

Acute Spinal Cord Injury Guidelines

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1. Overview

This document provides guidance on the management of patients with Spinal Cord Injury which includes; acute management, rehabilitation and psychological wellbeing. This guideline is suitable for use in the Emergency Department, Critical Care and within a ward based setting.

All clinical personnel required to care for, manage or review a spinal cord injured patient should be familiar with this guideline.

2. Scope

This guideline is the framework for acute Spinal Cord Injury (SCI) management and Multi-Disciplinary Team (MDT) care for adults whilst the patient is within the Northern Care Alliance. Southport Spinal Injuries Unit may offer advice on chronic management but ventilation weaning strategies and patient mobilisation plans must be set locally after MDT consultation.

3. Background

People who sustain a spinal cord injury require specialised care and rehabilitation. The initial management of a patient with a suspected spinal cord injury can have major implications for the patient's long-term management.

Patients with spinal cord injuries are extremely vulnerable to avoidable complications, particularly pressure ulcers, urinary tract complications, autonomic problems and joint stiffness / contractures. The avoidance of these complications requires a high level of input from a dedicated multidisciplinary team. The aim of this guideline is to ensure a high standard of care for this group of patients across the Northern Care Alliance (NCA).

4. What is new in this version?

This is revised guideline which has a new layout and focus on the journey of the patient with a Spinal Cord Injury from the Emergency Department, Critical Care to the ward and beyond. It also features revised input from the multi disciplinary team from a variety of specialities including; physiotherapy, critical care, major trauma and spinal surgeons.

5. Key Points

- All patients with a traumatic cord injury should be considered primed for acute lung injury.
- Hypotension and Bradycardia should be anticipated in this patient group.
- A full secondary survey must be performed within 24 hours of admission.

- Skin assessment and integrity must be inspected on every turn. Vigilance is required with patient devices such as catheters and nasogastric (NG) tubes.
- Pain is often poorly reported and described. Attempt to assess pain at least every 8 hours using a numerical scale.
- Low Molecular Weight Heparin (LMWH) in prophylactic dose should be introduced at 72 hours in the absence of a contraindication.
- Concerning ongoing rehabilitation, an MDT meeting should be arranged at the earliest opportunity to agree and set goals.

6. Guideline

6.1 Handling the Patient with a Spinal Cord Injury

Patients are frequently transferred into Emergency departments on a scoop stretcher. Ideally patients with potentially unstable spinal fractures should be placed onto a trolley with a transferable trauma mattress and the scoop removed to minimise the need to logroll patients whilst transferring onto CT scanners. If a trauma mattress isn't available or it is the Trauma Team Leader's preference the patient can be scanned on the scoop stretcher. Transfer onto an appropriate trolley or bed **MUST** be undertaken at the earliest possible opportunity. Ensure sufficient personnel are available for continued maintenance of spinal alignment. Ensure all blocks and straps are removed before transfer.

To ensure that total protection and alignment of the spine is maintained while moving the patient there are two techniques which can be applied:

1. Logroll
2. Multi Hand Lift

Log rolling is the method normally employed in the acute phase of the spinal cord injury management when the spine has not been stabilised. This requires sufficient staff to control the head, shoulder girdle, pelvis and legs. A senior member of staff should control the head and give the directions.

Patients with an unstable spine should not be nursed on dynamic/airflow mattresses. Use of the spinal bed should be considered if the patient is to remain on prolonged bedrest (for conservative management, delay in surgery).

Use of the spinal bed should be considered for all patients requiring spinal precautions and prolonged bed rest. A spinal bed should be considered for patients who require log rolling for the next 48-72 hours, complex poly trauma patients and those with deteriorating respiratory function. The use of a spinal bed should be a MDT consideration.

6.2 Spinal Clearance and Precautions

Rapid clearance of the spine in major trauma patients enables head up positioning, eliminates the need for a formal log roll and reduces the demand on attending nursing and medical teams.

All blunt trauma obtunded (Glasgow Coma Scale (GCS) ≤ 14) patients with injury below the clavicles **MUST** undergo complete imaging of the entire spine prior to admission to Critical Care.

All hard plastic cervical spine extrication collars must be removed within 2 hours of admission to Critical Care. If the spine is considered unstable or is not yet cleared, then either an Aspen, Miami J or a Philadelphia collar can be applied if deemed appropriate. If the patient is sedated and within Critical Care it could be appropriate to use sand blocks to avoid the risk of pressure damage.

Formal reports of CT imaging by the oncall radiologist must be documented in the clinical notes;

- there should be a 'hot' report available within 5 minutes.
- there should be detailed radiological report available within 1 hour;
- scans should be reported by a consultant radiologist within 24 hours.

Clinical correlation between the CT imaging, clinical picture and mechanism of injury, must be made by the attending team prior to mobilising the patient without spinal precautions.

If it is anticipated a patient will remain unconscious, unassessable or unreliable for clinical examination for more than 48 hours, radiological spinal clearance imaging should be undertaken.

In the presence of an unstable spinal injury and coexistent traumatic brain injury, the collar should be removed whilst the patient is sedated and ventilated but log-rolling should continue.

Should any bony or spinal injury exist, an MRI is mandatory prior to removal of spinal precautions. This is best done early, and if the patient's clinical condition allows, should be done prior to admission to critical care.

Despite 'radiological clearance' the MDT must be vigilant for the development of new signs attributable to a previously undiagnosed spinal cord injury.

Within 24 hours there should be a review by a spinal orthopaedic consultant. Clear communication of the spinal plan including the allowed mobilisation **MUST** be clearly documented in the notes.

ALL patients with suspected traumatic spinal cord or bony injury
 Begin with full spinal precautions :
 In line stabilisation, blocks and tape. 30 degree tilted unbroken bed. Full log rolls
 Remove all extraction collars to reduce risk of increasing ICP, pressure sores and respiratory compromise.

Is there any evidence of spinal bony injury on CT trauma scan?

NO CT EVIDENCE OF SPINAL INJURY

Consultant radiology report
 Does not exclude ligamentous injury

CT EVIDENCE OF BONY SPINAL INJURY

Is there clinical evidence of cord injury^a?

^aNeurology, priapism or absence of anal sphincter tone

- Maintain MAP >90mmHg
- Consider MRI in stable patients prior to Critical care admission

STABLE C-SPINE
 STABLE T&L SPINE

STABLE C-SPINE
 UNSTABLE T&L SPINE

STABLE C-SPINE IN
 HARD COLLAR
 STABLE T&L SPINE

UNSTABLE C-SPINE +/-
 UNSTABLE T&L SPINE

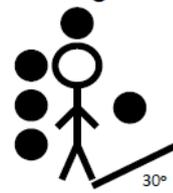
PLAN A

No collar
 Patient sat-up
 Normal turns



PLAN B

No collar
 Bed tilted head up
 Full Log roll



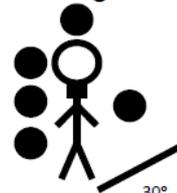
PLAN C

Aspen collar
 Patient sat up
 Normal turns with head hold



PLAN D

Aspen collar
 Unbroken head up tilted bed
 Full Log roll



**MDT Intensive Care/Spinal Consultant plan
 Operative management vs. conservative therapy
 Our Goal is early mobilisation**

In the sedated patient with evidence of vertebral fusion/degenerative disease or high velocity injury, apply an ASPEN collar during sedation holds until formal clinical or MR spinal clearance

6.3 Initial ABCDE management of Spinal Cord Injury

Any patient with cervical or thoracic cord injury requires close respiratory observation in a critical care area.

DO NOT wait for oxygenation to deteriorate before intubation.
Early intubation should be considered in order to maintain adequate oxygenation to the injured cord.

Even patients with low thoracic injuries may require respiratory support as a result of poor sputum clearance.

Observation

- Look for evidence of breathing difficulties, obstruction or aspiration
- Listen for noisy breathing, stridor or gurgling – evidence of airway compromise
- Feel for chest wall expansion observe for any deformity.
- Check for any foreign bodies in the mouth/throat, spinal cord injured patients may have an impaired swallow.

Action

- Clear airway of any obstruction.
- Remove any foreign bodies from the mouth or throat.
- Suction may be necessary.
- To protect a threatened airway do not hyperextend the neck; use instead the jaw thrust technique.
- Minimise movement of the cervical spine
- Consider naso-pharyngeal or oro-pharyngeal airway
- Anaesthetic/Critical Care review would be required.

The following indicate a likely need for intubation and further anaesthetic/medical review:

- Serial vital capacity measurements <15ml/kg
- RR>35
- Inadequate PaCO₂ control
- Sputum retention or poor cough
- Post-operative support

There is no evidence to demonstrate superiority of fibrescopic intubation over conventional laryngoscopy with manual in-line stabilisation. The approach chosen is at the discretion and competence of the attending clinician. Best practice dictates a size 8 ETT with an integral subglottic suction port.

BREATHING

“Is there a coexistent Traumatic Brain Injury?”

If present refer to the Salford Royal Traumatic brain injury protocol:

[Traumatic Brain Injury Guidelines](#)

All patients with traumatic cord injury should be considered primed for acute lung injury.

