The Newcastle upon Tyne Hospitals NHS Foundation Trust

Critical Care Management of Patients with a new Spinal Cord Injury

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1 Introduction

- Spinal cord injury (SCI) is a rare and complex impairment.
- Incidence of 12-16 per million population
- Most common in young males
- Compromise to the spinal cord may result from traumatic insult, vascular disruption or a disease process and may be immediate or insidious in onset.
- Majority of injuries caused by trauma (~75%)
    - Road traffic accidents
    - Falls
- The consequence of such an injury is loss or reduction in voluntary motor function, sensory deprivation and disruption of autonomic function related to the level and severity of the cord damage.
- The management of spinal cord injured patients involves every member of the multidisciplinary team
- Final outcome from spinal cord injury depends upon patient destination, initial resuscitation, diagnosis, surgical management and prevention of complications
- This guideline outlines best practice in these areas

2 Guideline scope

This document is intended to guide caregivers within critical care in the management of patients with an acute spinal cord injury. It does not replace expert knowledge, experience and training in this area.

3 Main Body of the guideline

3.1 Pre-Hospital Care

Spinal Immobilisation

- Emergency medical services (EMS) should immobilise the spine of all patients with a potential spinal injury from the scene of injury to definitive care
- EMS should use the following criteria to determine the potential for cervical spine injury in a trauma patient (These factors hold true for patients regardless of mechanism of injury)

    - Altered mental status
    - Evidence of intoxication
    - Suspected extremity fracture or distracting injury
    - Focal neurological deficit
    - Spinal pain or tenderness
- EMS should use a combination of rigid cervical collar and supportive blocks on a backboard with straps to secure the entire spine of a potential spine injury
    - Up to 20% of fractures may be multiple at non-contiguous levels

Triage

- There are clear North of England Trauma guidelines to identify which patients should be transferred directly to a Major Trauma Centre
    - See appendix 1
    - There are mortality benefits for patients with a high Injury Severity Score and those with spinal cord injury when treated in a high volume centre
- Transfer all patients with new spinal cord injury to a Major Trauma Centre
    - Royal Victoria Infirmary, Newcastle Upon Tyne
    - James Cook University Hospital, Middlesbrough
- Consider early (within 24 hours) transfer to a specialised spinal cord injury centre
    - James Cook University Hospital, Middlesbrough
    - Complications from spinal cord injury can occur within the first 24 hours
    - There is evidence in support of early transfer of patients to specialised centres

3.2 Resuscitation

Spinal Immobilisation

- In the emergency department the patient should be transferred as soon as possible off the backboard onto a firm mattress, whilst maintaining spinal alignment.
    - At this early stage reduced tissue perfusion and a hard backboard can predispose to the later development of pressure ulcers
- Logroll the patient with a potentially unstable spine when repositioning, turning or transferring
    - As indicated in appendix 2
- Perform a baseline skin assessment on removal of the backboard
- In cases of confirmed spinal column or cord injury, maintain immobilisation until definitive treatment with one of the below
    - Rigid collar, sandbags, tape and a firm mattress (heavily sedated and paralysed patients can have rigid collars removed to reduce the risk of pressure areas)
    - Halo fixation
    - Tongs and traction
- At the extremes of age or in the presence of pre-existing spinal deformity maintain the patient in the position of greatest comfort

- Consider a specialist bed for patients with an unstable spine when prolonged immobilisation is anticipated

Airway

- Provide a definitive airway for any patient with trauma who has signs of airway obstruction, GCS <9 or respiratory distress
    - All patients with major trauma, fulfilling at risk criteria listed above should be assumed to have an unstable spinal injury until proven otherwise
    - They should be intubated with manual in-line stabilisation of the cervical spine

Choice of induction agent depends upon several factors including cardiovascular stability and associated injuries

        - Propofol
        - Thiopentone
        - Ketamine
    - Suxamethonium remains the muscle relaxant of choice within 48 hours of potential spinal cord injury
    - Prepare for difficult intubation
        - Senior anaesthetist
        - Appropriate assistance
        - Difficult intubation trolley

Breathing

- Patients should be ventilated according to the guidelines on ventilation with tidal volumes of 6-8 mls/kg, appropriate levels of PEEP and plateau pressure <30 cmH2O
- Target
    - O2 saturation >97%
    - PaO2 >10 KPa
    - Pa CO2 4-5 KPa

Circulation

- Prevent and treat hypotension
    - Patients with polytrauma are frequently hypovolaemic
    - Predict hypotension following administration of induction agents
    - Treat hypotension with fluid or blood resuscitation and vasopressors
- Exclude other injuries before attributing the cause of hypotension to neurogenic shock
- Determine initial base deficit and lactate level to assess severity of shock and monitor response to resuscitation
    - Standard haemodynamic parameters do not provide a good guide to the severity of shock in patients with high spinal cord injury
- Recognise and treat neurogenic shock
    - Spinal cord injury above T6 causes significant sympathetic denervation
    - Spinal cord injury above T1 causes interruption of cardiac sympathetic innervation

    - Hypotension, bradycardia and impaired myocardial contractility may ensue
- Monitor and treat symptomatic bradycardia
    - Bradycardia may follow loss of cardiac sympathetic innervation
    - At the extreme, episodes of asystole may follow stimulation
        - Suctioning
        - Turning
    - Atropine
    - Chronotropic agents
        - Noradrenaline
        - Adrenaline
        - Aminophylline
    - Pacemaker

