ABC of Spinal Cord Injury

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EVACUATION AND INITIAL MANAGEMENT AT HOSPITAL

Evacuation and transfer to hospital

If the casualty is trapped in a vehicle it may be safer to apply a spinal board or Hines cervical splint before moving him. The Hines splint is used in conjunction with a foam collar of adult or paediatric size; together they prevent neck movement. Alternatively, a soft collar or even an improvised splint made out of rolled up newspaper has been advocated, but neither fully immobilises the neck, and such measures can generate a false sense of security. The Hines splint is also useful for immobilising the neck in the supine patient before and during transportation.

The patient should be moved by four people, one responsible for the legs; one for the hips and abdomen; one for the shoulders and chest; and one for head and neck. The person holding the head and neck directs movement.

The patient should be placed supine on a firm stretcher. A "scoop" stretcher is ideal as it can be slotted together around the casualty with minimal disturbance. In the absence of life threatening injury the patient should be transported slowly by ambulance, for reasons of comfort as well as to avoid further trauma to the spinal cord. If an injury of the cervical spine is suspected a Hines splint or a soft collar with sandbags on each side of the head should be used to prevent rotation. The patient should be transported to the nearest major accident and emergency department but must be repeatedly assessed en route; in particular vital functions must be monitored.

Hard objects should be removed from the patient's pockets and anaesthetic areas protected to prevent the development of pressure sores.

The usual vasomotor responses to changes of temperature are impaired in tetraplegics because the sympathetic system is paralysed. The patient is therefore poikilothermic, and hypothermia is a particular risk when tetraplegics are transported during the winter months. Thermal reflector blankets are often needed to maintain body temperature.

When the injury has been sustained in an inaccessible area or the patient has to be evacuated over a long distance, transfer by helicopter has been shown to reduce mortality and morbidity, although the cost is substantial. If a helicopter is used, the possibility of immediate transfer to the regional spinal injuries unit should be considered, after discussion with that unit.

Initial management at the receiving hospital

When the patient arrives at the nearest major accident unit a detailed history must be obtained and a full general and neurological examination performed. The general examination must be thorough because spinal trauma is often associated with multiple injuries, commonly affecting the head and chest. Specific signs of spinal injury should be sought, including local bruising and tenderness, deformity of the spine—for example, a gibbus or an increased interspinous gap—and priapism, which invariably indicates a high spinal cord lesion.

Diagnosis of intra-abdominal injury may be very difficult in patients with high cord lesions (above the 7th thoracic segment) during the initial phase of spinal shock, when paralytic ileus and abdominal distension are usual. Abdominal sensation is impaired, and this, together with the flaccid paralysis, means that the classical signs of an intra-abdominal emergency may be absent. The signs of peritoneal irritation do not develop and, in these circumstances, peritoneal lavage may be helpful.

The neurological examination must include assessment of the following:

- sensation to pin prick (spinothalamic tracts);
- sensation to fine touch and joint position sense (posterior columns);
- power of muscle groups according to the Medical Research Council scale (corticospinal tracts);
- reflexes (including abdominal, anal, and bulbocavernosus reflexes);
- cranial nerve function.

By examining the dermatomes and myotomes in this way, the level and completeness of neurological damage is determined.

Myotomes

Muscle group

Diaphragm
Shoulder abductors
Elbow flexors
Supinators/pronators
Wrist extensors
Wrist flexors
Elbow extensors
Finger extensors
Finger flexors
Intrinsic hand muscles
Hip flexors
Hip adductors
Knee extensors
Ankle dorsiflexors
Toe extensors
Knee flexors
Ankle plantar flexors
Toe flexors
Anal sphincter

Reflexes

nerve supply

C(3),4,(5)
C5
C5,6
C6
C6
C7
C7
C7
C8
T1
L1,2
L2,3
L3,4
L4,5
L5
S1
S1,2
S1,2
S2,3,4

Biceps jerk C5,6
Supinator jerk C6
Triceps jerk C7
Abdominal reflex T8-12
Knee jerk L3,4
Ankle jerk S1,2
Bulbocavernosus reflex S3,4
Anal reflex S5
Plantar reflex

An additional sign which may be of value in paraplegics is Beevor's sign, which is a superior displacement of the umbilicus during contraction of the abdominal muscles. The sign is present when there is a relative weakness of muscles below the umbilicus (10th thoracic segment) and is demonstrated when the patient tries to lift his shoulders off the couch.

Spinal shock

After severe spinal cord injury spinal shock with generalised flaccidity below the level of the lesion supervenes, and, although reflex activity may still be present, even this disappears after a period. Spinal shock may last from a few hours to several weeks. Its end is marked by a return of reflex activity in lesions of the suprasacral segments of the cord, the reflexes returning first usually bring the anal and bulbocavernosus reflexes. The early presence of a brisk bulbocavernosus reflex with evidence of a complete lesion of the spinal cord carries with it a poor prognosis for return of function. In lower motor neurone lesions affecting either the conus medullaris or cauda equina reflexes remain absent unless neurological recovery occurs.

Both the anal and bulbocavernosus reflexes depend on intact sacral reflex arcs. The anal reflex is an externally visible contraction of the anal sphincter in response to perianal pin prick. The bulbocavernosus reflex is a similar contraction of the anal sphincter felt with the examining finger in response to squeezing the glans penis. If the sacral segments are spared in an incomplete injury these reflexes persist throughout the phase of spinal shock, and the likelihood of a return of bladder and bowel control is increased.

Incomplete spinal cord injury

Assessment of the level and completeness of the spinal cord injury allows a prognosis to be made. If the lesion is complete from the outset—that is, there is no sign of spinal cord function below the level of injury—recovery is far less likely than in an incomplete lesion. There are recognised patterns of incomplete cord injury.

Anterior cord syndrome—The anterior part of the spinal cord is usually injured by a flexion-rotation force to the spine producing an anterior dislocation or by a compression fracture of the vertebral body with bony encroachment on the vertebral canal. There is often anterior spinal artery compression so that the corticospinal and spinothalamic tracts are damaged by a combination of direct trauma and ischaemia. This results in loss of power as well as reduced pain and temperature sensation below the lesion.

Central cord syndrome—This is typically seen in older patients with cervical spondylosis. A hyperextension injury, often from relatively minor trauma, compresses the spinal cord between the irregular osteophytic vertebral body and the intervertebral disc anteriorly and the thickened ligamentum flavum posteriorly. The more centrally situated cervical tracts supplying the arms suffer the brunt of the injury so that classically there is a flaccid (lower motor neurone) weakness of the arms and relatively strong but spastic (upper motor neurone) leg function. Sacral sensation and bladder and bowel function are often partially spared.

Posterior cord syndrome—This syndrome is most commonly seen in hyperextension injuries with fractures of the posterior elements of the vertebrae. There is contusion of the posterior columns so the patient may have good power and pain and temperature sensation but there is sometimes profound ataxia due to the loss of proprioception, which can make walking very difficult.

Brown-Sequard syndrome—Classically resulting from stab injuries but also common in lateral mass fractures of the vertebrae, the signs of the Brown-Sequard syndrome are those of a hemisection of the spinal cord. There is reduced or absent power but relatively normal pain and temperature sensation on the side of the injury because the spinothalamic tract crosses over to the opposite side of the cord. The uninjured side therefore has good power but reduced or absent sensation to pin prick and temperature.

The final phase in the diagnosis of spinal trauma entails radiology of the spine to determine the level and nature of the injury.

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