The management of patients with spinal cord injury

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Few diseases or injuries have greater potential for causing death or having a devastating impact on a person’s quality of life than cervical spine trauma. All patients admitted to hospital after significant trauma must therefore be assumed to have a potentially unstable spinal fracture until it is proven otherwise, to prevent their sustaining further injury owing to inappropriate management. It is vital that nurses are familiar with the signs and symptoms of such injuries and aware of the appropriate management techniques.

Spinal cord injury can affect people of all ages but, statistically, the 15 to 35-year-old age group is the most vulnerable (Desjardins, 2002). It is estimated that two to three per cent of all trauma patients sustain cervical spine injuries and that, of these, three to 25 per cent have extension of those injuries as a result of delays in diagnosis or unwarranted manipulation in the accident and emergency department (Banit et al, 2000).

Attention to detail and high-quality nursing care are mandatory in this patient group. Patients with spinal cord injury should be referred at the earliest opportunity to a specialist spinal injury unit.

Incidence of spinal cord injury in the UK

The most common cause of spinal cord injury in the UK is a sudden, unexpected impact or deceleration of a vehicle, generally as a result of a road traffic accident.

The causes of accidental spinal-cord damage can be broadly grouped into four categories (Harrison, 2000):

- Domestic and industrial accidents: 37 per cent;
- Road traffic accidents: 36 per cent;
- Sporting and recreational accidents: 20.5 per cent;
- Self-harm and criminal assault: 6.5 per cent.

Not included in these categories are non-traumatic (medical) spinal cord lesions (such as spinal tumours), which make up around 17 per cent of spinal cord lesions.

Anatomy and physiology

The spinal cord is the elongated, almost cylindrical part of the nervous system, suspended in the vertebral canal, and begins as a continuation of the medulla oblongata at the posterior portion of the brain stem. The cord is protected by the vertebrae and associated ligaments and muscles, the spinal meninges and cerebrospinal fluid. Collectively, the dura mater, arachnoid mater and pia mater form the spinal meninges. The vertebral column consists of 24 separate, movable bones – seven cervical vertebrae, 12 thoracic and five lumbar – plus the sacrum (five fused bones), and the coccyx (four fused bones) (see Fig 1).

The first two cervical vertebrae are atypical. The first, the atlas, consists of a ring of bone with two short transverse processes. The second, the axis, has an upward projecting odontoid process that articulates with the first cervical vertebra. The movement at this joint is responsible for turning the head from side to side. The transverse ligament maintains the odontoid process of the axis in the correct position in relation to the atlas.

Blood supply to the spinal cord is via three longitudinal arteries: the anterior spinal artery, formed by the union of branches of vertebral arteries, and the paired posterior spinal arteries, each of which is a branch of either the vertebral artery or the posterior inferior cerebellar artery.

Fractures, dislocations and fracture-dislocations may interfere with the blood supply to the spinal cord from the spinal and medullary arteries. Ischaemia of the spinal cord affects its function and can lead to muscle weakness and paralysis (Moore and Agur, 2002).

The autonomic nervous system (which is divided into the sympathetic and parasympathetic nervous systems) controls the visceral functions of the body and is largely activated by centres located in the spinal cord, brain stem and hypothalamus. It helps control arterial blood pressure, gastrointestinal motility, sweating and body temperature. The system carries efferent impulses only and its responses are involuntary. It is important to bear this point in mind when managing spinal injury: the sympathetic outflow is affected in higher spinal cord injury, which in turn has a major effect on systemic blood pressure. A complete cervical injury will therefore lead to a large drop in blood pressure owing to the reduction in tone in the sympathetically innervated blood vessels (Alderson, 1999).

In patients with injuries lower in the spine, there will be loss of sensation and motor power below the injury, but minimal (if any) effect on blood pressure.

Thirty one pairs of spinal nerves are attached to the spinal cord: eight cervical, 12 thoracic, five lumbar, five sacral and one coccygeal. Multiple rootlets emerge from the posterior and anterior surfaces of the cord and converge to form posterior and anterior spinal nerve roots. The posterior roots of the spinal nerves convey afferent (or sensory) fibres from the skin, subcutaneous and deep tissues to the cord. The anterior roots convey efferent (or motor) fibres from the cord to skeletal muscle.