Disability

- No clinical trial evidence exists to recommend the use of any pharmacological neuroprotective agent
    - Methylprednisolone
        - The three NASCIS trials that have examined different doses of methylprednisolone have been criticised for methodological flaws, failed to demonstrate any clinically significant patient benefit and highlighted the statistically significantly increased risks of infection and GI haemorrhage
    - GM-1
        - This ganglioside has the proposed ability to prevent apoptosis and induce neuronal sprouting
        - A large scale RCT and Cochrane systematic review failed to show any change in ASIA grade
    - Gancyclidine, Tirilazad, Naloxone
        - No clinical evidence of benefit

Exposure

- Monitor and regulate temperature
    - Disruption of the autonomic nervous system renders spinal cord injured patients poikilothermic
    - Strict attention to avoidance of hypo and hyperthermia

3.3 Diagnostic Assessment

Clinical Examination

- Perform a baseline neurological assessment on any patient with suspected spinal cord injury to document a neurological level and completeness of injury
    - Use the International Standard Neurological Classification of Spinal Cord Injury (ASIA impairment scale) in Appendix 3
    - The neurological level is classified as the lowest level with normal function
    - Completeness of injury is according to ASIA scale and has implications for prognosis
- Document assessment on the ASIA chart and place in the patients notes

- Because of the progressive evolution of neurological deficits, neurological examinations should be repeated on a daily basis for the first 3 days

Imaging

- Image the entire spine in a patient with potential spinal cord injury
    - In the vast majority of patients this is performed as part of the admission **CT trauma series**
    - If patients have had a head and neck CT performed alone then at least plain x-rays should be performed of the thoraco-lumbar spine
    - The most common cause of missed spinal injury is failure to image the area of concern
- MRI the known or suspected area of spinal cord injury
    - Allows detection of associated soft tissue, disc and spinal cord injury
    - Consider a saggital T2 image of the entire spine to detect non-contiguous spinal injuries
- Be aware that spinal cord injury can occur without radiological abnormality (SCIWORA)
    - Particularly in children
- In patients with a stiff spine, spondylosis or ankylosing spondylitis suspect a fracture in the presence of midline tenderness and have a low threshold for imaging
    - They are at increased risk of central cord syndrome following low energy injuries
        - 11.4 times greater risk of SCI than general population

3.4 Spinal Clearance

Surgery

- Perform closed or open reduction as soon as permissible on patients with bilateral facet joint dislocation in the setting of an incomplete spinal cord injury
    - A number of level II and III studies demonstrate there is a small benefit to reduction of bilateral facet joint dislocation **within 8 hours** of injury
- Consider early surgical spinal canal decompression in the setting of a deteriorating spinal cord injury
    - This is another area with a low level of evidence in support of early decompression **within 24 hours** of injury
- Consider early spinal stabilisation where indicated
    - There is no evidence of early surgery causing neurological deterioration
    - There is low level evidence that surgery may shorten time on a ventilator and intensive care length of stay
- There is an ongoing study to examine the impact of early vs delayed decompression

Anaesthesia

Airway

- Securing the airway in a patient with an unstable cervical spine and associated spinal cord injury can be a difficult and daunting process
    - Senior anaesthetist involvement
    - Adequate planning
    - Prepare for difficulty
    - Maintain manual in-line stabilisation
    - There is no evidence to support one technique over another and a decision should be made on a case by case basis
        - Simple laryngoscopy
        - LMA, fibre optic scope, Aintree catheter
        - Awake fibre optic intubation
- Choice of induction agent is also made on a case by case basis
- Suxamethonium should be avoided after 48 hours post injury due to the up regulation of Ach receptors and risk of hyperkalaemic response

Breathing

- Use protective ventilatory strategy with 6-8 ml/kg, plateau pressure <30 cmH2O
- High levels of PEEP may be needed to recruit atelectatic/collapsed lung
- With cervical cord injury consider the need for post operative ventilation and transfer to the ICU ventilated

Circulation

- Anticipate hypotension and bradycardia during induction of anaesthesia
    - Airway manipulation and hypoxia may precipitate bradycardia and, in extreme circumstances, asystole
- This may respond poorly to fluid challenge
- Use combined alpha and beta agonists
    - Noradrenaline, adrenaline, ephedrine
- Blood loss during surgery will require fluid and/or blood replacement but the normal indices of fluid loss may be misleading in a spinal cord injured patient
    - Have a low threshold for use of cardiac output monitoring

Disability

- Consider the use of spinal cord monitoring in patients with incomplete spinal cord injury
- Perform regular assessment of pain with self-reported numeric rating scale
- Treat pain with multimodal analgesia according to the analgesic ladder
- Treat neuropathic pain early with appropriate agents
    - Gabapentin
    - Amitriptylline
    - Carbemazepine
    - Sodium valproate
- Consider early referral to the acute pain service

Secondary Prevention

Spinal immobilisation and patient handling

- Logroll the patient with a potentially unstable spine when repositioning, turning or transferring
    - As indicated in appendix 2
- Perform a baseline skin assessment on admission to ICU
- In cases of confirmed spinal column or cord injury, maintain immobilisation until definitive treatment
    - Rigid collar, sandbags, tape and a firm mattress (heavily sedated and paralysed patients can have rigid collars removed to reduce the risk of pressure areas)
    - Halo fixation
    - Tongs and traction
- At the extremes of age or in the presence of pre-existing spinal deformity maintain the patient in the position of greatest comfort
- Consider a specialist bed for patients with an unstable spine when prolonged immobilisation is anticipated

