Perioperative management for patients with a chronic spinal cord injury

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Key points

• Autonomic dysreflexia (ADR) is a medical emergency characterized by severe hypertension. It can be brought on by a wide range of stimuli below the level of the lesion, often occurring intra-operatively. The anaesthetist must be aware of the presentation, prevention, and management.

• Anaesthetic management is dependent on the level and completeness of the lesion in relation to the surgical site, the presence of ADR and muscle spasms, and patient wishes.

• Thorough preoperative assessment is crucial to safe anaesthetic management.

• Pathophysiological changes complicating perioperative care are multi-systemic. Important considerations include cardiovascular and respiratory complications.

• Age-related comorbidities must be considered alongside the pathophysiological changes associated with the spinal cord injury.

Pathophysiology

Cardiovascular system

Autonomic dysreflexia

ADR is the most important and relevant complication of CSCI for the anaesthetist. It is a clinical emergency characterized by a massive disordered autonomic response to certain stimuli below the level of the lesion, such as bladder and bowel distension. The clinical manifestations include:

• an increase in blood pressure of at least 20%,
• headache,
• flushing,
• sweating,
• chills,
• nasal congestion,
• piloerection,
• pallor.

Severe hypertension can lead to raised intracranial pressure resulting in seizures and intracranial haemorrhage, and cardiac complications including myocardial ischaemia, arrhythmias, and pulmonary oedema.

Factors affecting the development of ADR include level of the spinal injury, duration of injury, and whether the injury is complete or incomplete. The incidence of ADR is between 50% and

Patients with chronic spinal cord injury (CSCI) have multiple comorbidities that frequently require emergency and elective surgical intervention. Pathophysiological changes after SCI are complex, and as such, the perioperative management of these patients requires careful consideration.

There are ~40 000 people in the UK living with a CSCI¹ and there are 10 spinal cord injury units in the UK and Eire (see Appendix). Data from the USA indicate that the average age at injury is increasing and is currently ~43 yr.² Consequently, the anaesthetist must also consider the increased risk of age-related medical comorbidity, in addition to the altered underlying physiology.

Overall life expectancy has largely remained unchanged since the 1980s despite an increase in survival in the first 2 yr post-injury, and remains less than that of the aged-matched general population.³ Leading causes of death are attributed to the cardiovascular, genitourinary, and respiratory systems.
70% in patients with lesions above T6 and increases in frequency with higher level lesions and complete lesions. There are reports of ADR with lesions as low as T10; however, symptoms are less severe in patients with lower lesions. Although it is most commonly observed in the chronic stage of SCI (a year after injury), early episodes can occur within weeks of injury, and 10% of patients with lesions above T6 experience ADR within first year of injury.

The pathophysiology of ADR is thought to be a result of a disorganized sympathetic response to stimuli below the level of the lesion (Fig. 1). Normal regulation of sympathetic output from the spinal cord is modulated by input from higher centres. Interruption within the spinal cord results in loss of this higher input. Spinal circuits below the lesion are established and result in exaggerated responses. Activation of the autonomic nervous system below the level of the lesion results in a profound sympathetic response up to the level of injury.

If the level is above T6, the splanchnic circulation becomes involved resulting in splanchnic vasoconstriction, and hence, a greater severity of symptoms. Compensatory mechanisms aiming to reduce the hypertension, via parasympathetic activity, are activated up to the level of the lesion. This results in the characteristic symptoms of bradycardia and vasodilation above the lesion.

Stimuli arise from caudal roots below the level of the lesion, with ~80% of patients being because of bladder distension. Other triggers include bowel distension, acute abdominal pathology, urinary tract infections, skeletal fractures, pressure ulcers, activation of pain fibres, sexual activity, and uterine contractions.
The management of ADR is illustrated in Figure 2.

**Arrhythmias**

Patients with high cervical lesions often have vagal hypersensitivity leading to bradyarrhythmias. This is usually temporary, mostly resolving within 5 weeks from injury, although occasionally it persists necessitating a pacemaker.

