



SPINAL TRAUMA GUIDELINE



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1. Key messages

The Victorian State Trauma System (VSTS) provides clinical support and retrieval services for critically injured patients requiring urgent transfer for definitive care and ongoing trauma management. This spinal trauma guideline provides evidence-based advice on the initial clinical management and transfer major trauma patients with who present to Victorian health services with spinal injuries.

This guideline is developed for clinical staff involved in the care of trauma patients throughout Victoria. It is intended for use by frontline clinical staff that provide initial care to major trauma patients; both those working directly at the Major Trauma Service (MTS) as well as those working outside of a MTS.

These guidelines provide the user with readily accessible resources to effectively and confidently provide early care for critically injured patients through the use of up to date and evidence-based guidelines. The guideline has followed the AGREE II methodology for guideline development and is under the auspice of the Trauma State Advisory Committee (TSAC) (1).

Clinical emphasis points

The early management of trauma patients should emphasise the possibility of a spinal injury with a focus on clinical protective mechanisms.

- Protective handling is essential to minimise secondary spinal cord injury in the early management of spinal trauma.



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- Regular neurological assessment should be undertaken to monitor for progressive deterioration in function.
- Deteriorating respiratory function in a spinal trauma patient may indicate the need for intubation. This requires specific planning and intervention.
- Once the patient is identified as suffering from a spinal injury, early activation of the retrieval process is crucial.
- All polytrauma patients are ideally managed at an MTS. Adult trauma patients with an isolated spinal injury should be transferred to the Victorian Spinal Cord Service (VSCS), Austin Health.
- Adult Retrieval Victoria (ARV) is the first point of call to initiate retrieval and transfer in the adult patient.
- The main goal of early care is to ensure optimum resuscitation in the emergency setting as well as activation of the retrieval network, with timely transfer to an appropriate facility.



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2. Rapid Reference Guideline



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3. Introduction

In Victoria, most spinal cord injuries (SCI) result in permanent neurological disability for patients. Australian data collected from 2007–16 indicated that 38% per cent of injuries were related to transport crashes and 28% were as a result of falls. These two mechanisms alone accounted for more than two thirds of all traumatic SCI (2, 3). Presentations of SCI have a bimodal distribution. Cases related to trauma in younger adults often involve higher velocity injury in a healthy spine. Injuries to the older adult often appear in later life with other causes, which may be associated with a lower velocity injury in a vulnerable spine. These may be a result of a pathological vertebral fracture, a first sign of malignancy and/or result from seemingly insignificant injury presentation.

Damage to the spinal cord may cause irreversible injury with the outcome of either temporary or permanent neurological deficit. The natural progression of SCI, in particular rising spinal cord oedema, may lead to an exacerbation of symptoms in the hours following an accident. Early care of SCI can have a significant effect on the long-term outcomes for these patients, with safe and appropriate transport to definitive care facilities a vital process (4, 5). Emergent surgical fixation, where indicated, and stabilisation of the spinal injury may provide the best outcome for patients and is the first stage of recovery.

Injuries to the spinal cord may be classified as: complete (with no neurological connection between the cortex of the brain and the lowest sacral spinal cord segment) and incomplete injury (with some connection maintained). The International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) Determines sensory, motor, and neurological levels, generates sensory and motor index scores, and assesses injury completeness and impairment classification (6). (Refer to Appendix 1)

Following a traumatic injury, the spinal cord becomes oedematous and, with limited capacity for swelling inside the vertebral column, normal neurological function rapidly becomes compromised.

Importantly, SCI trauma patients may present with an amalgamation of motor and sensory neurological deficits, which may be unilateral or bilateral, affecting upper and/or lower body regions. Conscious patients may describe various perceptions such as numbness, burning pain or absence of feeling or movement. The emerging and frequently ascending nature of spinal injury signs and symptoms indicate a need for exacting and ongoing assessment, as well as monitoring and management of the SCI trauma patient. Two important outcomes of a SCI are neurogenic shock and spinal shock.

Neurogenic shock is seen in SCI affecting the sixth thoracic vertebrae or above, thus loss of over 50% of sympathetic nervous system control typically occurring within 30 minutes of cord damage and lasting six to eight weeks following injury. It is a result of the loss of vasomotor and sympathetic nervous system tone or function. Its critical features are changed parameters with the triad of hypotension, bradycardia and poikilothermia.



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Spinal shock is a combination of the immediate loss of sympathetic tone, decreased reflexes and autonomic dysfunction that accompanies SCI. Skeletal and smooth muscles are therefore flaccid from hours to weeks.

All patients with spinal trauma must receive a rapid and systematic primary and secondary survey. The main goals are to ensure understanding of injury mechanisms and pattern, optimum management in the emergency setting, including prevention of secondary insults, and activation of the retrieval network, with timely transfer to an appropriate trauma facility.