Skin protection

- Assess bony prominences at risk of skin breakdown on a daily basis
    - Sacrum
    - Heels
    - Occiput
    - Scapulae
    - Trochanters
    - Around collar
- Document finding
- Place the patient on a pressure reduction mattress
- Provide meticulous skin care
    - Reposition every 2 hours
    - Keep the area under the patient clean and dry
    - Assess nutritional status
    - Inspect skin under pressure garments, splints and casts
- Educate the family on the importance of maintaining skin integrity

Venous thromboembolism (VTE) prophylaxis

- Spinal cord injury places patients at very high risk of VTE
    - Without prophylaxis more than 50% of spinal cord injured patients will develop VTE
    - With prophylaxis 6% still develop VTE
- Apply compression stocking if no contraindications
- Apply mechanical compression device if no contraindications
- Administer Tinzaparin 4500iu if no risk of bleeding
- If there is a predicted risk of bleeding >72 hours consider the placement of a vena caval filter

Respiratory management

- Admit patients with tetraplegia, with early signs of respiratory failure or with pre-existing lung disease to a critical care environment
- Monitor closely for signs of respiratory failure in the days following spinal cord injury
    - Up to 74% of patients with tetraplegia may develop respiratory failure
    - Repeated examination
    - Monitoring of RR, saturation and ABG
- Treat muscle weakness, poor cough and retained secretions with regular physiotherapy
    - Manually assisted coughing (appendix 4)
    - Mechanical insufflation-exsufflation (cough assist)
    - Pulmonary hygiene
- Intubation may be difficult
    - See earlier note
- Perform early tracheostomy for those patients who are likely to remain ventilator dependent for a prolonged period
    - If there has been an anterior approach for cervical spinal fixation do not perform tracheostomy until 5 days post-op
    - Particular care should be taken with patient positioning if tracheostomy is performed when the cervical spine is still unstable
- Institute a ventilator care bundle to prevent VAP
    - Semi recumbent position
    - Daily sedation hold
    - Oral chlorhexidine
    - Subglottic suction
    - Closed endotracheal suctioning
    - Weaning protocol (see page 11 for details)

Genitourinary tract

- Place a urinary catheter to allow drainage of urine
    - Even if incomplete injury as retention is common
- Leave in place until haemodynamically stable
- Priapism is usually self-limiting and requires no treatment

Gastrointestinal tract

- Place a nasogastic tube
    - Gastric stasis is common following spinal cord injury
    - It commonly lasts for 24-48 hours
- Initiate gastric protection with iv and subsequently oral PPI
    - The incidence of stress ulceration is high in this patient group
    - This risk persists for up to 4 weeks
    - Decision on continuation of PPI for a prolonged period is made on a case by case basis
- Commence ng feeding 24 hours post injury
- Evaluate swallowing function before commencing oral feeding in any patient with cervical cord injury, halo fixation, prolonged intubation or tracheostomy, or with associated TBI

Bowel care

- Sympathetic tone is lost below the level of the spinal cord lesion leading to paralytic ileus
- This may be exacerbated by ongoing inflammatory processes, surgery and medications
- Management of bowel dysfunction is complex and should follow the guideline in Appendix 4
    - Daily rectal examination
    - Digital removal of faeces +/- glycerine suppositories
    - Assessment of bowel function
        1. Reflex bowel
            - Injury above T12
            - UMN lesion
            - Preservation of anal wink and bulbocavernosus reflex
            - Responds to rectal stimulant suppositories
        2. Arreflexic bowel
            - Injury below L1
            - LMN lesion
            - Loss of anal wink and bulbocavernosus reflex
            - Does not respond to rectal stimulants
            - Require continued digital removal of faeces

Nutrition

- Provide appropriate nutrition
    - Enteral rather than parenteral
    - Standard feed formula
    - Caloric needs are 45-90% of calculated values
    - Dietician review
- Maintain glycaemic control

3.5 Prognosis

- The ASIA scale assessment, within the first 72 hours of spinal cord injury, can be used to guide prognosis
    - ASIA A – 7% convert to ASIA B but none to ASIA C (if examination is unreliable this may be increased)
    - ASIA B – 54% convert to ASIA C or D by 1 year
    - ASIA C – nearly all patients are expected to be ambulatory with aids on discharge from rehabilitation
    - ASIA D - nearly all patients are expected to be ambulatory with aids on discharge from rehabilitation
- Most motor recovery occurs within the first 6 months but strength gains can occur for up to 2 years
- If the clinical examination is unreliable/impossible then MRI can give some guide to prognosis
    - Cord haemorrhage
    - Cord oedema

3.6 Rehabilitation

- Assessment from a multidisciplinary rehabilitation team should occur early after traumatic injury
- Initiation of measures to prevent long term complications and maximise function
    - Range of motion and strengthening exercises
    - Pulmonary interventions
        - Suction
        - Percussion
        - Assisted coughing
        - Postural drainage
    - Seating and positioning
    - Mobilisation
    - Splinting
    - Swallow assessment
- Family members should be involved and educated about all aspects of the rehabilitation process
- Orthostatic hypotension may be managed with physical or chemical aids
    - Abdominal binders
    - Compression stockings
    - Fludrocortisone
    - Ephedrine

3.7 High Spinal Injury Weaning Guideline

These guidelines are based on the Respiratory Information for Spinal Cord Injury UK guidelines with local adaptations that allow alignment to the weaning guidelines followed by James Cook University Hospital Spinal Injury Unit

