic and monitoring tools are available, although care is aimed at maintaining adequate brain perfusion. Effective collaboration is essential to promote patient welfare, provide a smooth transition through the hospital and encourage patients and relatives to remain in control of their lives throughout an extremely stressful time

TIME OUT 8

Now that you have completed the article, you might like to write a practice profile. Guidelines to help you are on page 56

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