4. Early activation

Emergency medical services should notify the receiving hospital that a trauma patient is on their way. This information may be crucial to the management of the severely injured patient and can allow for communication to vital members of the response team as well as time to prepare the department for the patient's arrival.

The presence of acute SCI needs to be assumed in a multi-trauma patient, particularly with altered conscious state, until it can be dismissed by appropriate clinical and radiological examination.

The following sequence of actions should take place upon initial notification:

1. Gather vital information from the notifier using the IMIST mnemonic (7, 8)
 - I** Identification: Who and what is your role? Patient identifiers – name, age, sex.
 - M** Mechanism: Presenting problem, how it happened.
 - I** Injuries: specific injuries that have been found or potential to exist.
 - S** Signs: vital signs, such as HR, RR, BP, Temp, BGL, GCS, etc.
 - T** Treatment and Trends: treatment administered and patient's response to treatment, trends in vital signs.
2. Set up the trauma bay to receive the patient, including equipment checks, documentation, medications, and resuscitation equipment.
3. Activate the trauma team and available support departments (medical imaging, pathology). In small health service settings this may only consist of a clinician and a nurse. Additional staff may be gathered from wards or on call. It may be necessary to utilise the skills of all available resources including emergency response personnel in the initial trauma management.
4. Designation of roles and specific tasks to staff can help to maintain a structured approach based on teamwork. Ensure clear communication between all parties involved in managing the trauma. Use closed-loop communication, which ensures accuracy in information shared between response staff. Repeat instructions, make eye contact, and provide feedback. Misinterpreted information may lead to adverse events.
5. Ensure all staff involved in patient care are wearing gloves, aprons, and eye protection. Personal protective equipment is vital in the care of trauma patients.



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If it is anticipated that transfer to a major trauma service will be required, early retrieval activation is essential, phone ARV on 1300 368 661.

- Early retrieval activation ensures access to critical care advice and a more effective and prompt retrieval response.
- Early activation and timely critical care transfer can significantly improve clinical outcomes for the patient (9).

If you are undecided, call the ARV coordinator, who can provide expert guidance and advice over the phone or via teleconference, and link to MTS as required.

5. Early rapid neurological assessment

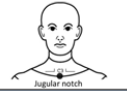
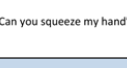
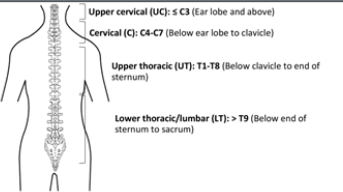
A rapid assessment to be used in the prehospital and emergency settings is called the Spinal Emergency Evaluation of Deficits (SPEED). It uses foot motor and sensory function to indicate injury severity and C3 dermatome sensation, handgrip strength and location of spinal pain to indicate the level of injury.

This approach to early SCI assessment is an important step as to undertake the complete American Spinal Injury Association (ASIA) assessment requires significant training and given the time and complexity cannot be undertaken in the field. The SPEED assessment appears capable of accurately determining the severity and level of cervical SCI in the first hours post-injury. A neurological assessment that can be performed rapidly after injury is important for clinical trials of early therapy and to identify patients most likely to benefit from intervention (10).



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S.P.E.E.D SPinal Emergency Evaluation of Deficits			
Motor Scoring Ankle or toe movement (please record)		Right	Left
	No movement	0	0
	Flicker movement at toe or ankle	1	1
	Definite movement at toe or ankle	2	2
Sensory Scoring Light touch S1 (please record)		Right	Left
	None	0	0
	Altered	1	1
	Normal	2	2
Exclusion high cervical injury Light touch C3 (please record)		Midline (Jugular notch)	
	None	0	
	Altered	1	
	Normal	2	
Confirmation of cervical SCI Hand grip (please record)		Right	Left
	No movement	0	0
	Weak	1	1
	Strong	2	2
Approximate location of spinal pain			
 Upper cervical (UC): ≤ C3 (Ear lobe and above) Cervical (C): C4-C7 (Below ear lobe to clavicle) Upper thoracic (UT): T1-T8 (Below clavicle to end of sternum) Lower thoracic/lumbar (LT): > T9 (Below end of sternum to sacrum) If applicable: Please record the region as indicated and/or approximate vertebrae level			
DATE AND TIME OF ASSESSMENT (please record):			

SPEED score

0 = nothing = complete

1 = something = incomplete

2 = normal

6. Primary survey

The primary survey is the initial assessment and management of a trauma patient.

Use a systematic approach based on <C> **ABCDE** (11, 12) to assess and treat an acutely injured patient. The goal is to manage any life-threatening conditions and identify any emergent concerns, especially in a burns patient who may present with other multisystem injuries.