3.7.1 Prerequisites for weaning:

- The patient is awake and cooperative
- The patient is haemodynamically stable without inotropic or vasopressor support
- Chest X-ray is clear or improving
- Apyrexial, white cell count normal, no other infection indicators present
- The patient does not require any further surgery
- The patient is requiring 40% or less inspired oxygen to achieve target saturation as determined by the consultant
- The patient does not require excessive ventilator pressures. Ideally 50mls per cm water or greater
- PEEP is less than 10cm (ideally closer to 5cm H2O)
- The patient has an unsupported vital capacity of at least 150mls

There may be situations when the patient's Vital Capacity (VC) does not meet the required minimum level but it may still be appropriate to attempt to wean them from ventilation. In this situation the patient must:

- Fulfil the other indications for weaning
- Have unsupported vital capacity greater than unsupported tidal volume, this is an indication that they have some reserve in their respiratory muscles

If a patient is expected to continue to require long term ventilation it may still be appropriate to attempt to wean from the ventilator for short periods. Advantages of this are:

- Improved safety in the event of disconnection.
- Improved ease of mobility when transferring (e.g. bed to wheelchair, or showering etc)
- Patient peace of mind

3.7.2 Exceptions/ contraindications to weaning:

- Unresolved paralytic ileus or abdominal distension causing diaphragm splinting.
- Fever
- Neurological changes
- Sedative drugs
- Pain
- Psychological disturbance
- Lack of sleep

3.7.3 Preparation for weaning:

Where ever possible, this group of patients should be managed on the Dräger V300 to facilitate all modes of respiratory support throughout the weaning process.

NB Triggered modes of respiratory support (eg CPAP ASB/ST/ SPN CPAP) **SHOULD NOT** be used as part of the initial weaning process (either rest or weaning mode). In other words, **Ventilator Free Breathing (VFB) is carried out using a TRACHY MASK only.**

Vital capacity should be assessed using a Wright's Respirometer. A vital capacity of at least 150mls is required to begin VFB. A vital capacity of around 1000mls predicts straight forward weaning.

With cord injuries at C4 and above, if there is doubt as to whether diaphragm activity is present, apnoea testing under sedation may be performed. This may show accessory muscle activity (Nasalis, sternomastoid) when the PaCO2 rises above 6kPa without diaphragmatic activity if the cord injury

involves the phrenic nerves. This does not necessarily imply permanent ventilator dependence but requires retesting at a later date.

NB: **VFB periods should initially be performed in supine, not sitting (max 30°head up)**. There is a drop of up to 20% in VC from supine to sitting, so VFB periods will be better tolerated supine.
Furthermore, when a patient is weaning they should not be mobilised out of bed. Consider performing weaning and rehabilitation on alternative days.

3.7.4 How to use a Wright's Respirometer

Measuring the VC needs to be performed when the patient is completely free from ventilatory support. If they are still on a relatively high PEEP, a few breaths before the measurement is performed is advised.
Before attaching the respirometer to the patient, make sure the needle is set to zero and the on/off button is set to start. Attach the respirometer to a filter. Ideally the filter should then be directly attached to the tracheostomy (ie a catheter mount should not be used as this adds to deadspace and resistance, giving an inaccurate reading). Some tracheotomies may require an adaptor to enable the filter to attach.
Make sure the respirometer is set to 'run' then instruct the patient to take a large inhale and then record the exhale volume. Use the rest button to return the needle to zero.

Using the Wright's Respirometer

Attachments are trachy - filter – connector (NB: more modern versions of the respirotmeter do not need the connector)

3.7.5 Choosing the starting point for ventilator free breathing:

The starting point for VFB is based on the initial vital capacity measurement. During VFB all ventilatory support (including CPAP) is removed for a specified time and then re-instituted for a rest period. In patients with a low initial VC or relatively high PEEP the ventilator may be allowed to deliver CPAP as long as no extra pressure/volume support is given.

Secretion clearance should be performed prior to VFB.

Suggested VFB times based on vital capacity are:

If VC is less than 250 mls, start with 5 minutes spontaneous respirations
If VC is 250 - 500 mls, start with 15 minutes spontaneous respirations
If VC is 500 - 750 mls, start with 30 minutes spontaneous respirations
If VC is 750 – 1000mls start with 45 minutes spontaneous respirations
If VC is greater than 1000 mls, start with 60 minutes spontaneous respirations

See appendix 2 for suggested weaning progression rates

The on-ventilator rest period, should be at least 1-2 hours. This should be repeated throughout the day. **The patient should be FULLY ventilated during the rest period and overnight, ie mandatory ventilator support (SIMV BiPAP ASB).** During this time, aim for tidal volumes of 10-15mls/kg (HIGHER than standard VT for acute lung injury).
Weaning progression is achieved by increasing VFB time by specified amounts dependant on the previous day's results.
It is important that the patient is not fatigued which can be estimated by re-measuring the vital capacity at the end of the VFB period. If it is less that 70% of the pre weaning VC then either the rest period should be extended or the VFB time reduced.

Where less than 12 hours is being achieved, VFB should only occur between the hours of 08:00 and 22:00.

3.7.6 Cuff deflation

Where the patient is expected to be a fast weaner, cuff deflation and use of a speaking valve during VFB should be considered.

Where the patient is expected to be a slow weaner, cuff deflation whilst on the ventilator should be considered.

The cuff should be fully inflated over night

The initial aim is for VFB up to 18 hours during daytime, but for ventilation at night, as spinal cord injured patients can have significant REM sleep

hypoventilation. To assess safe VFB overnight requires either PaCO2 or TcCO2 monitoring.