On exiting the vertebral canal, each spinal nerve...
divides almost immediately into a posterior primary rami and an anterior primary rami. The posterior rami supply the skin and deep muscles of the back, while the anterior rami supply the limbs and the rest of the trunk. The level of the body at which sensation is altered or absent, or at which weakness or absence of movement is noted, will indicate the type of injury (Harrison, 2000).

Presentation and types of injury

Tetraplegia or tetraparesis

This is also known as quadriplegia or quadriparesis. The term describes the complete or partial loss of all movements and/or sensation from the neck downward, affecting all four extremities and the trunk. It can also include paralysis of the diaphragm.

Paraplegia or paraparesis

This term describes the complete or partial loss of all movements and/or sensation from the chest downward, affecting the lower limbs only.

Complete spinal cord lesion

Transverse ischaemic necrosis occurs in this type of lesion, resulting in permanent loss of all voluntary movements and sensation below the level of the lesion.

Incomplete spinal cord lesion

When the lesion is incomplete, there is potential for any oedema to subside, with the consequent return of some neurological function, as it is possible that some nerve fibres may have survived.

Examples of incomplete spinal-cord lesions include:

- **Anterior cord syndrome**: this is the most common form of incomplete lesion and occurs after high-velocity impact trauma. The lesion develops as a result of physical trauma, bony compression and ischaemia;
- **Posterior cord syndrome**: this occurs with posterior impact injury or hyperextension of the neck. There may be a resultant loss of position ( proprioception), vibration and touch sense;
- **Brown-Séquard syndrome**: this involves hemisection of the spinal cord, commonly seen in stabbing or gunshot injuries. There is loss of voluntary motor control on the same side as the cord damage;
- **Central cord syndrome**: this type of injury usually occurs in older patients after a hyperextension trauma to the neck. There may be significant loss of function in the upper limbs and hands.

Cervical injuries

Any accident that results in the victim landing head first at speed is likely to cause cervical injuries. There are three common mechanisms in spinal cord injury:

- **Forced hyperextension**: the head and spine are forced backward with sufficient force to rupture the anterior spinal ligaments with or without accompanying bony injury. This often occurs in diving injuries, and results in high cervical cord injury (Moore and Agur, 2002);
- **Forced flexion injury**: the person’s head/neck are forced forward, with resultant damage to the posterior ligaments (common in road traffic accidents, when the head is thrown forward against the dashboard);
- **Compression fractures**: these injuries occur when the victim falls or lands on his or her head (for example, as a result of a swimming-pool accident or a fall from a horse). The vertebrae are compressed and may fragment – called a burst fracture – which involves invasion of bone into the vertebral canal with resultant cord damage (Harrison, 2000).

Managing spinal cord injury

There are three main areas to consider when treating patients suspected of having spinal cord injury (Alderson, 1999). Care involves:

- Preventing increasing and permanent damage to the spinal cord;
- Managing the spinal shock phase;
- Managing the reflex phase.

All patients admitted to hospital after significant trauma must be assumed to have a potentially unstable spinal fracture until it is proven otherwise (Brooks and Willett, 2001).

In an alert and conscious patient (who is not intoxicated and is able to cooperate with the clinical examination), the cervical spine may be cleared of being

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**REFERENCES**


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Cord Injury: Critical care.

REFERENCES


damaged if certain criteria are met (Banit et al, 2000). There should be:
- No neck pain;
- No bony cervical tenderness;
- No abnormal peripheral sensory or motor neurology;
- A pain-free full range of neck movement.

The patient should be transported to hospital on a spinal board, with the spine fully immobilised (Alderson, 1999). The basic principle of management begins with implementing the ABC of action: attending to the airway, breathing and circulation. Good airway control will improve tissue oxygenation in the spinal cord, which in turn may help limit tissue ischaemia (Harrison, 2000).

The manoeuvre of choice for opening the airway in spinal injury in an emergency is the jaw thrust. This brings the mandible forward and prevents the tongue from obstructing the airway. When intubating the spinally injured patient, the head and neck should be maintained in neutral alignment using manual-inline stabilisation (Resuscitation Council, 2000).