All patients with a mechanism of injury *likely* to have induced SCI must have an appropriately fitted and sized collar placed and inline immobilisation implemented. Regular assessment is crucial in SCI trauma patients as developing cord oedema may cause significant changes in neurological function

- Catastrophic haemorrhage
- Airway with in-line spinal immobilisation
- Breathing
- Circulation
- Disability (neurological)
- Exposure and environment



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Catastrophic Haemorrhage

Assess for catastrophic haemorrhage

- Identify any large volume external blood loss.
- Provide immediate management as required, consider; direct pressure, haemostatic dressings and tourniquets.

Airway with cervical spine protection

Early and safe airway management in the SCI patient can make a crucial impact to long-term patient outcomes and functional deficits.

Assess for airway stability

- Attempt to elicit a response from the patient.
- Look for signs of airway obstruction (use of accessory muscles, paradoxical chest movements, see-saw respirations).
- Listen for any upper-airway noises, breath sounds. Are they absent, diminished, or noisy?
- Assess for displaced dentures, especially in the older persons cohort.
- Spinal patients are at particular risk of passive regurgitation and subsequent aspiration. High cervical injuries potentiate loss or compromise of both gag and cough responses. (Nasogastric tube insertion is highly recommended although consideration of intubation and inherent airway protection should be considered prior to insertion.)

Attempt simple airway manoeuvres if required

- Open the airway using a chin lift and jaw thrust whilst avoiding neck extension to protect the C-spine.
- Suction the airway if excessive secretions are noted or if the patient is unable to clear their airway independently.
- Insert an oropharyngeal airway (OPA) if required.

Caution: Nasopharyngeal airways (NPA) should not routinely be inserted in patients with a head injury in whom a base of skull fracture has not been excluded (13). In the setting of airway obstruction, or failure to oxygenate, then an NPA can be inserted if delay to definitive airway management.

Caution: Bradycardia or cardiac arrest as a response to tracheal suction, endotracheal intubation, laryngoscopy or other tracheal stimuli are found mainly during the acute phase, in patients with high complete cervical SCI, and this problem usually resolves within the first 2–6 weeks after SCI (14).

Maintain full spinal precautions if indicated

- Suspect spinal injuries in all polytrauma patients. Ensure cervical collar, head blocks and in-line immobilisation is maintained throughout patient care.



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*Secure the airway if necessary (treat airway obstruction as a **medical emergency**)*

Consider early intubation if there are any signs of:

- Decreased level of consciousness, unprotected airway, an uncooperative/combatative patient leading to distress and further risk of injury.
- Apnoea or respiratory failure due to paralysis.

Intubation of the patient while maintaining full spinal precautions requires skill and a high level of teamwork.

- Manoeuvres to open the airway that mobilise the cervical spine, such as a neck tilt are contraindicated. Only jaw thrust and chin lift should be utilised.
- Manual in-line cervical stabilisation must be maintained while the cervical collar is removed to facilitate intubation. A second assistant may apply cricoid pressure over the cricoid cartilage ring while intubation is performed. The use of external laryngeal manipulation may be an effective procedure to mobilise the airway and to facilitate vocal cord identification.
- Prophylactic, pre-treatment of quadriplegic and high-paraplegic patients with atropine is indicated prior to airway management due to unopposed vagal tone and the risk of bradycardia during pharyngeal stimulation.

Breathing and ventilation

- Assessing for adequate ventilatory effort is essential.
- Administer high flow oxygen and record the oxygen saturation (SpO₂).

Patients with a spinal injury may have respiratory compromise relative to the level of injury and spinal cord compromise, remembering that the diaphragm is innervated by cervical nerves 3, 4 and 5. Breathing and ventilation may be compromised by direct pulmonary injury or aspiration. They may present with an inadequate cough reflex, hypoventilation and apnoea. Rising spinal cord oedema may result in progressive loss of diaphragmatic function.

Assess the chest

- Be mindful that thoracic injuries may have also occurred
- Count the patient's respiration rate and note the depth and adequacy of their breathing.
- Auscultate the chest for breath sounds and assess for any wheeze, stridor, or decreased air entry.

Paradoxical breathing, a sign of high spinal injury, results from activation of the diaphragm while thoracic muscles remain paralysed, causing the thorax to cave in (respiratory movements in which the chest wall moves in on inspiration and out on expiration, in reverse of the normal movements)



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Circulation with haemorrhage control

Assess circulation and perfusion

- Check the heart rate and blood pressure
- Inspect for any signs of external haemorrhage and apply direct pressure to any wounds.
- Insert two large-bore peripheral intravenous (IV) cannulas. If access is difficult, consider central or intraosseous insertion if the equipment/skills are available.
- Management of volume resuscitation is important in spinal patients and hypotension should be avoided; a general guide is to maintain a systolic blood pressure of above 90mmHg and targeting a MAP of 85-90mmHg (15, 16). It is important not to assume that hypotension in a patient with SCI is solely as a result of their cord injury without excluding other causes such as haemorrhage.
- Expect hypotension and bradycardia associated with spinal shock in those with lesions at or above T6 neurological level of injury.
- Additionally, neurogenic shock may cause a bradycardia, contributing to hypotension, and may require treatment with medication.