Suggested weaning progression

Time on VFB	Number of sessions per day
5 minutes	3
10 minutes	3
20 minutes	3
30 minutes	3
1 hour	2
1 1/2 hours	2
2 hours	2
2 1/2 hours	2
3 hours	2
3 1/2 hours	2
4 hours	2
4 1/2 hours	2
10 hours	1
11 hours	1
12 hours	1

NB: Patient should be fully ventilated during rest periods and overnight

3.8 Psychosocial Issues

- Assess mental health in general and risk of psychosocial problems after admission
    - Premorbid psychiatric disorders
    - Substance abuse
    - Social support network
    - Cognitive functioning
    - Life stressors
    - General health
    - History of mental health issues
    - Use of psychiatric medications
- Foster effective coping strategies and promote independence
    - Honest and accurate medical information
    - Honest and accurate prognostic information
    - Respect expressions of hope
    - Help to identify coping strategies
    - Use assistive devices
- Detect suicidal ideation. Take refusal of treatments seriously (Involve psychiatric team)
    - Acknowledge suffering
    - Assess depression and anxiety
    - Determine decision making capacity

    - Identify needs
    - Establish an agreed plan of care

3.9 Transfer

- The regional Specialised Spinal Cord Injury Centre is at James Cook University Hospital, Middlesbrough
- Inform the Specialised Spinal Injury Centre within 4 hours of injury
- Form a jointly agreed management plan for the patient
- Consider early (within 24 hours) transfer to a specialised spinal cord injury centre
    - James Cook University Hospital, Middlesbrough
    - Complications from spinal cord injury can occur within the first 24 hours
    - There is evidence in support of early transfer of patients to specialised centres
- On transfer follow North of England Critical Care Network transfer guidelines

3.10 Documentation

- All patients with a spinal cord injury should be registered as quickly as practicable on the National Spinal Cord Injury Database

4 Training, Implementation, Resource Implications

This guideline represents a formalisation of the care that is already being provided within Newcastle Hospitals. It should act to help those who are new to this area as part of their training.

5 Monitoring Section

Audit Parameters

All patients with cervical or high thoracic (above T6) SCI should be admitted to intensive care for monitoring and acute management.

- 100% of patients who sustained an injury with a mechanism compatible with spinal damage should have spinal immobilisation as part of the immediate resuscitation phase.
- 100 % of patients with a SCI above T6 should be admitted to intensive care.
- 100 % of patients should meet proposed targets within 4 hours of admission to intensive care including: Referral to SCI Specialist centre.
- Airway secured or regular vital capacity (VC) measurement.
- Target mean arterial pressure (MAP) documented.
- Insertion of arterial line.

- Insertion of nasogastric tube (NG) tube.
- Urinary catheter inserted.
- Venothromboembolism (VTE) assessment documented.
- ASIA score assessed and documented as complete/incomplete injury.
- Stress ulceration prophylaxis prescribed.
- 100 % of patients should meet proposed targets within 24 hours.
- Surgical plan documented.
- Spinal clearance form completed.
- Secondary survey completed and documented.
- Referral to Physiotherapists and Occupational therapists.
- Bowel care protocol implemented.
- Regular neurological observations (every 2 hours).
- Regular turning of patient (every 2 hours).

6 Evidence Review and Evaluation

This guideline is based on national and international guidelines on the care of patients with spinal cord injury.

7 References

North of England Trauma Guidelines
ATLS Guidelines
American Spinal Injuries Association Guidelines
RISCI UK - Weaning guidelines for Spinal Cord Injured patients in Critical Care Units (2012)
NWCCN Spinal Cord Injury Weaning Guidelines February (2014)
Leanne Scully/Isabel Gonzalez, JCUH SCI Unit

APPENDIX 1: MAJOR TRAUMA GUIDELINES

APPENDIX 2: GUIDELINES FOR TURNING SPINAL INURED PATIENTS

APPENDIX 3: ASIA ASSESSMENT SCALE

APPENDIX 4: BOWEL GUIDELINES FOR SPINAL INJURED PATIENTS

Major Trauma Bypass Protocol

This protocol should be used if major trauma is likely to have occurred based on a significant mechanism of injury. Examples may include:

- High speed road traffic collisions
- Motorcycle road traffic collisions
- Pedestrian or cyclist versus vehicle
- Death of an occupant in the same vehicle
- Ejection from a vehicle
- Fall from 2 storeys or more
- Crush injuries
- Assault with a weapon
- Prolonged entrapments
- Blast injuries

In the event of an unmanageable airway, transport to the nearest trauma-receiving ED and provide pre-alert

Contact the NEAS Control desk to inform them that the protocol has been applied and receiving destination

For all major trauma consider early HEMS activation

Step 1 – Physiological assessment

Any **one** of:

- Current GCS 13 or less
- Sustained loss of radial pulse or systolic BP <90mmHg
- Respiratory rate <10 or >29

Trigger

Step 2 – Anatomical assessment

Any **one** of:

- Penetrating trauma proximal to elbow or knee
- Spinal injury with new abnormal neurology
- Traumatic amputation proximal to wrist or ankle
- Chest injury with hypoxia or suspected flail
- Significant burns* or inhalational injury
- Pelvic fracture with obvious deformity/instability

Trigger

Step 3 – Special circumstances

No trigger in step 1 or 2 but **high degree of clinical concern**

PLUS

Any **one** of:

- Age > 65 years
- Bleeding tendency
- Pregnancy >20 weeks

Trigger

No triggers

*
10% burns in a child
15% burns in an adult
Circumferential burns
Hand or facial burns

Is Major Trauma Centre within 45 minutes?