It is important to closely monitor a patient’s respiratory system. Their ability to breathe, cough and clear secretions will be dependent on the level of spinal cord injury.

- Continuously monitor oxygen saturation levels and check respiratory rate regularly.
- O₂ target to be prescribed.
- Humidification of O₂ if prescribed.
- Monitor blood gases regularly.
- Monitor the vital capacity. If FVC falls to 1 litre or there is a deterioration of 30% compared to baseline reading, elective intubation and mechanical ventilation may be required. See Appendix 1 for a guide to measuring Vital Capacity in Critical Care.
- Regular turning to optimise lung ventilation/perfusion matching (two hourly, mechanical bed may be utilised)
- Early, regular and frequent physiotherapy is the mainstay of treatment, including assisted cough techniques and incentive spirometry.

In Critical Care suggested initial ventilator strategy:

- Recruitment manoeuvres post tracheal intubation
- A/C PC initially to maintain lung recruitment but allow spontaneous diaphragmatic initiation of breathing
- Tidal volume 8-10ml/kg Ideal Body Weight
- Bedside titration of PEEP to optimize lung compliance (normally 5-7.5 cmH₂O)
- Plateau pressures <30cmH₂O
- Consideration should be given to maintaining ETCO₂ 4.5-5kPa only prior to surgical cord decompression.

β₂-agonist therapy (Salbutamol MDI 10 puffs 4-hourly) may be indicated to counteract the reflex bronchoconstriction caused by the unopposed parasympathetic tone seen in high thoracic and cervical cord injuries.

Pressures used during oropharyngeal and tracheal suctioning should be maintained at 150-200mmHg/ 20-27 kPa due to risk of a vaso-vagal response sufficient to cause extreme bradycardia or asystole.

CIRCULATION

Hypotension should be anticipated, secondary to the loss of vasomotor tone below the level of cord injury (neurogenic shock). Mild hypovolaemia or cardiac impairment may also be present as a result of mass sympathetic discharge at the time of injury.

Commence fluid resuscitation as per trust policy 250-500ml Plasmalyte-148 stat and then repeat as necessary. Once the patient stable and if maintenance fluids is required then please consult IV Fluid trust policy. Haemodynamically unstable multiple trauma patients may require activation of the major haemorrhage protocol and transfusion of packed red cells and blood products to maintain adequate oxygen delivery to the injured spinal cord. Patients who are hypotensive and are a major trauma patient must be carefully examined for potential masked haemorrhagic injuries for which resuscitation fluid of choice would be blood products.

Measure the serum lactate and base excess within 1 hour of admission to SRFT. These markers should be tracked over the first 24 hours to ensure the adequacy of intravascular resuscitation and tissue oxygenation. Be vigilant for transient responses to fluid challenges, which may be indicative of other significant injury.

Noradrenaline infusion via a central venous catheter may be required to maintain MAP 85-90mmHg and restore adequate cord perfusion. Adequate cord perfusion must be maintained for 10-14 days post injury or until dynamic changes in neurological examination have ceased / any cord oedema rescinded on subsequent imaging. **No more than 10ml/hr 4mg/50ml noradrenaline infusion should be given without the consideration of flow monitoring and consultant approval.** If a patient does not have central access and requires inotropic support to facilitate a safe transfer then an IV metaraminol 10mg/50ml infusion up to 10ml/hr can be used peripherally short term until central access is gained and it can be switched to a noradrenaline infusion.

Invasive vasoactive support via a central venous catheter is not risk free and should only be undertaken within critical care. In selected patients, oral/enteral ephedrine at a starting dose of 30mg tds is an alternative vasopressor therapy.

Bradycardia is common when the injury affects the cardiac accelerator fibres situated in the thoracic cord (T6 and above). Steps should be taken to reduce vagal tone prior to the development of bradycardia. These include:

- NG tube insertion for gastric decompression
- Urinary catheterisation.
- An abnormal vaso-vagal response can occur through stimulation such as rapid changes in body positioning, i.e. log rolling too quickly, tracheal suctioning, passing an N.G. tube etc. In patients with tracheostomy, during suctioning, stimulation of vagal afferents can result in a marked vagal response, bradycardia and consequent hypoxia. Manual hyperinflation with a water circuit with 100% O₂ pre and post tracheal suction is a useful manoeuvre to minimise these effects

Extreme bradycardia can result in cardiac syncope. If heart rate drops below, and remains below, 40 beats per minute give IV atropine 200 - 600 micrograms or IV glycopyrronium 200 –

600 micrograms as a bolus to clinical effect. If repeated dosing is required please contact medical staff.

Consider temporary pacing wire insertion or positive chronotropic agents, if asystolic episodes are apparent dobutamine can be used via a central line.

If symptomatic bradycardia persists beyond the first 14 days post injury, then a permanent pacemaker may be required.

NEUROLOGICAL DEFICIT

A full secondary survey must be performed and documented in detail in the clinical notes using a body map, within 24 hours of admission to the Northern Care Alliance. This should be followed by a documented Major Trauma Tertiary Survey.

Radiological findings should be closely correlated with examination findings and supplementary imaging undertaken to reduce the incidence of missed injuries.

Careful neurological assessment is absolutely essential for the patient with spinal cord injury. In the first hours and days following injury the neurological level may change. An extension of the lesion by one or even two levels may be observed and it is critical that any change is monitored, to prevent any avoidable deterioration of neurological deficit. In adults in a ward based setting neurological observations should be performed at two hourly intervals

As soon as a neurological examination is possible, the patient must have formal ASIA (now known as the International Standards for Classification of Spinal Cord Injury Motor Score) grading recorded and the zone of partial preservation determined. This examination can then be used to chart the extent of any ascending oedema or neurological recovery and assess the efficacy of interventions.

Use the website www.ais.emsci.org for an interactive ASIA map or utilize the ASIA scale in Appendix 2, there is an 'Asia Assessment' clinical note within EPR.

ASIA assessment can be distressing for patients as it reminds them of their disability. It should be ideally performed within 4 hours of admission and considered once weekly if changes in Neurology occur.

Multiple randomised controlled trials have failed to demonstrate any evidence to support routine systemic steroid administration, including dexamethasone. They are therefore not routinely indicated.

EXPOSURE

Anticipate the development of hypothermia as normal autoregulatory responses will be absent below the level of the cord injury. Passive warming measures should be used routinely in all patients to **maintain normothermia.**

Active warming with a forced warm air blower should be used if temperature falls below 35°C.

6.4 Early Surgical Management

Institute a Multidisciplinary plan for early operative fixation. This plan must include a documented ceiling of care discussion between the MDT and patient or their advocate.

Spinal surgery comprises two components; decompression of the neural tissues and reduction and stabilisation of the spine. Conservative management is also appropriate in some injuries.

Effects of surgery;

- My improve neurology in select cases
- Allows safe head-up positioning
- Positive gravitational effects on ascending oedema
- Reduces the incidence of pulmonary micro aspiration and pneumonia
- Reduces length of stay both in ICU and in acute hospital
- Reduces the need for log rolling and consequent manpower demands
- Allows use of pressure relieving mattresses
- May increase the need for post-op ventilation

Adequate spinal cord perfusion and oxygenation should be maintained throughout the peri-operative period. Patients with acute spinal cord injury are autonomically dysfunctional and surgery does carry a risk of neurological deterioration if oxygenation and blood pressure are not precisely controlled or if post operative oedema and swelling creates any further anoxic insult to the injured tissues. This is of particular importance in the cervical spine where the difference between a C5 lesion and a C6 lesion is very substantial in terms of independent living.

6.5 Prevention of Pressure Ulceration and skin care

- Time on a scoop or spinal board MUST be kept to an absolute minimum. NO patient should be left for >30 minutes on any form of rigid extrication or transfer device.
- Skin assessment and integrity must be inspected and documented with every turn.
- All patients with an unstable injury should be turned using a log roll technique every two hours, to minimise the development of pressure ulceration. Exemption from this practice is a consultant level decision if the patient is considered too unstable to turn safely.
- All hard plastic cervical spine extraction collars MUST be removed within 2 hours of admission to SRFT or on admission to Critical Care. If the spine is considered unstable then either an Aspen, Miami J or a Philadelphia collar and blocks should be applied. Monitor the use of all collars in TBI patients as this may increase a patient's ICP.
- In a patient with raised intracranial pressure, all collars should be removed whilst the patient is intubated and ventilated. The collar should be reapplied prior to log rolls or during transfers or sedation holds.
- In patients who require aspen collar and braces these should be removed every four hours and skin checks performed. The foam pads should be renewed every 24 hours.

- Consider early use of a rotational spinal bed if there is co-existent chest trauma or polytrauma. SCI patients can be transferred onto a pressure-relieving mattress (Nimbus) after stabilisation and MDT discussion.
- Vigilance is required to prevent and manage device-related pressure ulceration, e.g. NG tube or urinary catheter. Catheter related urethral erosions can be prevented by securing the catheter to the body at all times (as appropriate to gender).

6.6 Respiratory Management and Prevention of Hospital acquired infection.

Respiratory physiotherapy in the acute phase aims:

- To optimise/maintain respiratory function
- To contribute to tracheostomy weaning plans including the facilitation of voice via an appropriate speaking valve.