A heart rate less than 45 bpm and blood pressure under 90 mmHg require treatment in consultation with ARV and the receiving unit.

Disability: neurological status

Assess level of consciousness

- Complete an **AVPU** assessment (Alert, responds to Voice, responds to Pain, Unresponsive) A more detailed neurological assessment using the GCS will be performed in the secondary survey.
- Until ruled out by appropriately qualified clinical personnel (and where necessary with supportive radiological examination), major trauma patients should be considered at risk of spinal injury.
- Identifying a cervical spinal injury in primary assessment is important. Priapism, diaphragmatic breathing and loss of anal tone are key signs of high spinal cord compromise.
- Combative patients should not be physically restrained due to the increase in leverage and potential for further injury. Sedation, intubation and ventilation may be indicated to manage severe agitation.
- Check pupillary response

Test blood sugar levels

- Ensure that any alterations in level of consciousness are not related to a metabolic cause.

Exposure/environmental control

- Remove the patient's clothing and any jewellery in order to be able to fully assess all areas of the body.



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- An SCI patient can become hypothermic due to the loss of autonomic regulation, so it is important to monitor their temperature and keep them in a warm environment.

7. Secondary survey

The secondary survey is only to be performed once the primary survey has been completed and any life-threatening injuries have been managed. If during the examination any deterioration is detected, reassess the primary survey from the beginning.

eFAST point of care ultrasound and chest and pelvic x-rays may be performed as part of the early assessment of a major trauma patient, when required, available and the patient condition allows.

History

Taking an adequate history from the patient, bystanders or emergency personnel of the events surrounding the injury can assist with predicting other damage that may have occurred (17). Emphasis should be placed on understanding the mechanism, initial level of consciousness and any concurrent injuries noted. Note any history of drugs or alcohol prior to and at the time of injury.

Use the AMPLE acronym to assist with gathering pertinent information (17, 18):

- A** Allergies
- M** Medication
- P** Past medical history including tetanus status
- L** Last meal
- E** Events leading to injury

Head-to-toe examination

During this examination, any injuries detected should be accurately documented and any required treatment should occur, such as covering wounds, managing non-life-threatening bleeding and splinting fractures.

A thorough examination of motor, sensory and reflex capacity is crucial, and systems should be assessed independently and systematically. A head-to-toe assessment is an established approach in assessing neurological function. Where transfer to a MTS or the Victorian Spinal Cord Service at the Austin is imminent, a full ASIA assessment can be delayed while preparing the patient for transfer if the SPEED assessment has been completed.

- **Motor:** Muscle groups should be assessed. It is often difficult to test some segments due to traumatic injuries, therefore upper limbs are often most easily assessed. Strength rated 1/5 to 5/5 should be documented in addition to any deficits of left or right responses.
- **Sensory:** Sensation should be assessed systematically with initial tests using light touch. If no response, then increase to sharp stimulation. The trigeminal nerve,



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exiting above the spinal cord, is a useful reference point for assessing primary SCI where intact facial sensation is expected.

- **Reflexes:** Reflex responses should be obtained by usual assessment practice.

Head and face

- This examination should be conducted with the patient remaining supine.
- Inspect the face and scalp. Look for any lacerations and bruising as well as mastoid or periorbital bruising, which is indicative of a base of skull fracture. Gently palpate for any depressions or irregularities in the skull.
- Assess the ears for any signs of *cerebrospinal fluid* leak, bleeding, or blood behind the tympanic membrane.
- Check the nose for any deformities, bleeding, nasal septal haematoma, *cerebrospinal fluid* leak.
- Look in the mouth for any lacerations to the gums, lips, tongue, or palate. Note any swelling, which may indicate inhalation injury. Inspect the teeth, noting if any are loose, fractured or missing.
- Test eye movements, pupillary reflexes, vision, and hearing.
- Palpate the bony margins of the orbit, maxilla, nose, and jaw.
- Inspect the jaw for any pain or trismus.

Neck

NEXUS criteria

- All potential major trauma patients suspected of having a cervical spine injury will arrive in the Emergency Department with a soft collar applied by ambulance crew. Assessment and imaging will occur while the patient has the soft collar in-situ. Clinical examination using the NEXUS low risk criteria should be performed, however this can only occur four hours after the last administration of narcotics.
- The NEXUS low risk criteria constitute a decision tool for use in the initial assessment of conscious patients to indicate those at very low risk of cervical spine injury following blunt trauma who may not need radiographic imaging.
- Patients are considered to be at extremely low risk of cervical spine injury if ALL of the following criteria are fulfilled:
 1. No midline cervical spine tenderness
 2. No focal neurologic deficit
 3. No evidence of intoxication
 4. No painful distracting injury
 5. No altered mental status
- If all of the above criteria are satisfied, clinical examination may then proceed. If there is no evidence of any bruising, deformity or tenderness on examination, and if a full range of active movement can be performed without pain (including 45° rotation to left and right), the cervical spine can be cleared without radiographic imaging and the cervical collar be removed.