No → Transport to nearest trauma receiving hospital. Pre-alert ED for all triggering cases

Yes → BYPASS TO MAJOR TRAUMA CENTRE
PRE-ALERT RECEIVING EMERGENCY DEPARTMENT

RVI	JCUH
0191 2820311	01642 282767

10/2/12

APPENDIX 2: GUIDELINES FOR TURNING SPINAL INURED PATIENTS

ADAPTED ATLS HEAD HOLD FOR ACTUAL OR POTENTIAL CERVICAL SPINAL INJURY

Advanced trauma life support manual and training stipulate a standardized approach to head holding in the event of actual or suspected spinal injury. The healthcare worker responsible for head holding is designated as the Team Leader and directs all patient movement. However, the degree of lateral flexion experienced by the Team Leader during logrolling is excessive and this represents an adaptation of the current technique as recommended by American College of Surgeons' Committee on Trauma (ACS). (2008) *Advanced Trauma Life Support Manual for Physicians* (8th edition). American College of Surgeons Press, Chicago.

Explain to the patient what is happening and why. A suitably qualified and experienced health care worker will be designated as Team Leader. The Team Leader positions self at top of trolley / bed, placing hands either side of patient's head. With fingers spread wide, slides both hands downwards so the thumb rests either below the jaw or above the clavicle and the fingers are spread behind the neck encompassing C7. If sandbags / headblocks are present an assistant removes them, one at a time and the Team Leader brings each hand into position individually. Forearms are then brought together either side at the back of the head.

Prior to rolling the patient., care must be taken to position the bed height at optimum level to reduce excessive forward trunk flexion of the Team Leader. Patient is then rolled on the command of the Team Leader. To accommodate this roll, Team Leader may be required to adopt a side flexed position. Note fingers crossed behind cervical spine as described above.

In order to maintain a comfortable head hold during the logroll, the Team Leader releases top hand and maintaining contact with the skin throughout, moves hands slowly to the top of the patient's head with fingers spread wide. They should then adjust their base of support (feet and legs) to a more comfortable and sustainable position while maintaining the head in the aligned position.

Shows adapted ATLS head hold from the opposite side showing alignment nose – chin – sternum. A chair can be made available for the Team Leader to sit down during prolonged holding to enable the elbows to be rested on a pillow. The Team Leader must be aware that they are allowed to return the patient to the supine position if they feel the strain of maintaining the turn becomes excessive and beyond their limitations. In patients with broad shoulders, a pillow or pad can be used to support the Team Leader's underlying arm but it must be of the correct depth to maintain spinal alignment.

ACUTE TETRAPLEGIC SPINAL LOGROLL – Method 1

During an acute tetraplegic logroll the patient's head and vertebral column must be kept in alignment when rolling from supine to side-lying and vice versa. During this manoeuvre the alignment of the vertebral column and the body as a whole is maintained through the manual support provided by the turning team. (1st assistant – Team leader & acute head hold in accordance with adapted ATLS procedure; 2nd assistant – shoulder level; 3rd assistant – hip level; 4th assistant – lower leg level; 5th assistant – operating the bed controls, supporting arms, checking patient's skin, placing pillows in situ etc)

Logrolling on a trolley in the Emergency Department or within a ward setting on a normal hospital bed or tilt and turn bed is essential to enable examination of the back and necessary for relieving pressure on the skin, hygiene, bowel care and postural chest drainage. The following technique is applicable in all clinical settings.

Team leader undertakes acute initial head hold in accordance with adapted ATLS procedure. 5th assistant passively positions patient's arms across chest but above diaphragm. This is important as the arms are paralysed and may fall down causing injury to the shoulder joint.

2nd assistant reaches over patient. First hand on shoulder and second hand on top of hip. 5th assistant supports patient's arm during this action.

3rd assistant positions hands. First hand at hip level alongside the 2nd assistant, and second hand underneath furthest thigh.

4th assistant positions hands. First hand under the knee of the furthest leg, and second hand under the ankle of the same leg.

Close up of hand positions – ensure all parties are in contact with the patients natural skeletal landmarks and not just adipose tissue.

MECHANISED TURN FOR POSTURAL CHANGE

The availability of a mechanical turning bed can enhance the experience of turning in alignment for patients with actual or suspected spinal injury. This is particularly beneficial for tetraplegic patients, patients with multiple trauma and acute chest complications, as well as for patients whose size causes a significant risk for staff during routine manual turning. (1st assistant – Team leader & acute head hold in accordance with adapted ATLS procedure; 2nd assistant – shoulder level; 3rd assistant – hip level; 4th assistant – operating the bed controls, supporting arms, checking patient's skin, placing pillows in situ etc)

Team leader undertakes acute initial head hold in accordance with adapted ATLS procedure. 2nd assistant provides contact guard against inappropriate patient movement, 3rd assistant positions pillow between the legs to maintain hip abduction.

2nd and 3rd assistant provide contact guard (counter traction) against inappropriate movement of the patient during mechanical turning of the bed. Team leader gives the command when all the team are in position to commence the turning of the bed.