**Cardiovascular disease**

Patients are at risk of cardiovascular disease because of a lack of physical activity, reduced muscle mass, and the development of metabolic syndromes including diabetes. The risk of cardiovascular disease increases with age, and also with higher and more severe spinal cord lesions. Some 40% of deaths in patients with SCI are attributable to cardiovascular disease.7

**Temperature regulation**

Thermoregulation is often impaired, especially if the lesion is high. There is a reduced sensory input to higher thermoregulatory centres, reduced sympathetic control of vascular tone, and reduction in sweating below the level of the injury.

**Thromboembolism**

The risk of venous thromboembolism in the first 3 months after an acute SCI is ~85% if left untreated, necessitating prophylactic anticoagulation. After this period, the risk decreases and prophylaxis is not routinely required.8 This reduction in risk from 3 months may be secondary to the effect of lower limb spasms on muscle pump action along with femoral artery atrophy and reductions in venous distensibility. However, in the perioperative period, the risk is again increased and standard thromboprophylaxis is recommended according to local hospital policy, with low-molecular-weight heparin and antithrombotic stockings, or mechanical devices as appropriate for the procedure.

**Other cardiovascular changes**

Blood volume is reduced, and anaemia is present in ~50% of patients.9 Patients are prone to postural hypotension because of a combination of reduced plasma volume, pooling of blood in the lower limbs, and an altered baroreceptor reflex. I.V. access is often difficult because of atrophic, hyperaesthetic skin with reduced cutaneous blood flow.

**Respiratory system**

**Respiratory mechanics**

Respiratory mechanics are altered after SCI, with the degree of ventilatory dysfunction dependent on the level and completeness of the lesion. Complete injury renders ventilatory muscles below the injury completely non-functional. Incomplete lesions may allow for variable muscle function.

**Effect of the level of the lesion**

- Lesions above C3: complete dependence on mechanical ventilation because of phrenic nerve denervation causing complete diaphragmatic paralysis.
- Lesions between C3 and C5: variable dependence on ventilatory support because of variable effect on diaphragmatic and accessory muscle function.
- Lesions between C6 and C8: they may require intermittent non-invasive ventilatory support. Intact diaphragmatic function and accessory neck muscles enable adequate inspiratory effort. However, intercostals and abdominal wall muscles remain paralysed. Exhalation occurs via passive recoil of the chest wall, and cough is impaired. There is an increased risk of pneumonia because of poor mobilization of lung secretions.
- Thoracic injuries: little respiratory compromise; the main problems are attributable to an inefficient cough.

Vital capacity is increased in the supine position as abdominal wall paralysis permits greater displacement of abdominal contents during caudal diaphragmatic excursion. Patients will benefit from being recovered in the supine position. Lung volumes are altered and patients with cervical SCI exhibit a restrictive ventilatory deficit with reduced forced vital capacity and forced expiratory volume in 1 s values. Expiratory reserve volume, total lung capacity, and functional residual capacity are also reduced and correlate with the level and completeness of the lesion.10

Cervical lesions also result in reduced lung and chest wall compliance because of intercostal muscle spasticity and blunted responses to hypercapnia. There is an increased risk of sleep apnoea,11 possibly because of increased neck circumference.

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associated with a higher incidence of obesity and accessory muscle hypertrophy.

**Ventilatory support**
Around a fifth of patients with cervical SCI patients require a tracheostomy. This is commonly necessary for prolonged mechanical ventilation resulting from respiratory muscle fatigue, impaired secretion clearance, and respiratory complications such as pneumonia and atelectasis. Occasionally, they are needed for airway protection in patients of high cervical lesions involving cranial nerves. Most are uncuffed tubes for use with domiciliary ventilators. These allow greater tolerance of leaks, compared with conventional ventilators, facilitating communication.

**Musculoskeletal system**

**Spasticity and contractures**
Spasticity occurs as a result of hyper-excitable spinal reflexes causing exaggeration of the stretch reflex arc. Spasms can be a cause of severe morbidity and can be provoked by minor stimuli. Contractures are also common and can complicate optimal surgical positioning. The most common oral treatment for spasticity is the GABA-B agonist baclofen, with an occasional use of benzodiazepines; both of which may cause sedation. Increasingly, intrathecal baclofen delivered via indwelling infusion pumps are used and vigilance to the position of the diathermy plate must be paid in these instances.