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- Should the patient exhibit any of the criteria, however, clinical examination is unreliable and radiographic assessment of the cervical spine is advised.
- For further details on the NEXUS criteria, refer to Appendix 2.

Neck Examination

- To ensure adequate access have another colleague maintain manual in-line stabilisation while the collar is removed for palpation and throughout the examination.
- Gently palpate the cervical vertebrae. Note any cervical spine pain, tenderness, or deformity. The point of maximum tenderness should be noted.
- Check the soft tissues for, bruising, pain, and tenderness.
- Complete the neck examination by observing the neck veins for distension and palpating the trachea and the carotid pulse. Note any tracheal deviation or crepitus.
- The patient will need to be log rolled to complete the full examination. This can be combined with the back examination.

Chest

- Inspect the chest, observing movements. Look for any bruising, lacerations, penetrating injury, or tenderness.
- Palpate for clavicle or rib tenderness. Look for bilateral chest expansion.
- Auscultate the lung fields; note any percussion, lack of breath sounds or adventitious sounds.
- Check the heart sounds: apex beat and the presence and quality of heart sounds.

Abdomen

- Inspect the abdomen. Look for any distension or swelling, bruising, lacerations or penetrating injuries.
- Palpate for areas of tenderness, especially over the liver, spleen, kidneys and bladder.
- Check the pelvis.

Limbs

- Inspect all the limbs and joints. Note any bruising or lacerations and muscle, nerve or tendon damage. Look for any deformities, penetrating injuries or open fractures.
- Palpate for bony and soft-tissue tenderness and check joint movements, stability and muscular power.
- Note any inequalities with limb response to stimulation and document these findings.
- Examine the sensory and motor function of any nerve roots or peripheral nerves that may have been injured.
- Assess distal perfusion for capillary refill, pulse and warmth.

Refer to Appendix 1: *American Spinal Association: International Standards for Neurological Classification of Spinal Cord Injury*



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Back

- Log roll the patient. Maintain in-line stabilisation throughout. Inspect the entire length of the back and buttocks noting any bruising, lacerations or injuries.
- Palpate the spine for any tenderness or steps between the vertebrae. Include a cervical examination at this stage. Many patients with SCI have vertebral injury at more than one level. Do not sit the patient up.
- Digital examination should be performed in suspected SCI. Note any loss of tone or sensation.

Buttocks and perineum

- Look for any soft-tissue injury such as bruising or lacerations.

Genitalia

- Inspect for soft-tissue injury such as bruising or lacerations.
- Note any priapism that may indicate spinal injury.

8. Planning and communication

For a trauma team to run effectively there must be an identifiable leader who will direct the resuscitation, assess the priorities and make critical decisions (19, 20). Clear communication between the trauma team members is vital, as is ensuring that local senior staff are aware and can provide additional support if required.

Once the initial assessment and resuscitation is underway, is it important to plan the next steps in immediate management. Priorities for care must be based on sound clinical judgement, patient presentation, and response to therapies. Awareness of limitations in resources as well as training in the emergency field is vital. If escalation of care to senior staff is warranted, then do so early in the patient care episode. Do not wait until the patient deteriorates to ask for assistance.

Frontline clinical staff should initiate contact with ARV early in the patient care pathway or, more importantly as soon as it is identified that the patient meets the inter-hospital trauma transfer criteria or may have sustained injuries beyond the clinical skill set of the emergency department or urgent care service. ARV can be contacted at any time throughout the patient care episode to offer clinical advice and specialist consultation as well as expedite the retrieval process.

ARV coordinators can facilitate a three-way conversation between the referring health service, specialist clinical resources and an ARV consultant to discuss the best, timely management of the patient.

The decision of when to transfer an unstable patient should ideally be made by the transferring and receiving clinicians in collaboration with the retrieval service. Clear communication is crucial: the transmission of vital information allows receiving clinicians to mobilise needed resources while the inadvertent omission of such information can delay definitive care. Information should be conveyed in both verbal and written (via the patient record) form and should include the patient's identifying information, relevant medical



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history, pre-hospital management and emergency department evaluation and treatment (including procedures performed and imaging obtained).

It is important that additional communication with the ARV coordinator is initiated when there is:

1. Significant deterioration in:
 - Conscious state.
 - Blood pressure.
 - Heart rate.
 - Respiratory status.
 - Oxygenation.
2. Major clinical developments such as significantly abnormal diagnostic tests or new clinical signs.
3. The need for major interventions prior to the retrieval team arriving (for example, intubation or surgery). This will ensure the retrieval team is prepared; the patient receives the appropriate care enroute and is referred to the correct facility.