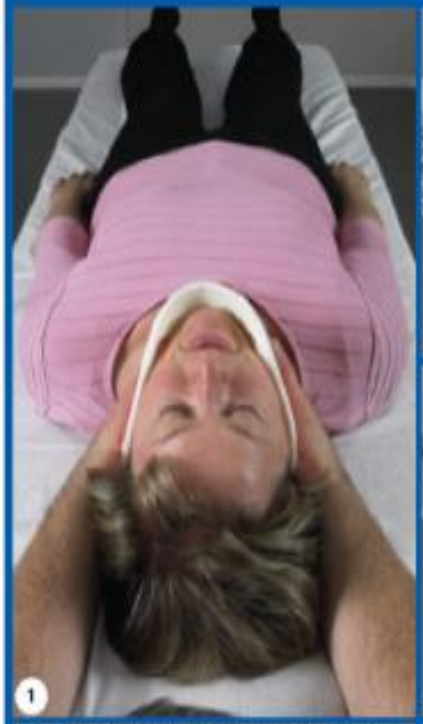
4th assistant checks inclinometer fitted to the bed and stops the bed at the required degree of tilt.

Team insert pillows under both arms and legs for patient comfort and alignment.

Legs are positioned to prevent hyperextension of the knees, a bed end is placed in situ and additional pillows placed at the end of the bed to support the patient's feet in neutral to prevent foot drop. The heels are left 'floating' free from pressure to prevent skin breakdown (not illustrated)

POSTURAL ALIGNMENT

Physical landmarks are visualised to demonstrate postural alignment of the spine during turning and positioning of SCI patients.



During all patient movements all commands come from the team leader who also takes responsibility for monitoring the physical alignment of the patient's spine during and after turning and transfer procedures by monitoring the alignment of body landmarks.

From their sight position at the patient's head they can monitor the alignment of the nose, sternum and pubic symphysis. They can also observe lateral alignment of shoulders, ribcage, hips and legs for signs of spinal rotation. When at rest, the head should be supported to maintain mid-line position using pads or blocks.

The accompanying pictures illustrate correct postural alignment of SCI patients following turning and transfer procedures. Upper limbs should be supported in a position that guards against contractures of elbow, wrist and fingers until the patient is assessed for splints.

Legs are positioned to prevent hyperextension of the knees, a bed end is placed in situ and additional pillows placed at the end of the bed to support the patient's feet in neutral to prevent foot drop. The heels are left 'floating' free from pressure to prevent skin breakdown.

Repositioning A Patient with HALO Brace

•Gain consent from patient if applicable.
•Check HALO secure
•Ensure trache & vent tubing secure (dedicated person).
•Roll patient onto side. Remove back & leg pillows.
•Insert slide sheet

•Ensure trache (dedicated person), IV lines, catheter etc secure
•Using slide sheet turn patient onto back/other side.
•Remove slide sheet

•Insert pillow into back

•Use pillows to support legs/protect vulnerable pressure areas

•Use pillows/towels to support hands
•Check occipital pressure area

Patient Name _____

Examiner Name _____ Date/Time of Exam _____

ASIA
AMERICAN SPINAL INJURY ASSOCIATION

INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

ISCOS

MOTOR

KEY MUSCLES (scoring on reverse side)

	R	L	
C5			Elbow flexors
C6			Wrist extensors
C7			Elbow extensors
C8			Finger flexors (distal phalanx of middle finger)
T1			Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

Comments:

	R	L	
L2			Hip flexors
L3			Knee extensors
L4			Ankle dorsiflexors
L5			Long toe extensors
S1			Ankle plantar flexors

(VAC) Voluntary anal contraction (Yes/No) ☐

LOWER LIMB TOTAL (MAXIMUM) ☐ + ☐ = ☐ (25) (25) (50)

SENSORY

KEY SENSORY POINTS

	LIGHT TOUCH R	LIGHT TOUCH L	PIN PRICK R	PIN PRICK 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)

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

☐ (DAP) Deep anal pressure (yes/No)

☐ PIN PRICK SCORE (max: 112)

☐ LIGHT TOUCH SCORE (max: 112)

• Key Sensory Points

NEUROLOGICAL LEVEL — The most caudal segment with normal function — SENSORY R ☐ L ☐ / MOTOR R ☐ L ☐

SINGLE NEUROLOGICAL LEVEL ☐

COMPLETE OR INCOMPLETE? ☐ — Incomplete = Any sensory or motor function in S4-S5

ASIA IMPAIRMENT SCALE (AIS) ☐

(In incomplete injuries only) ZONE OF PARTIAL PRESERVATION — Most caudal level with any innervation — SENSORY R ☐ L ☐ / MOTOR R ☐ L ☐

REV 04/11

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 peson.

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 contracture 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? If **YES**, AIS=A and can record ZPP (lowest dermatome or myotome on each side with some preservation)

NO ↓

Is injury motor Incomplete? 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)

YES ↓

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.

ASSISTED COUGH

Paralysis of the abdominal muscles causes severe impairment of forced expiration. The cough mechanism will be altered in SCI patients with a neurological level of T11 and above. The higher the level of lesion the more likely the patient will require assistance with coughing. Patients with complete cervical spinal cord lesions are at greatest risk of respiratory complications. Medical advice should always be sought first before attempting assisted coughing in new SCI patients, those with chest injuries, cardiovascular disease, abdominal trauma or disease or who are pregnant.

Two-person technique: Clear verbal direction and co-ordination between the person(s) helping and the patient is essential for these techniques to be successful.
Stand on either side of the bed. Each person places their hands on the upper and lower ribs of the same side with their fingers spread and pointing upwards and centrally. As the patient attempts to cough, push inwards and upwards simultaneously. This method may not be suitable for a patient who has an unstable spine because if the actions are not performed simultaneously it introduces rotation of the thorax.