Normal respiration involves the interactions of several muscles, the most important of which is the diaphragm, innervated by the phrenic nerve from the cervical spinal cord (Alderson, 1999). High spinal injuries necessitate controlled ventilation and possibly long-term tracheostomy. High-quality respiratory physiotherapy is essential in such patients, both to maximise tidal volume and optimise clearance of secretions (Murphy, 1999).

Suxamethonium – a depolarising muscle relaxant – can be used to assist with intubation. However, patients with spinal injury can be extremely sensitive to this drug, owing to the expansion of the area of muscle sensitive to acetylcholine beyond the normal neuromuscular junctions. Alderson (1999) recommends using an alternative agent in all cases. Atropine may also be required on intubation, owing to the possibility of bradycardia brought on by stimulation of the (unopposed) vagus nerve.

The early administration of steroids may help prevent ‘secondary injury’, that is, injury related to reversible factors such as tissue oedema and ischaemia. The second National Acute Spinal Cord Injury Study (NASCIS 2) trial (Nesathurai, 1998) showed improved outcome for patients treated with methylprednisolone (30mg/kg intravenously) within eight hours of injury, followed by an infusion of 5.4mg/kg/h for 23 hours (Nesathurai, 1998; Bracken et al, 1990).

Spinal shock

High spinal cord injury is followed by a period of spinal shock, when all spinal reflexes are lost and there is no muscle tone. After a time, reflexes recover and increase in amplitude, reaching a hyper-reflexive state, particularly of the flexion reflexes (Davies et al, 2001).

Spinal shock is most pronounced in cervical injury, with a consequent reduction in sympathetic tone in the blood vessels under the control of the sympathetic nervous system (Alderson, 1999). There is often a profound drop in blood pressure and, as the parasympathetic nerve supply (vagus nerve) is still functioning, there may be a notable bradycardia. When the heart rate is slow enough to compromise cardiac output, intravenous atropine or glycopyrronium should be administered.

Nursing procedures that cause vagal stimulation, such as oral or tracheal suctioning, can also cause bradycardia, but it may be prevented with hyperoxygenation: administering 100 per cent inspired oxygen for two minutes before the manoeuvre (Grundy and Swain, 1996).

Fluid resuscitation can be problematic, especially at the scene of an accident or in transit to hospital, when cardiovascular monitoring will be limited. Copious intravenous fluids infused into the spinally shocked patient will lead to ‘pooling’ of the fluid in the lower limbs or lungs, leading to gross pulmonary oedema (Grundy and Swain, 1996). Unless major blood loss is established, fluid should be replaced judiciously.

Temperature control

Because of the dysfunction of the autonomic nervous system in spinal cord injury, body temperature cannot be controlled (Royle and Walsh, 1992). Maintaining an appropriate environmental temperature is therefore very important. Accurate, invasive temperature monitoring devices should be employed (Harrison, 2000).

Elimination

A urinary catheter should be inserted at the earliest opportunity in spinal-injured patients, as urine retention is likely. In addition, their fluid balance should be measured accurately. Harrison (2000) recommends changing the urinary catheter rather than flushing it, as there is no guarantee that fluid will be returned.

The presence of priapism (penile erection) in the unconscious male is a strong indicator of spinal cord injury. Loss of anal tone also suggests cord damage, therefore a rectal examination should be undertaken (this should have been performed in the accident and emergency department).

Patients are started on an aperient regimen to prevent constipation; the importance of attention to detail in bowel care in such cases cannot be overstated.

Gastrointestinal issues

A nasogastric tube should be inserted to decompress the stomach and prevent its impinging on the diaphragm and worsening respiratory problems. There may also be

USEFUL WEBSITES

National Institute for Clinical Excellence
www.nice.org.uk

Trauma surgery, injury and critical care
www.trauma.org

Spinal Injury Association (UK)
www.spinal.co.uk

● Turn the patient every two hours, avoiding friction and shearing forces.

● Avoid turning the patient onto a discoloured area of skin where possible.

● Minimise the risks of other contributory factors for pressure sore formation: maintain adequate nutrition/hydration, correct anaemias, clean patient as soon as possible after soiling.
a paralytic ileus in the early stages. Once this has resolved, it may be necessary to implement enteral feeding via the nasogastric tube: spinal-injury patients require a high calorific and high-protein intake to combat the negative nitrogen balance associated with immobility (Royle and Walsh, 1992).