9. Early management

Airway management

- If there is potential that the patient's airway may deteriorate due to injuries or respiratory insufficiency, intubation prior to retrieval should be discussed with the ARV consultants.
- Assess adequacy of oxygenation and ventilation. Frequent reassessment of the patient must take place as injury sequelae may cause further airway compromise.
- In an intubated patient, end-tidal carbon dioxide (ETCO₂) monitoring (if available) should be used to assess respiratory status and the adequacy of ventilation. Always have emergency airway equipment by the bedside.

Fluid resuscitation

- IV fluids, usually normal saline. Order intravenous (IV) fluids, usually normal saline initially (until other trauma is excluded) then transfer to maintenance fluids.
- Avoid fluid overload in the presence of neurogenic shock – use urinary output as the indicator and monitor fluid balance.
- It is important to maintain an accurate fluid balance chart from the early stages of treatment to assess the effectiveness of fluid resuscitation. This will also assist retrieval staff with further management during transfer.
- A general guide is to maintain a systolic blood pressure of above 90mmHg and targeting a MAP of 85-90mmHg (15, 16). However, in setting of multi trauma / TBI these targets need to be altered to account for other pathologies.



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Monitoring

- Monitoring of the heart rate, respiration rate, blood pressure, temperature and oxygen saturation should take place at 15/60 intervals or less if indicated. Monitor continuously via electronic monitoring if facilities are available. All monitoring should be maintained until the retrieval team arrives.
- A baseline ECG should be taken prior to transfer if time permits and facilities exist.
- Expect hypotension and bradycardia associated with spinal shock in those with lesions at or above T6 neurological level of injury. The pulse commonly falls to 55 bpm or less. Blood pressure often falls to 90 mmHg systolic. A heart rate less than 45 bpm and blood pressure less than 90 mmHg require treatment in consultation with ARV and the receiving spinal unit or trauma service.
- Ongoing assessment of the patient's neurological function is indicated to assess for symptom extension due to ascending spinal cord oedema.

Medical imaging

- Radiological examination is crucial in the diagnosis of SCI.
- Plain x-rays may provide initial information on spinal injury, however, are not used to clear the trauma patient of injury. The patient should be cared for as a possible cervical vertebral injury.
- A CT scan/MRI should be undertaken if the NEXUS criteria for cervical spine clearance has not been met, or the patient is unconscious. Should the patient exhibit any of the criteria as mentioned previously, then clinical examination is unreliable and radiographic assessment is advised.
- Where facilities do not have CT imaging available, then consultation with ARV and the MTS regarding retrieval and transfer should take place. X-ray imaging of the cervical spine is not suitable to clear the neck of the trauma patient. It may be appropriate to delay exhaustive imaging investigations if they are not going to alter management. Definitive imaging may be performed at the receiving specialist unit.

Wound care

- All wounds should be covered with a suitable and secure occlusive or dry dressing.
- All other injuries / wounds should be appropriately managed.

Pressure area care

- Special attention should be paid to pressure area care and surveillance in consideration of the extended time that spinal patients may remain supine.
- Importantly if equipment is available, an appropriately sized, rigid foam, soft collar should ideally be fitted as soon as possible or within 6 hours of injury.

Analgesia

- Opioids are the drug of choice in the acute SCI management phase. IV administration is the most effective route due to its rapid absorption, for both adults and children. Administer as per local protocols and titrate to effect.



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- Strongly consider anti-emetics at this stage, especially if transfer and retrieval is anticipated.

Minimise Heat Loss

- It is important to maintain normothermia.
- Patients with high SCI present with poikilothermia, where normal thermoregulation is compromised, and hypothermia becomes a concern.
- If available, the use of a forced air-warming machine is encouraged. Ensure wound care is attended to before commencing. Re-assess the room temperature at regular intervals while awaiting the retrieval team.

Glasgow Coma Scale

- A focused neurological assessment using the GCS should be performed (see table below). This should include a description of the patient's level of consciousness as well as assessments of pupillary size and reactivity, gross motor function, and sensation. Document the findings and reassess at frequent intervals.

Best response	Eye opening	Verbal response	Motor response
6			Obeys commands
5		Oriented, converses normally	Localises to painful stimuli
4	Opens eyes spontaneously	Confused, disoriented	Withdrawal to painful stimuli
3	Opens eyes in response to voice	Utters inappropriate words	Abnormal flexion to painful stimuli (decorticate response)
2	Opens eyes in response to painful stimuli	Incomprehensible sounds	Extension to painful stimuli (decerebrate response)
1	Does not open eyes	Makes no sounds	Makes no movements



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Pathology

- Pathology tests should be taken for FBC (full blood count), UEC (urea, electrolytes and creatinine) and glucose as well as a blood gases if available. Consider taking a group and cross-match if the patient is involved in a trauma presentation with a high index of suspicion for further injuries.