**Osteoporosis**
Decreased bone density is common in SCI patients, with 60% of patients having osteoporosis at 15 yr after their injury and 34% have had at least one fracture. This must be considered in patient handling and positioning.

**Extrajunctional acetylcholine receptors**
Denervated muscle results in an increase of extrajunctional acetylcholine receptors, spreading from motor end-plate of affected muscle fibres to cover the whole muscle membrane. On administration of a depolarizing neuromuscular blocking agent, depolarization will occur across the whole muscle. This can result in large increases in serum potassium concentrations and potentially cause serious cardiac disturbances and cardiac arrest. The duration of this effect is difficult to determine, although it is generally agreed that succinylcholine is safe to use after a period of 6 months from injury.

**Spinal fixation**
Spinal fixation in the form of surgical fusion and bracing may have been carried out to obtain stability. Lumbar metal work may prohibit the use of spinal or epidural anaesthesia, while fixed necks may make airway management and intubation difficult.

**Pressure ulcers**
Pressure ulcers are common and result from tissue damage because of unrelieved pressure, typically occurring over bony prominences. Poor nutrition, muscle atrophy, and altered blood flow to the dermis contribute. Pressure ulcers may precipitate ADR, and be a source for local and systemic infection.

**Neurological system**

**Chronic pain**
Around 65% of SCI patients have chronic pain. Pain may be both nociceptive and neuropathic in nature, with nociceptive pain arising for musculoskeletal structures and viscera, and neuropathic pain from spinal cord and nerve damage. It is important to identify painful stimuli and take this into consideration when cannulating or positioning patients. It can be a source of discomfort, but also could trigger ADR.

**Psychological complications**
Psychological complications of post SCI include depression, suicide, and drug addiction.

**Gastrointestinal system**
Gastric emptying is delayed in patients, particularly with high-level injuries. The most common gastrointestinal disturbances are constipation, distension, abdominal pain, and rectal bleeding. Bowel distension is a potent trigger for ADR. There is a high incidence of gallstones, with patients at an increased risk of developing advanced biliary complications.

**Genitourinary system**
Commonly there is impaired sensory and motor innervation to the bladder resulting in a neurogenic bladder. Sequelae of this include reduction in bladder capacity, incomplete emptying, chronic retention, and frequent urinary tract infections. Urinary tract infections are the most frequent source of septicemia in SCI patients, which carries a significant mortality.

**Other**
The prevalence of nosocomial bacterial colonization is high amongst SCI patients and common organisms include Methicillin-resistant Staphylococcus aureus (MRSA), Multi-resistant Acinetobacter Baumannii, Escherichia coli, and Pseudomonas aeruginosa. The patient status must be checked before operation, with appropriate consideration to the order of the list, protective equipment, patient isolation, and antibiotic prophylaxis.
Musculoskeletal. Osteopenia, contractures, spasticity, and falls all increase the risk of limb fractures requiring emergency orthopaedic procedures. Pressure sores may be the source of sepsis or osteomyelitis and require intervention.

Elective surgery, Urological. Recurrent urinary tract infections and long-term catheterization increase the risk of bladder cancer. Cystoscopy is a common procedure as is insertion of suprapubic catheters and botox injections for the management of neuropathic bladders.

General. Patients may require a defunctioning colostomy to prevent infection from perineal and sacral pressure sores and allow healing or for the management of neuropathic bowel and chronic constipation.

Spinal surgery. In the acute phase, patients often require reduction, decompression, and stabilization of fractures. Occasionally, metalwork will need to be revised or removed. It is common for patients with longstanding SCI to develop scoliosis, which requires correction.

Intrathecal baclofen pumps. Baclofen pumps are used in patients which severe spasticity requiring large doses of anti-spasmodic medications precipitating unwanted side-effects. The operation includes insertion of a lumbar or low thoracic catheter, tunnelled to the connecting pump that is inserted in the lower abdominal wall.

Preoperative assessment and investigations

History and examination—key points (Table 1). Level of and completeness of the injury. High and incomplete injuries are more likely to experience ADR. The time since the injury may influence choice of drugs used, such as succinylcholine.