Respiratory physiotherapy assessment will occur within 24 hours of admission for any patient with a T6 spinal cord injury or above who is admitted to ICU. Assessment is required to determine effectiveness of cough and basal expansion.

Respiratory physiotherapy assessment for patients admitted to high dependency or ward level care will occur following referral from medical or nursing staff.

Respiratory physiotherapy treatment will occur daily if indicated utilising a range of techniques with the aim to optimise respiratory function. These include breathing exercises, intermittent positive pressure breathing, cough assist, manual hyperinflation, manual assisted cough and suctioning.

Peak cough flow can be used to help determine if cough assist is required for patients. If a patient has a peak cough flow of less than or equal to 160 l/min then either manual assisted cough or use of the cough assist machine will need to be considered to ensure adequate secretion clearance.

Spirometry use in Non- Ventilated Patients

Spinal cord injury patients with an injury at T6 or above are at risk of respiratory failure in the first few days following spinal cord injury due to weakness in inspiratory muscles and/or expiratory muscles (dependent on the level of injury).

The inability to effectively cough or ventilate basal areas of lung can lead to sputum retention and de-recruitment; which can ultimately result in respiratory failure.

Spirometry is an objective tool that measures the volume of air expelled following a maximal inspiration. It can be useful to assist in the monitoring of respiratory function of these patients. It does not replace other assessment/analysis skills and can be used alongside a standard respiratory assessment by those competent to do so.

The information gained from spirometry readings can help determine if ventilation and/or escalation to intensive care needs to be considered.

Any infection acquisition post injury is associated with a reduction in native functional recovery.

For Critical Care at SRFT the spirometer is kept on NHDU Pod D and trained nurses and physiotherapists may use the spirometer with SCI patients. The trauma therapy team also have access to a spirometer which is kept in the inpatient therapy department at SRFT, only trained physiotherapists in department can use it.

Pneumonia

The most common hospital acquired infection in spinal cord injury is pneumonia. There is a 3% daily additive risk of ventilation-associated pneumonia (VAP) in an invasively ventilated patient. It is therefore imperative that weaning is instituted as early as clinically possible.

VAP may be prevented by adherence to SRFT best practice:

- 30-45° head-up positioning as soon as the spine is stabilised
- Have a permanent tracheal tube cuff pressure monitor in place or manually check cuff pressure is 2cmH₂O higher than peak airway pressure or 30cmH₂O, every 2 hours.
- Aspirate the subglottic suction port to dryness every 2 hours (if no secretions are immediately apparent then 10ml warmed 0.9% NaCl can be flushed through the port prior to a further aspiration attempt).
- Apply Chlorhexidine 0.2% mouthwash, 10mls 4 times a day and Chlorhexidine 1% dental gel 2 times a day throughout the critical care stay when an artificial airway is present as per VAP prevention policy.
- Utilise a closed suctioning device and ventilator tube management as per unit policy.

Consideration should be given to the insertion of a tracheostomy early in the course of care to reduce the work of breathing and facilitate an attempt at early weaning from ventilation. This may be performed by a careful percutaneous or surgical approach after MDT discussion. Tracheostomies should be of a large size and MUST have a removable cleanable inner cannula.

Surveillance tracheal aspirate or non-directed bronchial alveolar lavage cultures should be performed three times per week (Monday, Wednesday and Fridays) to enable early targeting of antimicrobial therapy. If the patient progresses to needing a tracheostomy this may reduce to once per week. Antibiotics should be considered when clinical pulmonary infection score is 5 or greater, in these circumstances please review recent microbiology ward round documents for antibiotic choice.

For patients with a tracheostomy and high secretion load early introduction of cough assist should be considered. Manual hyperinflation pre and post turns can be considered in the critical care unit to aid additional secretion clearance and management.

If there are signs of respiratory infection/ atelectasis an aggressive strategy may expedite resolution of the pathophysiological process. This may include:

- Increased chest physiotherapy input with early instigation of cough assist
- Therapeutic bronchoscopy
- Humidification of the ventilator circuit
- Inhaled β_2 agonist therapy
- Intermittent positive pressure devices

- Recruitment manoeuvres
- Mucolytics e.g. carbocisteine, initial trial for a week.

The left lower lobe is most commonly affected by hypostatic atelectasis or pneumonia in spinal injury patients. If so consider:

- Left side up positioning
- Early Bronchoscopy
- Cough Assist (implemented regularly)

Urinary Tract Infection

The development of urinary retention is expected as a result of concurrent detrusor contraction and sphincter activation post spinal injury. Conventional signs and symptoms of infection may be absent, and the patient is often asymptomatic.

All patients should have a 12-14G urinary catheter sited in the acute phase. Short-term catheters should be routinely changed every 30 days or at the first suspicion of catheter associated urinary tract infection. A single dose 120mg gentamicin should be given for prophylaxis when metalwork is present and a catheter change is indicated.

6.7 Pain and Spasticity Management

Every SCI patient will have pain which can often be poorly reported and described. Each patient should undergo pain assessment, using a numerical scale, every 8 hours as a minimum.

Nociceptive pain may be musculoskeletal, visceral or a headache related to autonomic dysreflexia. Neuropathic pain may occur at the level of SCI, below the level of SCI or related to pressure injury.

Multimodal analgesia is often required using Paracetamol, Opioids and atypical agents including antidepressants (Tricyclic Antidepressants) or Gabapentin.

A referral to the acute pain consultants should be made to optimise therapy if pain is not adequately controlled after commencing Gabapentin 300mg tds in addition to regular paracetamol and initial opiate regime.

After 2-3 weeks pain and/or spasticity may become problematic.

Common issues are:

- Pain around the shoulders.
- Spasms
- Increase in tone
- Over activity in unopposed muscle groups

Specialist MDT input can be accessed via a referral to the weekly Spasticity Ward Round. They can provide input and advice about the use of systemic anti-spasticity and neuropathic agents,

focal treatments such as Botulinum toxin injections and nerve blocks. Ward therapists can provide T-rolls, E-rolls, foot blocks and pillow wrapping to aid positioning, as part of a 24 hour positioning programme.

6.8 Thromboprophylaxis

All patients with spinal cord injury are at high risk of thromboembolism. There is a significant incidence of clinically apparent DVT (15%) and PE (5%) despite treatment. The usual signs and symptoms of PE may be absent and any respiratory deterioration may warrant radiological investigation.

- Mechanical compression prophylaxis should be instituted on admission to critical care.
- Low Molecular Weight Heparin (LMWH) in a prophylactic dose should be introduced at an appropriate time post injury in the absence of a contraindication (e.g. concurrent intracranial injury with subarachnoid haemorrhage or un-evacuated haematoma), please refer to current Trust VTE Guidelines.

The use of lower limb cannula should be minimised to reduce the incidence of subsequent thrombophlebitis.

Treatment dose LMWH anticoagulation is only indicated for the treatment of DVT/PE.

Inferior Vena Caval filters should be considered in patients with recurrent DVT/PE despite therapeutic anticoagulation or absolute contraindications for systemic anticoagulation.

6.9 Nutrition, Metabolism and Bowel Management

Paralytic ileus is common in spinal shock. There is a risk of vomiting/aspiration. Ileus usually occurs immediately in thoraco-lumbar injuries but can be delayed for anything up to 48 hours in cervical injuries. Abdominal distension may impede breathing by splinting the diaphragms. Gastric dilatation may occur even if bowel sounds are present.

- Listen to the abdomen for presence of bowel sounds
- Observe for abdominal distension

If abnormality occurs;

- Nil-by-mouth
- Pass a naso-gastric tube – free drainage (beware possible bradycardia)
- If the abdomen is distending due to the build-up of gas, undertake digital rectal examination and decompression to avoid over-distension of the bowel.
- Re-commence nutrition when ileus resolves

Management of Nutritional Needs

- Enteral nutrition should be commenced on admission via a fine bore NG, unless the surgical plan precludes it.
- Make a referral to Dietetics to guide ongoing nutritional plan.
- 25-30 kcal/kg/day MUST be provided and prescribed as per the enteral feed calculator. High protein requirements should be anticipated.
- Oral intake is possible even in the presence of a cuffed tracheostomy but only after speech and language assessment.
- All patients at risk of refeeding syndrome should receive IV Pabrinex 1 pair daily for 3 days.
- Prokinetics may be needed to counteract the physiological ileus seen post SCI.
- An early PEG tube is indicated in the majority of patients with a high spinal lesion.
- Proton pump inhibitors are indicated only until full enteral feed is established.

Hyperglycaemia should be avoided and insulin prescribed in accordance to the ward based or critical care based regime.