In-dwelling catheter

- A urinary catheter should be inserted, and urine output measured hourly. The desired urine output for adults is 0.5–1.0 mL/kg/hr (21).
- A urinalysis should also be performed to check for blood.

Naso/orogastric tube (N/OGT)

- All patients should be kept nil orally in the initial post-resuscitation phase of injury.
- NGT insertion should be considered for managing paralytic ileus in spinal-injured patients and must be placed for all SCI retrieval/transfers.
- The potential for a base of skull fracture in polytrauma should be considered as a relative contraindication in the decision to insert an NGT. An OGT may be inserted following consultation and under direct visualisation.

Antibiotics

- Routine antibiotic administration is not recommended in the initial phase of trauma injury management.

Reassess

- The importance of frequent reassessment cannot be overemphasised. Patients should be re-evaluated at regular intervals as deterioration in a patient's clinical condition can be swift. This will be evident in their vital signs and level of consciousness. If in doubt, repeat the primary survey.

10. Retrieval and transfer

ARV is the initial point of contact for transferring or retrieving all adult major trauma patients - **1300 36 86 61**.

In all cases, the decision regarding the timing of the transfer and the retrieval destination will be coordinated by ARV clinicians in consultation with the receiving facility.

Isolated spinal cord injury

- Patients with an isolated SCI and neurological deficit should be transferred to the Victorian Spinal Cord Injury Service at Austin Health at the earliest possible time and ideally in less than six hours.

Potential multi-trauma

- Patients in whom it is unlikely that other significant trauma can be confidently excluded will be referred to an MTS. A significant proportion of SCI patients have coexistent multisystem injuries, in particular upper thoracic and intracranial injuries.



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- The transfer and retrieval response will be managed according to patient need after clinical consultation.

It is important to note that an exhaustive clinical workup and interventions are not always necessary or appropriate prior to transfer. Stabilisation and ensuring life-threatening problems are addressed, as well as taking measures to prevent deterioration enroute, are essential aspects of early care. Delaying transfer to obtain laboratory results or imaging studies may simply delay access to definitive treatment.

In liaison with ARV clinicians, interventions to stabilise the patient prior to retrieval personnel arriving should be commenced. ARV will coordinate the retrieval and will evaluate the practicality and clinical needs involved in transferring the patient from the referring hospital. Once retrieval staff arrives on scene, be prepared to give a thorough handover. Retrieval staff will assess the patient prior to transfer and may update care to ensure the patient is safe during transfer.

Adult Retrieval Victoria recommends a standardised recognised handover tool such as **ISBAR** or **IMIST-AMBO** to facilitate clarity and completeness amongst health professionals and patient safety (7).



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Steps in Classification

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

- 1. Determine sensory levels for right and left sides.**
The sensory level is the most caudal, intact dermatome for both pin prick and light touch sensation.
- 2. Determine motor levels for right and left sides.**
Defined by the lowest key muscle function that has a grade of at least 3 (on supine testing), providing the key muscle functions represented by segments above that level are judged to be intact (graded as a 5).
Note: in regions where there is no myelome 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 neurological level of injury (NLI)**
This refers to the most caudal segment of the cord with intact sensation and an integrity (3 or more) muscle function strength, provided that there is normal (intact) sensory and motor function rostrally respectively.
The NLI 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 grading)
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 myelome on each side with some preservation)

NO

Is Injury Motor Complete? If YES, AIS=B

(No 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 (half or more) of the key muscles below the neurological level of injury graded 3 or better?

NO

YES

AIS=C

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.

ASIA Impairment Scale (AIS)

A = Complete. No sensory or motor function is preserved in the sacral segments S4-5.

B = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) 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 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 International Standards at this time allow 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 **neurological level of injury** is used.



INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY



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 specific position
 - 5 = (normal) active movement, full ROM against gravity and full resistance in a functional muscle 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, disease) 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 normal range of motion)

Sensory Grading

- 0 = Absent
- 1 = Altered, either decreased/impaired sensation or hypersensitivity
- 2 = Normal
- NT** = Not testable

Non Key Muscle Functions (optional)

May be used to assign a motor level to differentiate AIS B vs. C

Movement	Root level
Shoulder: Flexion, extension, abduction, adduction, internal and external rotation	C5
Elbow: Supination	C6
Elbow: Pronation	C6
Wrist: Flexion	C7
Finger: Flexion at proximal joint, extension, Thumb: Flexion, extension and abduction in plane of thumb	C7
Finger: Flexion at MCP joint, Thumb: Opposition, adduction and abduction perpendicular to palm	C8
Finger: Abduction of the index finger	T1
Hip: Adduction	L2
Hip: External rotation	L3
Hip: Extension, abduction, internal rotation	L4
Knee: Flexion	L4
Ankle: Inversion and eversion	L5
Toe: MP and IP extension	L5
Hallux and Toe: DIP and PIP flexion and abduction	L5
Hallux: Adduction	S1

Available from:

http://www.asia-spinalinjury.org/elearning/ISNCSCI_Exam_Sheet_r4.pdf



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12. Appendix 2: NEXUS criteria

1. Midline cervical spine tenderness

Present if the patient indicates the existence of neck pain on palpation of the posterior midline neck region from the nuchal ridge to the third thoracic prominence, or palpation of any cervical spinous process.