Autonomic dysreflexia. The focus should include identification of susceptible patients, establishing a history of previous episodes including known triggers, frequency, and severity. A review of previous anaesthetic charts will reveal prior anaesthetic techniques and any episodes of ADR under anaesthesia. Potential triggers for ADR should be sought and treated before operation including checking for catheter blockages, ensuring bowels have been emptied and vigilance for skin ulceration.

Muscle spasms and contractures. Spasms and contractures can make patient positioning and surgery difficult. Spasms can be spontaneous or in response to cutaneous stimuli.

Ventilation. A history of prior ventilatory problems including sleep apnoea, recent pneumonia, or intensive care admissions should be noted. If patients use non-invasive ventilation (NIV), their usual device and mask must be available in the perioperative period and in recovery. If the patient has a tracheostomy, the size, whether it is cuffed, fenestrated, or has a speaking valve should be noted. Uncuffed tracheal tubes should be changed to cuffed tubes before operation to allow adequate ventilation under anaesthesia.

Airway assessment. Previous cervical spine surgery/fixation should be noted and a difficult airway predicted. Previous tracheostomies may cause tracheal stenosis.

Table 1 Common anaesthetic preoperative workup

<table>
<thead>
<tr>
<th>Blood workup</th>
<th>Anaemia and infections are common</th>
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<tbody>
<tr>
<td>FBC</td>
<td>Renal impairment and electrolyte disturbances</td>
</tr>
<tr>
<td>Urea and electrolytes</td>
<td>May be required if there is chronic sepsis</td>
</tr>
<tr>
<td>Liver function tests</td>
<td>If there are concerns regarding hypoventilation, or an active chest infection. A baseline is useful before operation for patients on assisted ventilation</td>
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<tr>
<td>Arterial blood gas</td>
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Microbiology

Routine swabs To identify colonization with nosocomial acquired organisms including urine, blood, and sputum in the presence of a suspected infection

Cultures

Respiratory

Vital capacity To provide a baseline, this may indicate the necessity of perioperative assisted ventilation

Hypoventilation may be because of collapse or active infection requiring attention before operation

Chest radiograph

MRI

Patients with prolonged periods of intubation that have subsequently been decannulated may be left with tracheal stenosis. An MRI may be useful if there is a history suggesting tracheal stenosis

Cardiovascular

Observations Baseline blood pressure and heart rate

Electrocardiogram If there is any evidence of rhythm disturbances or ischaemic heart disease

Echocardiogram Not routine unless otherwise indicated

Musculoskeletal

Plain radiographs or computerized tomography X-ray and CT scans of metal work in the spine that may compromise the insertion of regional anaesthesia should be reviewed

Pressure areas. Any pressure sores should be noted and appropriate dressing and protection applied before operation.

Anaesthetic management

There are three options for providing anaesthesia (Fig. 3): no anaesthesia with an anaesthetist on standby, regional anaesthesia, and general anaesthesia. Consideration must be given to patient preference, the level and the completeness of the lesion relative to the operative site, previous anaesthetic management, the presence of ADR, and spasticity. In all instances, access to emergency drugs for the management of ADR should be immediately available.

No anaesthesia, anaesthetist on standby

Patients having operations below the level of the lesion may not require an anaesthetic. Agreeable patients must give full consent and will require an anaesthetist on standby in case ADR occurs.
Spinal anaesthesia is safe in patients with CSCI and is an effective way of abolishing ADR and spasms. Spinal anaesthesia is becoming a widely accepted technique in patients with pre-existing spinal cord pathology and is routinely used in Stoke Mandeville Hospital, with a low dose (1.5–2 ml) hyperbaric bupivacaine 0.5%, for most procedures. Spinals can be challenging to site because of poor positioning as a result of spasms and contractures, the presence of spinal metal work, and bony deformities.

The effectiveness and the level of the block are difficult to ascertain. The loss of the Babinski response to a positive test and a change in tone from spasticity to flaccid paralysis indicate an established block; although the height of the block remains difficult to assess. The anaesthetist must be vigilant for the signs and symptoms of a total spinal block.