Bowel management

Two Types of Spinal Cord Injury (SCI) Bowel Management QRG	
Injury level T12 and above: Upper Motor Neurone Damage	Injury level L1 and below: Lower Motor Neurone Damage
<p>Spastic/Reflexic bowel</p> <ul style="list-style-type: none"> •Anal sphincter tone is maintained. •Reflex activity is maintained. •Bowel will contract and empty when stimulated. •Injury above T12 and no anal tone (Spinal Shock), please follow 	<p>Flaccid/Areflexic bowel</p> <ul style="list-style-type: none"> •Anal sphincter will be flaccid. •Reflex activity is not maintained. Peristalsis will return, however these movements are ineffective without the support of the spinal reflex. •Faecal retention and overflow of faecal fluid may occur.
Commence Day 1 of SCI and continue until bowels opened	
<p>Daily Stimulant Laxatives 8 – 12 hours before planned bowel care (Senna 10mls at 10pm)</p> <p>Daily Digital Rectal Examination (DRE) and insertion of Bisacodyl suppositories 10-20mg Wait 30 minutes to 1 hour</p> <p style="text-align: center;">↓</p> <p>Digital rectal Stimulation (DRS)</p> <p style="text-align: center;">↓</p> <p>Digital Rectal Removal of Faeces (DRF) (if required)</p> <p style="text-align: center;">↓</p> <p>Digital Rectal Examination (DRE)</p> <p style="text-align: center;">↓</p> <p>Rectum empty?</p> <p style="text-align: center;">↙ ↘</p> <p>Stool in Rectum Yes – complete 2nd DRE in 5 minutes, if rectum still empty then evacuation complete</p>	<p>Daily Stimulant Laxatives 8 – 12 hours before planned bowel care (Senna 10mls at 10pm)</p> <p style="text-align: center;">↓</p> <p>Daily Digital Rectal removal of faeces (DRF)</p> <p style="text-align: center;">↓</p> <p>Digital Rectal Examination (DRE)</p> <p style="text-align: center;">↓</p> <p>Rectum empty?</p> <p style="text-align: center;">↙ ↘</p> <p>Stool in Rectum Yes – complete 2nd DRE in 5 minutes, if rectum still empty then evacuation complete</p>
<p>Depending on stool consistency a stool softener, Docusate Sodium 200mg can be used twice a day at any point</p> <p style="text-align: center;">Once bowels opened then commence on the below SCI bowel management</p> <p>If difficulties opening bowels with above regimen contact spinal cord injury specialist team for further management</p>	
<p>Spastic/Reflexic bowel</p> <p>Daily Rectal examination and Removal of faeces (if required)</p> <p style="text-align: center;">↓</p> <p>Commence Alternative day Stimulant Laxative 8 – 12 hours before planned bowel care (Senna 10mls at 10pm) with alternative morning insertion of Bisacodyl suppositories 10-20mg Wait 30 minutes to 1 hour</p> <p style="text-align: center;">↓</p> <p>Digital rectal Stimulation (DRS)</p> <p style="text-align: center;">↓</p> <p>Digital Rectal Removal of Faeces (DRF) (if required)</p> <p style="text-align: center;">↓</p> <p>Digital Rectal Examination</p> <p style="text-align: center;">↓</p> <p>Rectum empty?</p> <p style="text-align: center;">↙ ↘</p> <p>Stool in Rectum Yes – complete 2nd DRE in 5 minutes, if rectum still empty then evacuation complete</p>	<p>Flaccid/Areflexic bowel</p> <p>Daily Stimulant Laxatives 8 – 12 hours before planned bowel care (Senna 10mls at 10pm)</p> <p style="text-align: center;">↓</p> <p>Daily Digital Rectal removal of faeces (DRF)</p> <p style="text-align: center;">↓</p> <p>Digital Rectal Examination (DRE)</p> <p style="text-align: center;">↓</p> <p>Rectum empty?</p> <p style="text-align: center;">↙ ↘</p> <p>Stool in Rectum Yes – complete 2nd DRE in 5 minutes, if rectum still empty then evacuation complete</p>

6.10 Rehabilitation and Psychological Support

Each spinal cord injury patient should have a named Consultant within named multidisciplinary team members. This consultant is responsible for realistic goal setting and taking the lead in communication with the SCI patient and their relatives.

An MDT meeting should be arranged at the earliest opportunity with all members, to agree and set goals.

It is paramount that uniform messages are communicated to the patient across all members of the MDT and that room for hope is left in every interaction.

A dedicated individualised nursing team should be created over the first week of admission to facilitate continuity of care and provide informal psychological support.

All patients with traumatic SCI will be known to the Trauma Rehabilitation Co-ordinators and the Consultants in Neurorehabilitation/Rehabilitation medicine who are involved with Major Trauma rehabilitation. All traumatic SCI injured patients will be discussed once per week at the Major Trauma MDT Outreach ward rounds. The neurorehabilitation team will maintain involvement with patients throughout their admission to Salford Royal.

Suicidal ideation is commonplace following SCI. Individual capacity and consent must be recognised and psychological support offered to all patients to aid in the development of effective coping strategies.

Family support should be encouraged and a visit from spinal injury association offered after discussion within the MDT on timing.

Specific consideration should be given to:

- The use of assistive devices e.g. head-controlled call bells, bed controls, mirrors, prism glasses, communication boards, interactive electronic media.
- A trip outside of the ward/ICU, visit from children or pets.

Physiotherapists will complete a full specialist neurological assessment within 24 hours of admission, for patients who are not sedated. From this they can:

- Manage any abnormal tone and/or pain issues
- Maintain joint range of movement to optimise patients for rehabilitation
- Maintain/strengthen muscle strength/activity
- Commence aspects of rehabilitation suitable within the acute setting, when medically stable, including early mobilisation

Mobilisation

Patients with high lesions (above T6) will have very significant postural hypotension and this can exacerbate poor perfusion in the critical zone.

Early mobilisation can occur following spinal stability (either surgically via fixation or conservatively via orthotic management as directed by the spinal team), providing patients are cardiovascularly stable and not in spinal shock. Mobilisation should occur very cautiously in patients with incomplete SCI and potential for neurological recovery, as upright positioning can compromise spinal cord perfusion and limit recovery.

Early mobilisation should consist of gradual head up positioning in bed with close monitoring for signs of neurological deterioration. Once able to tolerate sitting fully upright, then an initial seating assessment can be completed.

Cervical and high thoracic (above T6) injured patients should be mobilised with long TED stockings and an abdominal binder to minimise the impact of postural hypotension. In a ward based setting, patients may need pharmacological agents if postural hypotension remains symptomatic. In this case, consider prescribing Ephedrine 15mg to be given 30 minutes before therapy session and monitor effects, this can be increased to 30mg if required. If symptomatic orthostatic hypotension persists, please refer to spinal rehabilitation team.

If a tilt table is used, gradual tilting and measurements of blood pressure are required together with monitoring of neurological function particularly at the levels adjacent to the injury itself. Significant hypotension or appearance of increasing deficit mandates return to the recumbent position.

Patients should initially be gradually sat up in bed, monitoring for any drop in blood pressure. Only if the patient can tolerate sitting upright in bed (70-80 degrees) for 1 hour without any symptomatic hypotension, or systolic dropping below 80 mmHg, should transfer out of bed be considered.

Once this has been achieved, the patient should be hoisted out into a recliner chair with their legs elevated. If BP is maintained, then legs should slowly be lowered and the backrest elevated. Appropriate pressure relieving cushions will be required for all SCI patients with altered sensation and sitting should be limited to 1 hour initially, whilst pressure areas are monitored.

6.11 Autonomic Dysreflexia

Autonomic Dysreflexia (AD) is a life-threatening medical emergency in which an abrupt onset of excessively high blood pressure occurs as a consequence of uncontrolled sympathetic activity and loss of supraspinal inhibitory control of major vasculature in patients with spinal cord injury (SCI) at or above the level of T6. It can arise suddenly and unpredictably and can be provoked by any noxious stimulus. A simplified Autonomic Dysreflexia Algorithm is shown in Appendix 3.

Although the majority of AD cases present within the first 6 months following SCI, the literature reports a 5.7% incidence of early onset AD within the first month and a 15.4% incidence during

the acute phase. In general, it is estimated that up to 85% of patients with an injury at T6 or above experience AD at some point.

Common triggering factors for AD include:

- Blocked/ kinked catheter leading to bladder distention.
- Urinary Tract Infections.
- Constipation or faecal loading leading to rectal distention.
- Anal fissure or Haemorrhoids
- Acute abdominal pathology
- In growing toe nail.
- Pressure ulcers, infected wounds or other skin conditions.
- Tight clothing.

An individual with SCI above T6 level often has a lower resting BP than the general population. Therefore, it is important to document the usual baseline BP for these patients in the notes. A rise in the systolic blood pressure of 20- 40 mmHg above baseline can signify onset of AD. The clinical signs include:

- Sudden and severe uncontrolled hypertension.
- Bradycardia.
- Cardiac arrhythmias.
- Change in the level of consciousness.
- Severe pounding headache.
- Profuse sweating that can occur above and below the spinal level of injury.
- Hot flushes or skin flushes above the level of injury, or chills without fever.
- Feeling of anxiety and agitation.
- Chest tightness.
- Blurred vision.
- Nasal congestion.

The most important part in the management of AD is the early recognition and the identification of the cause. Therefore, all staff caring for patients with SCI at T6 or above should be aware of the condition and trained on how to deal with it. Patients and their carers should also be trained prior to discharge from hospital.