2. Focal neurologic deficit

Motor or sensory examination indicates the presence of a focal neurologic deficit e.g. segmental weakness, numbness or paraesthesia.

3. Intoxication

The patient is considered to be intoxicated if:

- The patient or an observer reports a recent history of intoxication or consumption of intoxicating substances.
- Evidence exists of intoxication on physical examination e.g. odour of alcoholic beverage, ataxia, slurred speech, dysmetria, other cerebellar signs or any behaviour suggestive of intoxication.
- Tests of bodily fluids are positive for drugs or alcohol which affect mental alertness.

4. Painful distracting injury

Any non-spinal related condition causing sufficient pain to distract the patient from a possible cervical spine injury. Suggestions include:

- Any long bone fracture.
- A visceral injury requiring surgical consultation.
- Extensive laceration, crush or degloving injury.
- Considerable burns.
- Any other injury producing functional impairment.
- Any other injury thought to impair the patient's ability to appreciate cervical spine pain.

5. Altered mental status

An altered state of mental alertness can be demonstrated by:

- GCS < 15.
- Disorientation to time, place, person or event.
- Inability to recall 3 objects at 5 minutes.
- Delayed or inappropriate response to stimulus.

Clinical spinal clearance



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If all of the NEXUS criteria are negative, there is no evidence of bruising or deformity, and if a full range of active neck movement (including 45° rotation to left and right) can be performed without pain, the cervical spine can be clinically cleared without radiographic imaging and the cervical collar can be removed. Documentation must be made on the electronic Spinal Assessment and Clearance Form.

Cervical spine imaging

Should the patient exhibit any signs of cervical spine tenderness, focal neurologic deficit, evidence of intoxication, painful distracting injury or altered mental status, however, **clinical examination is unreliable** and radiographic assessment of the cervical spine is advised. Assessment tools:

- Cervical Multi Segmental CT.
- MRI may be required if CT images are abnormal or if abnormal neurology is present.

Adapted from The Alfred Spinal Clearance Management Protocol (November 2009). Developed by Helen Ackland. Accessed August 25 2014, available from http://www.alfredhealth.org.au/Assets/Files/SpinalClearanceManagementProtocol_External.pdf



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13. Appendix 3: AGREE II Score Sheet – Spinal Trauma guideline

Domain	Item	AGREE II Rating						
		1 <i>Strongly Disagree</i>	2	3	4	5	6	7 <i>Strongly Agree</i>
Scope and purpose	1. The overall objective(s) of the guideline is (are) specifically described.							X
	2. The health question(s) covered by the guideline is (are) specifically described.							X
	3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.							X
Stakeholder involvement	4. The guideline development group includes individuals from all the relevant professional groups.						X	
	5. The views and preferences of the target population (patients, public, etc.) have been sought.							X
	6. The target users of the guideline are clearly defined.							X
Rigor of development	7. Systematic methods were used to search for evidence.						X	
	8. The criteria for selecting the evidence are clearly described.						X	
	9. The strengths and limitations of the body of evidence are clearly described.						X	
	10. The methods for formulating the recommendations are clearly described.						X	
	11. The health benefits, side effects and risks have been considered in formulating the recommendations.						X	
	12. There is an explicit link between the recommendations and the supporting evidence.							X
	13. The guideline has been externally reviewed by experts prior to its publication.							X
Clarity of presentation	14. A procedure for updating the guideline is provided.							X
	15. The recommendations are specific and unambiguous.						X	
	16. The different options for management of the condition or health issue are clearly presented.							X
	17. Key recommendations are easily identifiable.							X

Domain	Item	AGREE II Rating						
		1 <i>Strongly Disagree</i>	2	3	4	5	6	7 <i>Strongly Agree</i>
Applicability	18. The guideline describes facilitators and barriers to its application.							X
	19. The guideline provides advice and/or tools on how the recommendations can be put into practice.							X
	20. The potential resource implications of applying the recommendations have been considered.							X
	21. The guideline presents monitoring and/ or auditing criteria.							X
Editorial independence	22. The views of the funding body have not influenced the content of the guideline.							X
	23. Competing interests of guideline development group members have been recorded and addressed.							X
Overall Guideline Assessment	1. Rate the overall quality of this guideline.	1 <i>Lowest possible quality</i>	2	3	4	5	6	7 <i>Highest possible quality</i>
Overall Guideline Assessment	2. I would recommend this guideline for use.	Yes	Yes, with modifications			No		
		X						



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