This two person method is preferred if spinal stability is a consideration as both people are pushing bilaterally which will minimise rotation. Stand on either side of the bed. Each person places one forearm across the upper abdomen of the patient with their other hand on the upper or lower ribs of both sides of the chest. As the patient attempts to cough, push inwards simultaneously.

Single person technique: spread your hands anteriorly around the lower rib cage and upper abdomen. With your elbows extended push inwards and upwards with both arms as the patient attempts to cough. Arms must be kept extended for this technique to work effectively; it may therefore not be appropriate to use if the patient's bed does not lower to a suitable height.

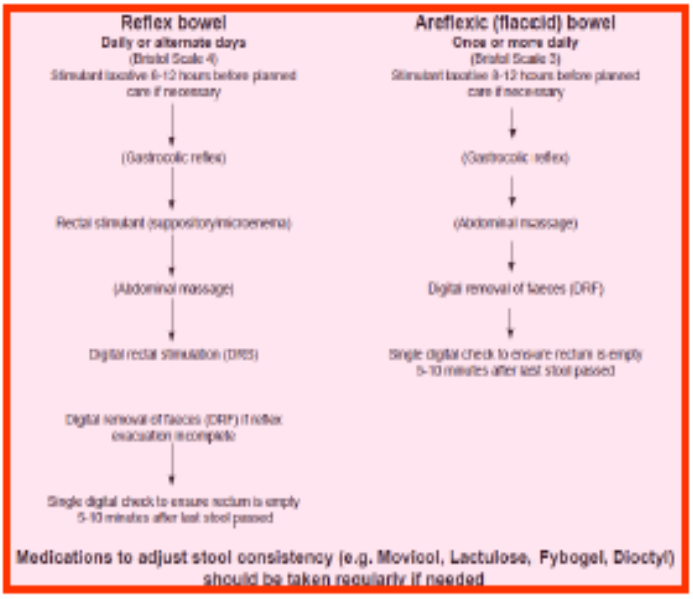
RVI NVW Critical Care 18: Summary of guideline for neurogenic bowel dysfunction after spinal cord injury 2011. Coggrave et al. (Lobaz/Shelton 02/04/12)

Bowel Management: Acute spinal cord injury / Spinal Shock

- All individuals after injury present with a loss of sensation, movement and reflex activity below the level of the spinal cord injury. Sympathetic activity below the level will be suppressed. The rectum and anus become areflexic/flaccid and peristalsis of the bowel will be absent (paralytic ileus).
- Bowel Management must start on day of admission: obtain and record consent if possible, prior to assessment

1. Initially: All patients with spinal cord injury should be kept NIL Enterally for 48hrs post injury. Regular assessment of abdominal girth and daily bowel sounds assessment should be undertaken.
2. Digital rectal examination (DRE) to be conduct as part of initial neurological assessment. If faeces present: Digital removal of Faeces (DRF) should be undertaken with ample lubrication +/- glycerin suppository.
3. During spinal shock: Daily DRE and DRF +/- glycerin suppositories. Observe for signs of autonomic dysreflexia* (See below). Observe Anal tone during DRE. If spinal cord lesion is at or above T12, an increase in anal tone would be expected as spinal shock resolves. Assess sacral sensation daily.
4. Daily assessment for bowel sounds. As spinal shock resolves so does paralytic ileus/bowel sounds return.
5. On resolution of spinal shock:
   - Individuals with complete spinal cord lesions at or above T12 = REFLEX bowel (Upper Motor neuron UMN bowel). Here reflexes: bulboanal reflex and anal wink will be present.
   - If lesion at or below L1 usually AREFLEXIC bowel (Lower Motor neuron LMN bowel).
   - If injury incomplete or involving the conus, remaining function less predictable and will be determined by DRE.
6. Continuing Bowel Management: dependent on DRE findings - Motor: Reflex bowel or Areflexic Bowel (see flow charts below). Sensory: if sensation present in saddle area around perineum likely to have anorectal sensation – digital intervention may be uncomfortable. Rectal stimulants (enemas, suppositories) may cause less discomfort. Local anaesthetic gel can be introduced into the rectum prior to bowel care to increase tolerance if needed. (see guideline Coggrave et al. for detailed information)

Reflex bowel function	Areflexic (flaccid) bowel function
Positive anal reflex (anal wink) – visible contraction of anus in response to pinprick of surrounding skin	No anal reflex (anal wink)
Positive bulbo-anal reflex – contraction of anus in response to pressure on glans penis/clitoris	Absent bulbo-anal reflex
Injury/damage usually at or above T12 Reflex paralysis	Injury/damage usually L1 and below (conus or cauda equina, flaccid or areflexic paralysis)



Autonomic Dysreflexia*:

- associated with spinal cord injury at or above T6
- Abnormal sympathetic nervous system response to noxious stimuli below level of injury
- Acute episodes: may result in rapidly rising blood pressure with risk of brain haemorrhage/death if persistent and associated with symptoms.
- Symptoms: rapidly developing severe headache, flushing, sweating, blotchiness, chills, nasal congestion.
- Some individuals experience symptoms every time they evacuate bowel. Less often, can occur when rectum loaded, haemorrhoids, fissures etc.
- Management: stop bowel management. Seek medical help. Sublingual nifedipine or GTN patch useful. Anorectal problems should be treated and bowel management adapted. Bowel care MUST still be continued on a regular basis. Local anaesthetic gel prior to DRE may reduce or eradicate autonomic dysreflexia during bowel care, but not suitable for prolonged use.