Once AD is recognised, it is imperative to promptly identify and treat the triggering factor. Literature suggests that urinary causes are responsible for up to 75% of AD cases followed by bowel distention due to faecal impaction in 20% of the cases. Therefore, the priority is to ensure that the urinary catheter is patent, not kinked and is draining freely. This is followed by ensuring that the patient is not constipated and doesn't have a triggering skin condition.

Treatment for Autonomic Dysreflexia:

1. Sit the patient in an upright position, ensuring spinal stability, to try and reduce both BP and intracranial flow.
2. Loosen any tight clothing and constrictive devices including dressings, abdominal binders, plaster casts etc.

3. Continuous monitoring of BP and HR every 2-5 minutes and regularly check O2 saturation and temperature during the acute episode.
4. If an indwelling catheter is in place, check for kinks or blockage. Flush with 10-15 ml 0.9% sodium chloride. Avoid cold irrigation as it may exacerbate AD.
5. If an indwelling catheter is not in place, or if flushing of an existing blocked catheter fails, then a new catheter should be inserted using 2% Lidocaine gel (Instillagel). If difficulties arise during insertion of urinary catheter, contact more senior medical staff.
6. If hypertension persists, faecal impaction should be ruled out and digital removal of faeces be performed if required. This can aggravate AD, therefore it is important to use Lidocaine gel (Instillagel) with this procedure.
7. If hypertension persists, consider administration of pharmacological agent to reduce the systolic BP without causing hypotension. Nifedipine capsules (immediate release – bite and swallow) is the preferred agent at a dose of 5 mg. A dose of 5 – 10 mg can then be repeated every 20 minutes if required up to a maximum dose of 40mg per 24 hours. Nifedipine can cause severe reduction in BP and reflex tachycardia therefore monitor closely after administration as per point number 3. Nifedipine capsules are unable to be administered via NG tubes therefore consider GTN spray (see below). Sublingual administration of nifedipine is not recommended due to erratic absorption. Extraction of liquid from immediate release capsules is not recommended.
8. Should nifedipine (bite and swallow) use be contraindicated consider using nitrates. Sublingual GTN spray 400 micrograms (1 spray) can be used and repeated if necessary after 5-10 minutes, up until a maximum of 3 sprays in 15 minutes.

If hypertension persists and no clear cause is found for AD, other causes should be ruled out including skin conditions, intra-abdominal pathologies and syring. The patient may need to undergo abdominal and spinal scans to rule out other causes. In this case referral to senior medical teams and escalation of care should be considered.

6.12 Weaning mechanical ventilation.

Weaning from mechanical ventilation should be instituted as early as clinically possible to reduce the risk of pneumonia and maximise native functional recovery. An early tracheostomy may facilitate this strategy.

Weaning patients following spinal cord injury requires an individualised approach and therefore weaning plans should be specific to individual patients. Many factors impact on the speed of a wean including the level of injury, sputum load, degree of derecruitment when off the ventilator, other co morbidities and patient anxiety.

A weaning plan should be utilised when weaning spinal cord injury patients as it allows a graded approach to be used which facilitates steady progress towards ventilator independence whilst closely monitoring patients for any sign of fatigue or derecruitment.

There should be a phased approach to weaning, initially establishing pressure support ventilation (8-10ml/kg IBW), then progressive spontaneous breathing trials on CPAP (with nocturnal rest on pressure support to support 8-10ml/kg IBW).

Pre requisites to weaning:

- Good pulmonary compliance 50ml/cmH₂O or greater
- FiO₂ <0.4
- PEEP < or equal to 5cmH₂O
- Awake and cooperative. Minimal opiates. Preferably no delirium
- No active sepsis
- Some evidence of spontaneous respiratory activity
- Involved staff. Weaning proceeds more efficiently if it is an MDT approach

Weaning plans can be either exponential or stepwise (Template in Appendix 4)

Exponential: Time on CPAP or Ventilator Free Breathing (VFB) increases daily.

Stepwise: Time on CPAP or VFB increases every 2 days.

This allows for increased demand one day followed by a day of stabilisation/consolidation. May be more suited to patients with anxiety issues or problems with fatigue/de-recruitment.

Points to consider when setting weaning plans:

- Patients should only complete 2 periods of wean per day.
- Starting point for ventilator free breathing is determined by measuring the patient's vital capacity.
- Application of an abdominal binder when upright to maximise diaphragmatic curvature and mechanical efficiency. This can be obtained from the orthotics department.
- Weaning in the supine position should be considered.
- The use of larger tidal volumes to maximise recruitment, if appropriate, prior to the commencement of weaning periods.
- Initial aim is for 16 hours day time ventilator free breathing.
- Periods of CPAP/VFB should be gradually increased and combined until achieving 12 hours ventilator free breathing then increase gradually until 16 hours ventilator free breathing is achieved.
- Reassess at this point to determine if able to progress to ventilator free breathing overnight – this will depend on level of injury.

- Weaning plans should be made on a weekly basis with realistic goals lead by the patients lead consultant with involvement of the MDT (example template see appendix 4).
- Weaning should initially only take place between the hours of 06.00-22.00hrs and primarily should not be sat out of bed during the weaning periods.
- Minimum rest periods should be 1-2hrs.
- The onset of spasticity in the intercostal and abdominal musculature after 2-6 weeks may then indicate a transition to a more rapid wean and independence from ventilation.

If the above strategy fails then consideration should be given to:

Ventilator-free breathing (VFB)/Sprints

This involves intermittently removing the patient from the ventilator for short periods of time. The periods can be repeated frequently during the day with the patient rested on adequate pressure support or assist control ventilation overnight (>8ml/kg tidal volume to maintain recruitment).

All ventilator-free breathing periods should be preceded by 30 minutes of chest optimisation and secretion clearance as below:

- Stop enteral feed and aspirate NG tube
- Position patient either flat or upto 15^o Trendelenburg.
- Increase pressure support to deliver a tidal volume of 15-20ml/kg Ideal Body Weight
- Hold in this position for 30 minutes
- Apply abdominal binder and return to 45^o degree head up position or supine and begin a VFB/Sprint period.

Patients with a tracheostomy should be provided with a tracheostomy mask with humidified oxygen or a Passy Muir valve, with the cuff deflated, when starting VFB periods.

Ventilator free breathing is guided by their measured vital capacity (VC) and should be co-led by the physiotherapist and bedside nurse.

- VC <250ml start with 5 minute periods of spontaneous respiration
- VC 250-500ml start with 15 minute periods
- VC >750ml start with 30 minute periods
- VC >1000ml start with 60 minute periods

Using this approach it is paramount that the patient does not become physically fatigued during the weaning and VC should be measured at the start and end of each ventilator-free breathing episode. If at the end of the episode the VC is <70% of the initial measurement then the rest time should be lengthened or the episode duration shortened.

6.13 Communication and restoration of voice

Patients should be referred to SLT (Speech and Language Therapist) at an early stage to provide assessment and management of communication and provide 'augmentative and alternative communication' (AAC) where required.

Restoration of voice should be considered early as part of the weaning plan. In some cases SLT will consider the use of above cuff vocalisation to enable patients with a cuffed tracheostomy tube to have short periods of voicing throughout the day or it may be established using a Passy Muir valve set into the breathing circuit with the cuff on the tracheostomy tube deflated and the ventilator set in non-invasive or leak mode.

For patients with a cuffed tracheostomy there is also the 'Eye Gaze' that could be considered to facilitate communication.

Swallow

In patients with a tracheostomy, the SLT team can work jointly with the physiotherapy team to provide assessment of secretion management via Fiberoptic Endoscopic Evaluation of the Larynx (FEES) to help inform the weaning plan and provide early swallow rehabilitation.

Swallow screening should only be considered and offered when the patient is tolerating tracheostomy cuff deflation or has been decannulated. However, in special circumstances (e.g. quality of life issues, prolonged weaning) the MDT may consider oral intake with the cuff inflated. In this scenario, referral should be made to the SLT team for objective assessment via FEES to inform this management decision.

If tracheostomy decannulation is to be considered soon after cuff deflation (i.e. a few days) then decisions regarding oral feeding should be deferred until the patient has been decannulated.

6.14 Impact of level of injury

C1-3 level injuries

Patients with a **C1-3 level will not be capable of weaning** in the acute phase and need some long-term ventilatory support.

C4 level injuries

Patients with a C4 level may be capable of weaning and should undergo spontaneous breathing trials on pressure support ventilation. They are likely to need nocturnal CPAP or BiPAP long-term as hypoventilation during REM sleep is common.

C5 level or lower

Patients with a C5 level or lower should be capable of independent ventilation, although some with pre-morbid respiratory problems may need either longer term ventilatory support or a prolonged wean from support.

Functional Recovery in SCI

Expected functional recovery is dependent on the level of injury. However, 3/100 patients with ASIA A complete injury are ambulatory after 2 years.

C4 level may become independent of invasive ventilation during daytime hours.

C5 level may become independent of invasive ventilation 24 hours a day. They will have some active elbow flexion and be capable of simple ADL's after developing the right set-up but are dependent for all transfers.

C6 level have added shoulder stability due to rotator cuff innervation, have active wrist extension (extensor carpi radialis) and can develop a useful tenodesis grip with orthotics. They will be capable of dressing the upper body, using a manual wheelchair for short distances and importantly develop a predictable independent bowel program.