**Pressure area management**

Patients with spinal injury are at high risk of developing pressure sores. The actions listed in Box 1 are recommended as preventive measures (Harrison, 2000).

Patients with unstable neck injuries must never be placed on airflow or dynamic alternating mattresses – expert advice should be sought at the first opportunity. A standard mattress is recommended in the early stages of patient management, as this provides optimal support for the fracture site (Harrison, 2000).

Once the spine has been surgically fixed, it is common practice to transfer the patient to an alternating airflow mattress specifically for pressure area care, but this should be sanctioned by the surgeon.

**Autonomic dysreflexia**

The most hazardous event that affects the spinal injury patient is the development of autonomic dysreflexia (Colachis, 1992). This involves intense vasoconstriction of the blood vessels in the area supplied by the nerves from the damaged part of the spinal cord.

Possible causes are listed in Box 2 (Harrison, 2000).

The problem generally manifests itself as acute hypertension and, if left unresolved, can cause fatal cerebral haemorrhage (Harrison, 2000). There may also be bradycardia, as the baroreceptors try to slow the heart rate via the vagus nerve to compensate for the drastic rise in systemic blood pressure (Alderson, 1999). Treatment is by swift removal of the offending stimuli and, if necessary, administration of an antihypertensive agent to control the blood pressure (Alderson, 1999).

**Lifting and handling the patient**

The purpose of log-rolling is to maintain alignment of the whole spine while turning and moving a patient who has a spinal surgery or who is suspected of having one (Groeneveld et al, 2001).

The standard log-roll technique requires a minimum of five staff. The nurse at the head of the bed is responsible for manually supporting the cervical spine (even if a hard collar is in situ) and for coordinating the move. The nurse controlling the head/neck must ensure immobilisation from the base of the skull through all the cervical vertebrae. The patient’s upper leg must be kept in alignment throughout the turn to prevent movement at a thoracic-lumbar site. Pillows may be placed along the length of the trunk and legs to tilt the patient 30°–90° (Harrison, 2000). It should be stressed that the use of a head immobiliser attached to the bed is a very dangerous practice, as sudden movement, coughing or vomiting will cause the body to pivot and cause movement at the neck (Cooke, 1998).

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**BOX 2. CAUSES OF AUTONOMIC DYSREFLEXIA**

- Distended bladder (the most common cause is a blocked urinary catheter)
- Distended bowel (usually caused by constipation)
- Ingrowing toenail
- Pressure sore
- Urinary tract infection/bladder spasms
- Renal calculi/bladder calculi
- Visceral pain or trauma
- Pregnancy/delivery
- Deep-vein thrombosis/pulmonary embolism
- Severe anxiety/emotional distress

Scoop stretchers and spinal boards are suitable for transferring patients having a computerised tomography or magnetic resonance imaging scan. Where it is necessary to slide a patient who may have a cervical injury on to the CT scanner, a minimum of seven staff should be employed to maintain spinal alignment (Harrison, 2000).

When using scoop stretchers, care should be taken to prevent soft-tissue trauma to the patient who has little or no skin sensation. A sheet must always be in place between the patient and the stretcher, therefore.

**Hard collars**

A hard collar should always be fitted as soon as possible in a trauma victim, in people complaining of neck pain or bony tenderness after their accident, and those complaining of motor/sensory deficit in their limbs or trunk. In suspected cervical spine injury the hard collar alone does not immobilise the neck.

Great care should be taken not to apply the collar over-tightly in those with head injury, thereby causing (further) increase in intracranial pressure. All collars come with fitting instructions, and it is of paramount importance that they are sized and fitted correctly.

**Urgent need for national care guidelines**

In a political and professional climate that requires nurses to define, maintain and seek to improve the quality of all aspects of health care practice, they are duty-bound to underpin decisions and actions with robust evidence (Sleep et al, 2002).

It is interesting to note that written protocols for cervical clearance, a notoriously contentious area in spinal injury management, are used in up to 78 per cent of US trauma centres, but in only 14 per cent of units in the UK (Lockey et al, 1998).

Many aspects surrounding the treatment of spinal cord injury require further clarification and guidelines. At present, there is little on the National Institute for Clinical Excellence website relating to spinal injury care. This is an area that requires urgent attention.