General:
- Respiratory complications are a major source of morbidity and mortality after spinal cord injury with most early deaths being due to pulmonary complications.
- While most cord injuries occur below C4 allowing the phrenic nerves to continue to innervate the diaphragm, the respiratory system is frequently affected despite this due to variable paralysis of intercostal muscles and accessory muscles. Loss of abdominal muscle tone & ileus also reduce the mechanical efficiency of breathing.

Respiratory insufficiency:
- Generally there is a period of grace in which the patient will maintain his or her respiratory status; however, it is not uncommon for patients with cervical injury to develop respiratory insufficiency 24–48 hours after admission. Additional injuries such as rib fractures may accelerate this deterioration.
- Preparation should be undertaken so that intubation can be performed with appropriate spinal precaution often supplemented by fibreoptic bronchoscope.

Respiratory complications:
- The most common respiratory complications include atelectasis, pneumonia, & PE.
- Patients often have difficulty taking deep breaths, coughing and clearing secretions.
- Tracheostomy: the likelihood of requiring tracheostomy increases after a high cervical injury, with pre-existing pulmonary disease and with increasing age.
- Although tracheostomy can be performed before anterior cervical instrumentation with a low risk of infection, it is often deferred until after stabilisation has been performed.

Epidemiology:
- Spinal cord injury typically occurs in young males.
- The prevalence of spinal cord injury is increasing due to improved survival in both acute and chronic stages of the disease.

Initial Management:
- Spinal shock alters the basics of ‘ABC’ of resuscitation in several ways.
- Blood pressure management:
  - Low blood pressure caused by neurogenic shock may respond to volume resuscitation; however, it is not uncommon for these patients to require low doses of pressors.
  - Maximisation of spinal cord perfusion to reduce the likelihood of secondary injury is a reasonable approach; however, precise blood pressure targets are undefined.
  - It is reasonable to aim for a MAP of 80mmHg provided this can be achieved without excessive vasopressor requirements.

Cardiovascular System:
- Hypovolaemic shock in the presence of spinal cord injury may be accompanied by relative bradycardia.
- The term spinal shock is often used erroneously to describe neurogenic shock. Strictly, spinal shock encompasses the manifestations of spinal cord injury varying from initial areflexia and flaccidity that is gradually replaced by hypertonia, exaggerated reflexes and in many cases spasticity.

Pharmacotherapy:
- Corticosteroids:
  - A number of studies have shown improved neurological recovery in animals with spinal cord injuries that have received either dexamethasone or methylprednisolone.
  - NASCIS-I examined 100mg and 1000mg of methylprednisolone given for 10 days. This study had no control group and no significant difference in outcome was found except that the high dose group had more wound infections.
  - NASCIS-II was a prospective randomised double blind multicentre trial that demonstrated improved neurological outcomes after 6 weeks, 6 months and 1 year in patients with non-penetrating spinal cord injury who had received methylprednisolone including a bolus of 30mg/kg. The improvement was only observed in the drug was given within 8 hours of injury when compared to placebo or naloxone.
  - Criticisms of this study have included difficulties in randomisation, reporting methods, analysis of benefit limited to small subgroups within the larger study and lack of replication of results by independent investigators.
  - NASCIS-III compared the dosage of methylprednisolone used in the NASCIS II protocol with a longer dosage regimen (48hrs). The results of this study suggested that when patients are seen within 3 hours they should receive a bolus of 30mg/kg of methylprednisolone followed by 23 hours of treatment at 5.4mg/kg iv. Patients seen between 3 and 8 hours should receive the same bolus followed by a 48 hour infusion.

Gangliosides:
- Gangliosides are complex sialic acid containing glycosphingolipids which are present in high concentration in neural membranes.
- A recent randomised double blind trial performed at a single centre found a beneficial effect in functional neurological outcomes when the ganglioside GM1 was administered within 72 hours of injury.
- A multicentre trial demonstrated no significant effect when administered at 26 and 52 weeks after injury.

Intramedullary haemorrhage on MRI signifies a worse injury and a worse prognosis.

Skin:
- The spinal cord injured patient is extremely prone to pressure areas & frequent turning is mandatory.

Urinary System:
- The spinal cord injured patient is at high risk for DVT and/or PE. Prophylaxis should be commenced with LMWH +/- pneumatic calf compression.
- The incidence increases with injuries above T6 because unopposed vagal tone slows the heart and reduces SVR.
- Hypovolaemic shock in the presence of spinal cord injury may be accompanied by relative bradycardia.
- The term spinal shock is often used erroneously to describe neurogenic shock. Strictly, spinal shock encompasses the manifestations of spinal cord injury varying from initial areflexia and flaccidity that is gradually replaced by hypertonia, exaggerated reflexes and in many cases spasticity.
- Most cervical injuries require nasogastric suction because impaired bowel motility, air swallowing produce gastric distention leading to respiratory compromise.
- Patients with spinal cord injuries are at high risk of developing stress ulcers particularly with the use of high dose steroids and PPIs or H2 blockers should be used (the risk of GI bleeding in the NASCIS II study for the methylprednisolone group was 4.5%).

Gastrointestinal System:
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- During the period of spinal shock after a cervical or thoracic injury the bladder becomes flaccid and may require a small capacity arial catheter to be placed initially.
- Patients with spinal injuries above T6 may develop autonomic dysreflexia if the bladder becomes overdistended or sometimes with catheterisation sympathetic overactivity occurs.
- The spinal cord injured patient is extremely prone to pressure areas & frequent turning is mandatory.
- Stress ulcers are a common complication after spinal cord injury owing to a lack of sympathetic modulation.
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