C7 level has functional strength in triceps which enables independent roll over, transfers, movement in seated position, and use of manual wheelchair.

6.15 Anaesthesia and Acute Spinal Cord Injury

Anaesthesia in this group of patients is extremely demanding. Autonomic dysfunction produces significant lability of blood pressure and it is preferable that an anaesthetist experienced in the management of spinal cord injured patients should undertake anaesthesia. The use of cardiac output monitoring may be indicated during surgery. Care should be taken when turning the patient from prone to supine (e.g. when coming off the table) as the external pressure on the capacitance vessels is removed and these vessels may have no tone. This can result in a sudden catastrophic fall in the venous return to the heart.

Pre-operative action plan.

- Bladder and bowel care, distension must be prevented to avoid autonomic dysreflexia.
- Ensure free urinary drainage by catheterisation if necessary.
- Check bowel programme and confirm empty rectum prior to theatre.
- Respiratory care pre-operatively, measure vital capacity and blood gases.
- Ensure normothermia.

6.16 Patient Advice and Adjustment

Experiencing a spinal cord injury is very frightening for the patient and their family, and, as patients are usually fully aware and maintain capacity, frequently produces extreme emotional reactions. Understanding this, and ensuring the provision of meaningful emotional support is important. What the patient most wants is certainty, but of course this can rarely be immediately provided. Spinal shock in the first days will make neurological assessment difficult and many practitioners in the acute setting will have little or no experience of the long-term outlook following modern spinal cord injury rehabilitation. Although certainty over the neurological prognosis is not possible, the provision of a definite plan of treatment to the patient is of enormous benefit, allowing them to have better understanding and a feeling of control. Early

discussion with the linked spinal cord injury centre will provide information on the proposed treatment after transfer, and will also provide advice on patterns of recovery in generic terms. Make full use of Psychology & Psychiatry support services

Information in support of the care for those people identified with pre-existing psychiatric conditions can usually be obtained through local liaison psychiatry teams and the patient's General Practitioner.

6.17 Pre-existing cord injury

Patients with existing spinal cord deficits may present with subsequent injuries, acute illness or for elective surgical procedures. The management of the cord deficit will need to continue. These patients remain extremely vulnerable and strict attention to management of skin, bladder and bowel is essential. These are "expert patients" in the true sense of the phrase and will be very knowledgeable on the management of their condition. The SCI Centre which routinely follows up the patient should be contacted, but where this is not possible, the linked SCI Centre (such as Southport or Sheffield) will be pleased to offer advice and will be able to arrange a visit from an outreach worker.

Specific areas to consider are:

- Medication - established spinal cord injured patients frequently are on significant numbers of medications including aperients, anti-spasmodics, bladder agents, pain management drugs etc. In some of these, for example Baclofen and Gabapentin, sudden cessation can lead to dangerous side effects. Interference with normal established bowel regime and associated digital and pharmaceutical prescriptions can give rise to major problems with bowel management.
- Intrathecal Baclofen (ITB) Pumps, anterior root stimulators and other intra-canal devices. Care will need to be taken when considering MRI scanning and during surgery, when Baclofen pumps can stall due to the magnetic field which temporarily stops the rotor of the pump motor. The ITB pump needs to be interrogated after an MRI to verify the pump has restarted and is running at the prescribed dose. This is done by the trust ITB Team (please refer to the trust ITB policy for more details).
- Patients with lesions above T6 will be at risk of autonomic dysreflexia
- Pressure ulcers are the most frequent and the most disabling of all the avoidable complications. Regular turning is essential at all times. It is never acceptable to allow the patient to rest weight on a pressure ulcer.
- When using plaster cast immobilisation for fractures in insensate limbs, there is a high risk of skin break-down. Any external splintage must be extremely well padded and removable. The skin must be inspected daily.
- The skeleton in the paralysed area will be grossly osteoporotic and this should inform any plans for internal or external fixation in orthopaedic management.

Spasm may be a major obstacle and management may need to be addressed. This may be done on a local basis for example with Botox or by manipulation of systemic anti spasmotics.

7. Roles & responsibilities

6.1 All staff will ensure that they have awareness of this document and where it can be found. They will escalate any problems experienced in the implementation of the guidelines and will report any adverse incidents or patient harm associated with its use.

6.2 Practice Trainers and Moving & handling link nurses will ensure awareness of this guideline, and provide education to the wider team..

6.3 Louise Hall will update and revise this guideline when required..

8. Monitoring document effectiveness

Key Standards: Standardised and appropriate care of spinal injured patients.

Methods: Compliance will be monitored via AIR surveillance and investigation, team feedback and patient/family feedback.

Team Responsible for monitoring: Critical care governance team, practice trainers, Unit Matrons and ACCP Louise Hall.

Frequency of monitoring: Dependent on number of patients admitted, document will reviewed at the required update date.

Process for reviewing results and ensuring in performance: Via the Critical Care Clinical governance group.

9. Abbreviations and definitions

Abbreviations

ASIA	American Spinal Injury Association.
A/C PC	Mandatory Ventilation with Pressure Control
CVP	Central Venous Pressure
ETT	Endotracheal Tube
FVC	Forced Vital Capacity
GCS	Glasgow Coma Scale
Kpa	Kilo Pascals
LMWH	Low Molecular Weight Heparin
MDI	Metered Dose Inhaler
MDT	Multi-Disciplinary Team
NCA	Northern Care Alliance
NG	Naso-gastric Tube
PaCO ₂	Partial Pressure of Carbon Dioxide
PICC	Peripheral Inserted Central Catheter
PEG	Percutaneous endoscopic gastrostomy
RR	Respiratory Rate
SCI	Spinal Cord Injury
V/Q	Ventilation/Perfusion

Definitions

Acute Lung Injury – Is defined as bilateral infiltrates (on x-ray) with hypoxia without any evidence of pulmonary oedema.

Conservative Management – Medical management that avoids using any invasive procedures or surgery.

Recruitment Manoeuvres – Is defined as a voluntary strategy to increase the transpulmonary pressure transiently with the goal to reopen those alveolar units that are not aerated or poorly aerated but reopenable.

Plateau Pressures - Plateau pressure is the pressure applied to small airways and alveoli during positive-pressure mechanical ventilation. It is measured during an inspiratory pause on the mechanical ventilator.

Normothermia – The maintenance of normal body temperature.

Microaspiration – The unintentional aspiration of very small amounts of reflux matter which may then cause laryngeal or airway inflammation/infection.

Anoxic – To be without oxygen.

Laminectomy - A surgical procedure in which the posterior arch of a vertebra is removed, which may then relieve pressure on the spinal cord or on the nerve roots that emerge from the spinal canal.

Decompression – A surgical procedure intended to relieve pressure on the spinal cord or on one or more compressed nerve roots passing through or exiting the spinal column. This normally involves the removal of tissue that is compressing the spinal cord. It has the potential to reduce intra-dural pressure and thus increasing blood flow to the spinal cord, reducing ischemia, and preventing secondary injury mechanisms

Clinical Pulmonary Infection Score – Scoring tool to assist the diagnosis of a ventilator acquired pneumonia.

Mucolytics – Drugs which assist in lowering the viscosity of respiratory tract secretions.

Paralytic Ileus - Obstruction of the intestine due to paralysis of the intestinal muscles, which may cause constipation, abdominal distention, and nausea and vomiting.

Syrinx – Fluid filled cavity/cyst within the spinal cord, this may grow and cause physical symptoms such as Autonomic Dysreflexia, weakness, pain and stiffness.

Spinal Shock - Involves a reversible loss of neurological function including, reflexes, rectal tone, sensation and motor power below a particular spinal level.

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11. Appendices

Appendix 1- Measurement of Vital Capacity

How to measure Vital Capacity via the Puritan Bennett 980 Series Ventilator

Part 1 - Change Ventilator mode to Tube Compensation.

1. Touch or swipe the **Menu** tab on the left side of the Graphical User Interface.
2. Select **Setup** and then **Vent**
3. From **Mode** options select **Spont**
4. From **Spontaneous Type** menu, select **TC** (Tube Compensation).
5. Set **Tube I.D** (Inner diameter) and **Tube Type** (ETT or Trache).
6. Press **Accept All**.