Epidural anaesthesia has been demonstrated to be effective in reducing ADR in labouring women; however, it is less reliable for general and urological surgical procedures. For patients with incomplete lesions or chronic pain having long and painful general surgical procedures, epidural anaesthesia may be helpful in reducing the incidence and severity of ADR in the postoperative period. Upper limb surgery may be amenable to brachial plexus block, and this should be done under ultrasound guidance as nerve stimulators may be unreliable in the presence of cervical injuries. Consideration should be given to the approach of the block. Supraclavicular and interscalene blocks carry a higher risk of pneumothorax and phrenic nerve paralysis. These will have greater implications in CSCI patients who may already have impaired respiratory function.

General anaesthesia

Premedication. Sedatives should be avoided as they may reduce respiratory drive. Premedication aimed at reducing the risk of ADR is occasionally used, such as nifedipine, although premedication with anticholinergics has not been shown to be of benefit. Fast ing times should be strictly adhered to as patients may have delayed gastric emptying.

Induction. Patients generally require lower doses of induction agents to achieve anaesthesia. This may in part be because of altered pharmacokinetics resulting from a reduced blood volume and muscle mass. The sympathetic response to hypotension is often absent, and thus myocardial and CNS hypoperfusion may ensue, requiring treatment with vasopressors. We routinely use propofol for induction; however, there is no evidence that any particular induction agent is superior for CSCI patients. Routine monitoring must be established before the induction of anaesthesia.

Airway. If tracheal intubation is required, precautions must be taken to ensure safe neck positioning and a difficult airway should be anticipated in patients with fixed cervical injuries. There should be a low threshold for awake fibrooptic intubation. A non-depolarizing neuromuscular blocking agent can be safely used to facilitate intubation, although caution must be taken when using succinylcholine. It is safe to use in injuries older than 6 months, but should be reserved for those patients requiring a rapid sequence induction. In patients with a tracheostomy, the tube should be changed to a cuffed tube before induction.

Maintenance. Anaesthesia can be maintained with either a volatile anaesthetic agent or via total i.v. anaesthesia. An adequate depth should be established to reduce the likelihood of ADR and prevent spasms. The addition of remifentanil and nitrous oxide has been demonstrated to reduce the amount of volatile agent required to prevent ADR, and the use of monitoring to assess the depth of anaesthesia such as bispectral index may be useful.

Spontaneous ventilation is mostly adequate for short procedures, although in patients with cervical lesions, hypoventilation may ensue and result in hypercapnia and hypoxia. Intermittent positive pressure ventilation should be used for longer procedures; however, caution should be given to cardiovascular instability as a result of high pressures. Opiates should be used sparingly if at all, because of their effect on postoperative ventilation.

Major surgery involving large fluid shifts may necessitate arterial blood pressure monitoring and cardiac output monitoring. This may however be difficult to interpret because of altered responses to blood loss; monitors capable of measuring stroke volume provide useful information.

Positioning and thermoregulation. Special attention must be paid to pressure areas and limbs should be secured and padded to prevent injury from spasms. Urinary catheters should be clearly visible and accessible. Warming should begin in the anaesthetic room and continue into the recovery period.

Emergence and recovery. Before extubation, patients should be fully antagonized if neuromuscular blockers were used, and the tidal volume and ventilatory frequency should be adequate. Patients may require a period of NIV if surgery was prolonged, or they routinely use domiciliary NIV. Patients with cervical injuries are best recovered in the supine position to aid ventilation. Pressure areas should be checked in recovery and temperature should be maintained as necessary. Routine monitoring including regular blood pressure measurement should be continued until patients have been fully recovered as ADR can occur well into the recovery period.

The obstetric patient with SCI

Pregnancy in patients with SCI is associated with the following problems.
• ADR
• Urological problems including sepsis and pyelonephritis
• Thromboembolism
• Pressure sores and ulcers
• Respiratory compromise because of the effects of the gravid uterus
• Pre-term delivery
• Higher rate of Caesarean section

The anaesthetist should be aware when considering regional block that patients with SCI have a lower blood volume and usually have a degree of anaemia, which can be exacerbated by the physiological changes in pregnancy. Thus, these patients can present their own challenges to the anaesthetic team on labour ward.

We would recommend that these patients should be assessed in an obstetric anaesthetic clinic. The level of the lesion and associated pathophysiology should be documented. Particular attention should be paid to the following.

Respiratory function
As mentioned previously, those patients with higher lesions may have underlying impairment in respiratory function. There is potential for the gravid uterus to impair respiratory function as pregnancy progresses, necessitating an increase in respiratory support. In high spinal lesions, vital capacity should regularly be assessed.

Previous spinal surgery
Previous surgery at the level one would like to site regional anaesthesia may pose a challenge. We recommend obtaining further information about previous surgery, including any relevant X-rays. In our experience, epidural insertion should be avoided in the areas where there has been spinal fusion, because of the high failure rate, increase in dural punctures, and potential, uneven, patchy distribution of block. It is usually possible to site a single shot spinal at the level of surgery should it be required.

Previous cervical surgery, especially fusion may make the airway particularly difficult. If intubation is likely to be difficult because of limited neck mobility, it is advisable to discuss in detail with the obstetricians. It is preferable to avoid the need for an emergency general anaesthetic.

Autonomic dysreflexia
A history of ADR and frequency should be documented and a plan for the management of labour should be devised.

Management on labour ward
Analgesic options depend on the level of the lesion. With lesions below T10, it is likely that contraction pain will be felt. If the lesion is high, then contractions may precipitate ADR, indeed this may be the first sign of the onset of labour. It is the experience in our unit that the early establishment of epidural analgesia is very effective at managing ADR associated with labour. It is recognized that epidural placement may be difficult in these patients. If regional analgesia is ineffective at managing ADR symptoms, then antihypertensive agents such as nifedipine, hydralazine, or verapamil can be considered. It has been reported that there may be a role for magnesium sulphate in this situation19 but ultimately delivery under general anaesthesia should be considered. It is the practice in our unit that epidural catheters remain in situ post-delivery, because the contracted uterus can still provoke ADR in susceptible patients. It is important to recognize that these patients still have the potential of developing pre-eclampsia during their pregnancy and this diagnosis should always be considered when hypertension is present.

Declaration of interest
None declared.

References
17. Yoo KY, Jeong CW, Kim SJ et al. Remifentanil decreases seoflavone requirements to block autonomic hyperreflexia...

Appendix: Spinal Injury Centres in the UK and Eire

Belfast
Spinal Cord Injuries Unit 028 9066 9501, Musgrave Park Hospital, Stockman’s Lane, Balmoral, Belfast BT9 7JB.

Rookwood
Welsh Spinal Injuries and Neurological Rehabilitation Unit 029 2041 5415, Rookwood Hospital, Fairwater Road, Llandaff, Cardiff CF5 2YN.

Glasgow
Queen Elizabeth National Spinal Injuries Unit 0141 201 2555, Southern General Hospital, 1345 Govan Road, Glasgow G51 4TF. Middlesbrough 01642 850 850, The North of England Spinal Injuries Centre, The James Cook University Hospital, Marton Road, Middlesbrough TS4 3BW.

Oswestry
The Midland’s Centre for Spinal Injuries 01691 404 655, The Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry SY10 7AG.

Salisbury
The Duke of Cornwall Spinal Treatment Centre 01722 336262, Salisbury District Hospital, Odstock Road, Salisbury SP2 8BJ.

Sheffield
The Princess Royal Spinal Injuries Unit 0114 2715644 (Unit), Northern General Hospital 0114 2434343 (Hosp.), Osborne Building, Herries Road, Sheffield S5 7AU.

Southport
The Regional Spinal Injuries Centre 01704 547471, Southport and Formby General Hospital, Town Lane, Kew, Southport PR8 6NJ. Stanmore, www.rnosh-stanmore.org.co.uk, The London Spinal Injuries Unit 020 8954 2300, Royal National Orthopaedic Hospital, Brockley Hill, Stanmore HA7 4LP.

Stoke Mandeville
National Spinal Injuries Centre 01296 315000, Stoke Mandeville Hospital, Mandeville Road, Aylesbury HP21 8AL.

Wakefield—Pinderfields
Yorkshire Regional Spinal Injuries Unit 01924 201688, Pinderfields General Hospital, Aberford Road, Wakefield WF1 4DG.

Dublin
National Medical Rehabilitation Hospital 00 3 531 2854 777, Rochestown Avenue, Dunlaoghaire, Dublin.