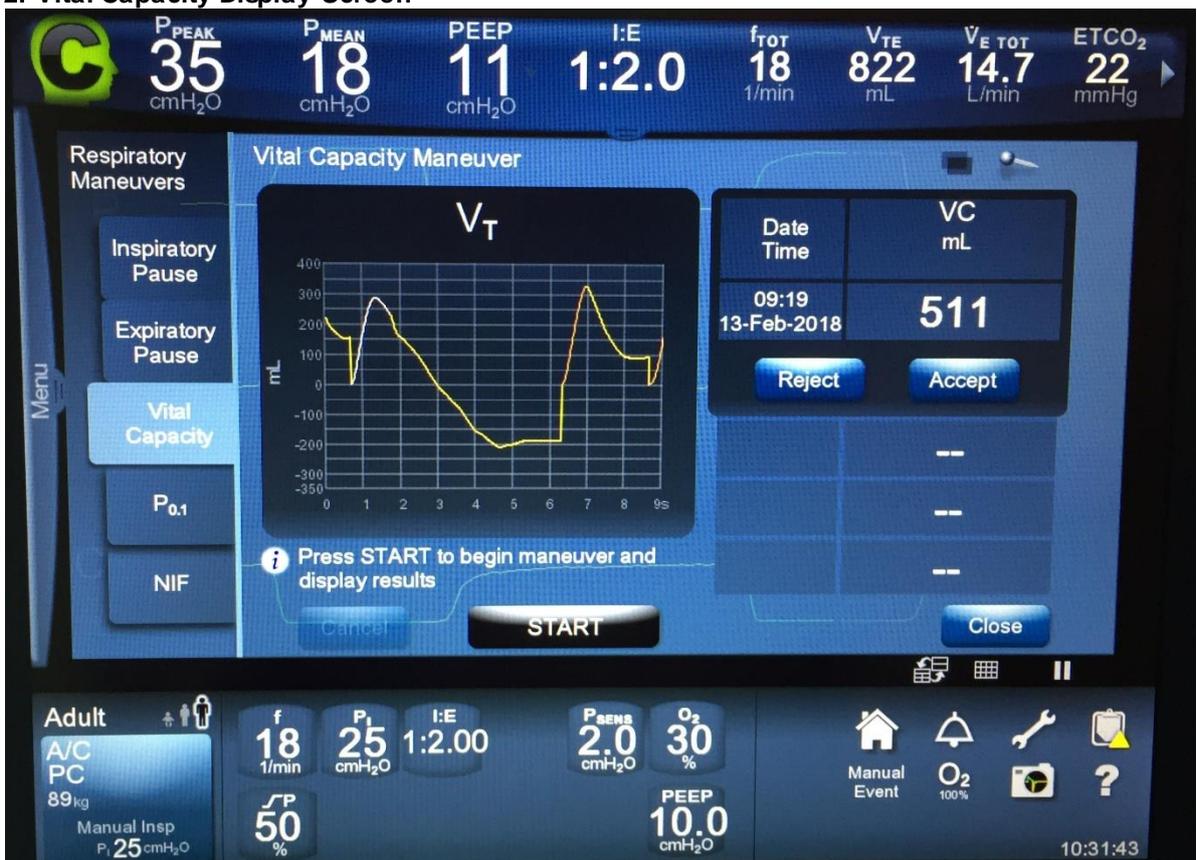
Figure 1: Vent Setup – Changing to Tube Compensation Mode



Part 2 - Obtaining Vital Capacity Reading

1. Touch or swipe the **Menu** tab on the left side of the Graphical User Interface.
2. Select **Respiratory Manoeuvres (RM)**.
3. Select **Vital Capacity**.
4. Prepare the patient.
5. Touch and release the **Start** button.
6. Coach the patient to inhale fully and then slowly and fully exhale.
7. Touch the **Accept** or **Reject** button to save or dismiss the results. If the result is accepted then the value will be saved.
8. Change ventilator mode back to normal settings via vent setup.

Figure 2: Vital Capacity Display Screen



Patient Name _____ Date/Time of Exam _____

Examiner Name _____

KEY SENSORY POINTS

0 = absent
1 = altered
2 = normal
NT = not testable

• Key Sensory Points

MOTOR

KEY MUSCLES (scoring on reverse side)

C5	Elbow flexors	R	<input type="checkbox"/>	L	<input type="checkbox"/>	=	<input type="checkbox"/>	(50)
C6	Wrist extensors	R	<input type="checkbox"/>	L	<input type="checkbox"/>	=	<input type="checkbox"/>	(25)
C7	Elbow extensors	R	<input type="checkbox"/>	L	<input type="checkbox"/>	=	<input type="checkbox"/>	(25)
C8	Finger flexors (distal phalanx of middle finger)	R	<input type="checkbox"/>	L	<input type="checkbox"/>	=	<input type="checkbox"/>	(25)
T1	Finger abductors (little finger)	R	<input type="checkbox"/>	L	<input type="checkbox"/>	=	<input type="checkbox"/>	(25)

UPPER LIMB TOTAL (MAXIMUM) + = (50)

SENSORY

	LIGHT TOUCH		PIN PRICK	
	R	L	R	L
C2				
C3				
C4				
C5				
C6				
C7				
C8				
T1				
T2				
T3				
T4				
T5				
T6				
T7				
T8				
T9				
T10				
T11				
T12				
L1				
L2				
L3				
L4				
L5				
S1				
S2				
S3				
S4-5				

TOTALS (MAXIMUM) (56) (56) (56) (56) = (56)

(DAP) Deep anal pressure (yes/no) (max: 112)

PIN PRICK SCORE (max: 112)

LIGHT TOUCH SCORE (max: 112)

Comments:

LOWER LIMB TOTAL (MAXIMUM) + = (50)

(VAC) Voluntary anal contraction (Yes/No)

NEUROLOGICAL LEVEL (MAXIMUM) + = (50)

NEUROLOGICAL LEVEL (with normal function)

SINGLE NEUROLOGICAL LEVEL	R	L
SENSORY MOTOR	<input type="checkbox"/>	<input type="checkbox"/>

COMPLETE OR INCOMPLETE?

Incomplete = Any sensory or motor function in S4-S5

ASIA IMPAIRMENT SCALE (AIS)

ZONE OF PARTIAL PRESERVATION (In complete flexions only)

SENSORY MOTOR	R	L
SENSORY MOTOR	<input type="checkbox"/>	<input type="checkbox"/>

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Muscle Function Grading

- 0** = total paralysis
- 1** = palpable or visible contraction
- 2** = active movement, full range of motion (ROM) with gravity eliminated
- 3** = active movement, full ROM against gravity
- 4** = active movement, full ROM against gravity and moderate resistance in a muscle specific position.
- 5** = (normal) active movement, full ROM against gravity and full resistance in a muscle specific position expected from an otherwise unimpaired person.
- 5*** = (normal) active movement, full ROM against gravity and sufficient resistance to be considered normal if identified inhibiting factors (i.e. pain, disuse) were not present.
- NT** = not testable (i.e. due to immobilization, severe pain such that the patient cannot be graded, amputation of limb, or contraction of >50% of the range of motion).

ASIA Impairment (AIS) Scale

- A = Complete.** No sensory or motor function is preserved in the sacral segments S4-S5.
- B = Sensory Incomplete.** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5 (light touch, pin prick at S4-S5; or deep anal pressure (DAP)), AND no motor function is preserved more than three levels below the motor level on either side of the body.
- C = Motor Incomplete.** Motor function is preserved below the neurological level**, and more than half of key muscle functions below the single neurological level of injury (NLI) have a muscle grade less than 3 (Grades 0-2).
- D = Motor Incomplete.** Motor function is preserved below the neurological level**, and at least half (half or more) of key muscle functions below the NLI have a muscle grade ≥ 3 .
- E = Normal.** If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

**For an individual to receive a grade of C or D, i.e. motor incomplete status, they must have either (1) voluntary anal sphincter contraction or (2) sacral sensory sparing with sparing of motor function more than three levels below the motor level for that side of the body. The Standards at this time allows even non-key muscle function more than 3 levels below the motor level to be used in determining motor incomplete status (AIS B versus C).

NOTE: When assessing the extent of motor sparing below the level for distinguishing between AIS B and C, the **motor level** on each side is used; whereas to differentiate between AIS C and D (based on proportion of key muscle functions with strength grade 3 or greater) the **single neurological level** is used.

Steps in Classification

The following order is recommended in determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
2. Determine motor levels for right and left sides.
Note: in regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level, if testable motor function above that level is also normal.
3. Determine the single neurological level.
This is the lowest segment where motor and sensory function is normal on both sides, and is the most cephalad of the sensory and motor levels determined in steps 1 and 2.
4. Determine whether the injury is Complete or Incomplete. (i.e. absence or presence of sacral sparing)
If voluntary anal contraction = No AND all S4-5 sensory scores = 0 AND deep anal pressure = No, then injury is COMPLETE. Otherwise, injury is incomplete.

5. Determine ASIA Impairment Scale (AIS) Grade:

Is injury Complete?
NO → If YES, AIS=A and can record ZPP (lowest dermatome or myotome on each side with some preservation)

Is injury motor Incomplete?
YES → If NO, AIS=B (Yes=voluntary anal contraction OR motor function more than three levels below the motor level on a given side, if the patient has sensory incomplete classification)

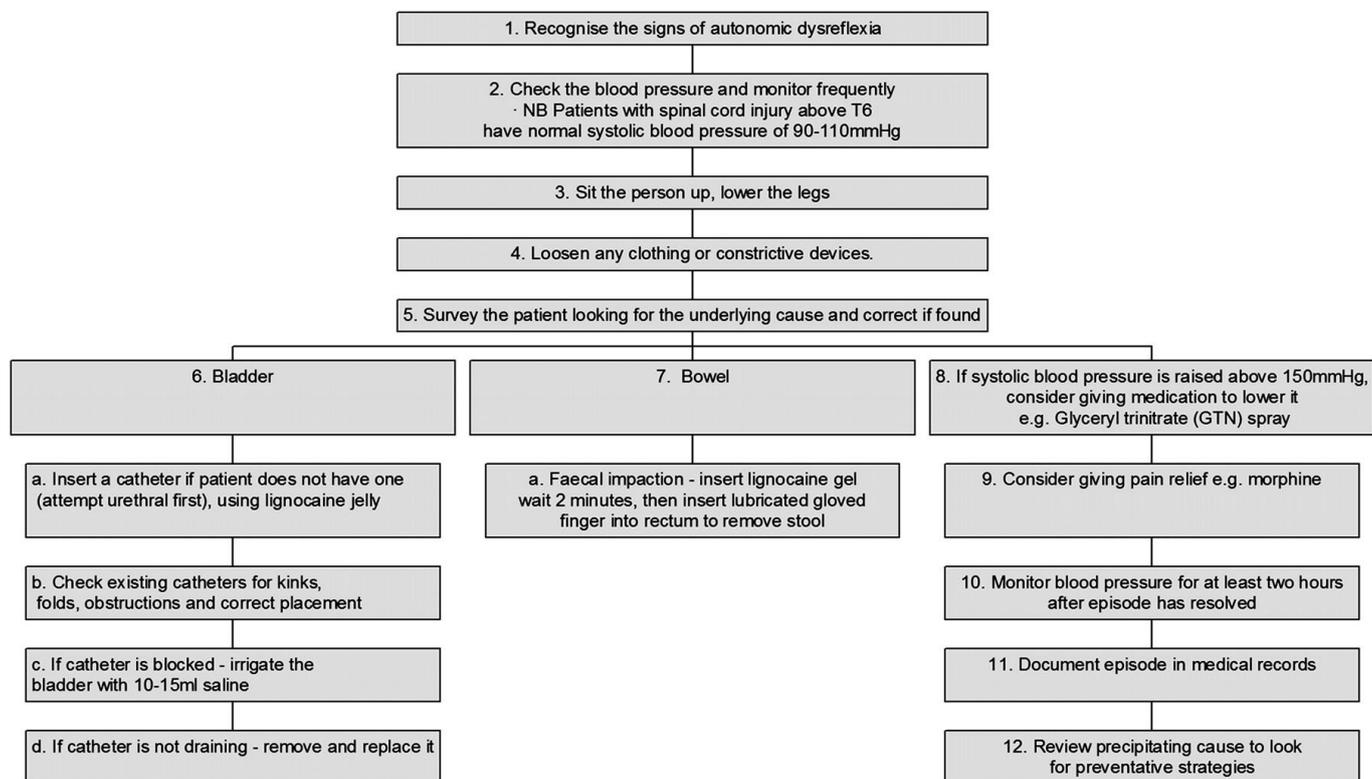
Are at least half of the key muscles below the single neurological level graded 3 or better?

NO → AIS=C
YES → AIS=D

If sensation and motor function is normal in all segments, AIS=E

Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.

Appendix 3 – Autonomic Dysreflexia Algorithm.



Appendix 4 – Example of a weaning template

Date	Session 1 - Morning (Tick box once completed)		Session 2 - Afternoon		Session 3 - Evening	
If successfully completed progress. If not stay on above.						
If successfully completed progress. If not stay on above.						
If successfully completed progress. If not stay on above.						
If successfully completed progress. If not stay on above.						
If successfully completed progress. If not stay on above.						
If successfully completed progress. If not stay on above.						

12. Document Control Information

All sections must be completed by the author prior to submission for approval

Lead Author:	Louise Hall (Advanced Critical Care Practitioner).		
Lead author contact details:	louise.hall@srft.nhs.uk 0161 206 8782		
Consultation List the persons or groups who have contributed to this guideline. (please state which Care Organisation)	Name of person or group	Role / Department / Committee (Care Org)	Date
	M. J. Naisbitt	Critical Care Consultant	18.06.19
	Jo Reason	Senior Physiotherapist	18.06.19
	Stuart Wildman	Consultant Nurse Major Trauma	18.06.19
	Sarah Brown	Speech and Language Therapist	18.06.19
	Raef Dahab	Consultant Spinal Surgeon	18.06.19
Endorsement List the persons or groups who have seen given their support to this guideline. (please state which Care Organisation)	Name of person or group	Role / Department / Committee (Care Org)	Date
	Clinical Governance	Critical Care	17.09.19
	Clinical Governance	Major Trauma	11.09.19
	Medicines Management	Pharmacy	17.02.20
	Janet Hegarty	CEC DAM	14.05.20
Keywords / phrases:	Spinal Cord, Spinal Cord Injury, Cord Injury, SCI.		
Communication plan:	Presented in various Clinical Governance committees across the NCA alliance. Will email all teams on publication to the intranet.		
Document review arrangements:	This document will be reviewed by the author, or a nominated person, at least once every three years or earlier should a change in legislation, best practice or other change in circumstance dictate.		

This section will be completed following committee approval

Guideline Approval:	Name of Approving Committee: CEC DAM	
	Chairperson: Janet Hegarty	
	Approval date: 14.05.20	
	Formal Committee decision ✓	Chairperson's approval ✓

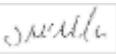
13. Equality Impact Assessment (EqIA) screening tool

Legislation requires that our documents consider the potential to affect groups differently, and eliminate or minimise this where possible. This process helps to reduce health inequalities by identifying where steps can be taken to ensure the same access, experience and outcomes are achieved across all groups of people. This may require you to do things differently for some groups to reduce any potential differences.

1a) Have you undertaken any consultation/ involvement with service users, staff or other groups in relation to this document?	No Please state:
1b) Have any amendments been made as a result?	No Please Comment:

2) Does this guideline have the potential to affect any of the groups below differently or negatively? This may be linked to access, how the process/procedure is experienced, and/or intended outcomes. Prompts for consideration are provided, but are not an exhaustive list.

Protected Group	Yes	No	Unsure	Reasons for decision
Age (e.g. are specific age groups excluded? Would the same process affect age groups in different ways?)		X		
Sex (e.g. is gender neutral language used in the way the document is written?)		X		
Race (e.g. any specific needs identified for certain groups such as dress, diet, individual care needs? Are interpretation and translation services required and do staff know how to book these?)		X		
Religion & Belief (e.g. Jehovah Witness stance on blood transfusions; dietary needs that may conflict with medication offered.)		X		
Sexual orientation (e.g. is inclusive language used? Are there different access/prevalence rates?)		X		
Pregnancy & Maternity (e.g. are procedures suitable for pregnant and/or breastfeeding women?)		X		
Marital status/civil partnership (e.g. would there be any difference because the individual is/is not married/in a civil partnership?)		X		
Gender Reassignment (e.g. are there particular tests related to gender? Is confidentiality of the patient or staff member maintained?)		X		
Human Rights (e.g. does it uphold the principles of Fairness, Respect, Equality, Dignity and Autonomy?)		X		
Carers (e.g. is sufficient notice built in so can take time off work to attend appointment?)	X			Carers involved in communication
Socio/economic (e.g. would there be any requirement or expectation that may not be able to be met by those on low or limited income, such as costs incurred?)		X		
Disability (e.g. are information/questionnaires/consent forms available in different formats upon request? Are waiting areas suitable?) Includes hearing and/or visual impairments, physical disability, neurodevelopmental impairments e.g. autism, mental health conditions, and long term conditions e.g. cancer.	X			

<p>Are there any adjustments that need to be made to ensure that people with disabilities have the same access to and outcomes from the service or employment activities as those without disabilities? (e.g. allow extra time for appointments, allow advocates to be present in the room, having access to visual aids, removing requirement to wait in unsuitable environments, etc.)</p>	<p>Yes</p>	<p>As stated in section 5</p>
<p>3) Where you have identified that there are potential differences, what steps have you taken to mitigate these?</p> <p>These are updated guidelines the good practice has been carried over from the previous policy, this policy has been approved by Critical Care, MMG and the Neurosciences clinical governance committees.</p>		
<p>4) Where you have identified adjustments would need to be made for those with disabilities, what action has been taken?</p> <p>With regards to the patients there are some implications around anticoagulation and BMI with regards to choice of anticoagulation and the choice of ventilation targets; clear guidance is given for these topics. There are no other implications</p>		
<p>5) Where the guideline impacts on patients how have you ensured that you have met the Accessible Information Standard – please state below:</p> <p>The guidelines will be available to staff in different formats such as large print or on different colour paper if requested.</p> <p>.....</p> <p>EDI Team/Champion only: does the above ensure compliance with Accessible Information Standard</p> <p><input type="radio"/> Yes</p> <p>If no what additional mitigation is required:</p>		
<p>Will this guideline require a full impact assessment? No</p> <p>Please state your rationale for the decision:</p> <p>(a full impact assessment will be required if you are unsure of the potential to affect a group differently, or if you believe there is a potential for it to affect a group differently and do not know how to mitigate against this - Please contact the Inclusion and Equality team for advice on equality@pat.nhs.uk)</p> <p>Author: Type/sign: Claire Silvester Date: 19/02/2020</p> <p>Sign off from Equality Champion:  Date: 25/02/2020</p>		