

Management of cervical trauma: A Brief review

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Abstract

Cervical injury is not uncommon in any trauma, especially in road traffic accident. A standard approach, towards, transport, workup, and management is required for best outcomes, and decrease morbidity. We tried to review the recent literature and briefly discuss the management protocols concluded that in our setting, emergency ambulance personnel and Emergency Room doctors should be trained in dealing with all kinds of cervical spine trauma, they should be aware of recent guidelines and should refrain from using steroids routinely. By following guidelines, large numbers of cervical spine injury patients can benefit.

Keywords: cervical trauma, CT, MRI, ASIA, Steroids, Cervical trauma management.

Introduction

Epidemiology

In North America 50,000 new cases of spinal injuries occur annually, of which, half are located in the cervical spine.¹ Almost 14000 of these will result in spinal cord injury.¹ Average patient is a male in his thirties. Cervical Spine Injuries accompanied by Respiratory or Cardiac Arrest; pose one of the most serious challenges. While it is tempting to focus on the cervical spine, it is important to assess and clear the entire spinal column. In this study we have tried to evolve best practice guidelines, for quick reference, after reviewing the available literature, guide lines and expert opinions, keeping local conditions in view.

Methods

A retrospective systematic review was conducted by searching the pubmed data base for latest literature on management, of cervical trauma. Guidelines, from different, associations, and organizations, were also studied, terms, like, cervical, trauma, spinal cord injury, cervical fracture, and cervical trauma, radiology and workup were included, from a period of 2000-2014.

All papers outside pubmed data base and papers published before 2000 were excluded.

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All the papers available on pubmed database, and published up to 2014, retrieved by using above terms were included for the analysis.

The sources of potential bias are that not all the data bases were included and, not all the papers ever published were included and emphasis was given to commonly cited papers and guidelines only.

Management

Suspect Cervical Trauma

All patients who have sustained poly trauma, unconscious trauma patients and minor trauma with neck pain should be suspected of Cervical Spine trauma. Factors leading to delayed diagnosis include concurrent head injury, altered state of consciousness, poor radiographic visualization and multiple injuries.²

Initial Management at the scene comprises of Evaluation, Resuscitation, Immobilization, Extrication and Transport.^{2,3} The spine board should be removed as soon as possible once the patient is on a firm trolley in the hospital. Prolonged use of spine boards can rapidly lead to pressure injuries. Full immobilization should be maintained during this time.^{4,5}

Hospital Management also includes management of neurogenic shock, Spinal shock and Autonomic dysreflexia. Intubation of trauma victim is best achieved via rapid sequence induction of anaesthesia and orotracheal intubation. Collar should be removed and manual, in-line protection re-instituted. Routine use of a gum elastic bougie is recommended.^{1,6}

Clinical Evaluation

If the patient is fully alert and oriented, has no head injury and is not under the influence of drugs or alcohol, we can safely rule out cervical spine injury.^{6,7} Also if the patient has no neck pain, no abnormal neurology and no significant other 'distracting' injuries, cervical spine may be excluded.² Principles of evaluation include assessing and classifying the skeletal, neurological, spinal and non-spinal injuries and establishing treatment priorities during the assessment phase. Injuries should be classified with universally available form like ASIA spinal cord injury standard neurological classification⁸ (Chart-1).⁶⁻⁸

Patient Name _____
 Examiner Name _____ Date/Time of Exam _____

ASIA **STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY** **ISC #S**

MOTOR **KEY MUSCLES** (provide on reverse side)

	R	L
C5	☐	☐
C6	☐	☐
C7	☐	☐
C8	☐	☐
T1	☐	☐
UPPER LIMB TOTAL (MAXIMUM)	☐	☐
	(20)	(20)

Elbow flexors
 Wrist extensors
 Elbow extensors
 Finger flexors (and pronators of wrist) (right)
 Finger flexors (and pronators) (left)

LOWER LIMB

	R	L
L2	☐	☐
L3	☐	☐
L4	☐	☐
L5	☐	☐
S1	☐	☐
LOWER LIMB TOTAL (MAXIMUM)	☐	☐
	(20)	(20)

Hip flexors
 Knee extensors
 Ankle dorsiflexors
 Long toe extensors
 Ankle plantar flexors

Boundary and sensation (N/A)

NEUROLOGICAL LEVEL
 The most caudal segment with normal function

COMPLETE OR INCOMPLETE?
 Incomplete: Any sensory or motor function is spared

ASIA IMPAIRMENT SCALE

ZONE OF PARTIAL PRESERVATION
 Sacral sensory or motor function

KEY SENSORY POINTS

1 = absent
 2 = impaired
 3 = normal
 NT = not testable

Any anal sensation (N/A)

PN PRICK SCORE (max 112)

LIGHT TOUCH SCORE (max 112)

Key Sensory Points

Chart-1: ASIA score as developed by the American Spinal Injury Association.⁸

Evaluation of Patient

Initial observations include looking for abrasions, laceration and deformities like if there are abrasions on the forehead and neck pain Hangman's fracture could be suspected. Palpating the spine for localization of pain after log roll is essential.^{9,10} Physiological effects of cervical cord injury are loss of sympathetic tone, Bradycardia, Hypotension and decreased respiratory exercise. All these should be considered when treating these patients.

Neurological examination consists of: Cranial nerve, GCS, Motor & Sensory function, Reflexes, Rectal tone, Bulbocavernosus Reflex, Incontinence (Loss of control of bladder, bowel). Primary treatment should focus on the ABC's of resuscitation.

Cervical Instability

A detailed history and neurological exam to check for sensory and motor levels and autonomic dysfunction

reflexes is required.

Asia (American Spinal Injury Association) (international standards of neurological and functional assessment of spinal cord injury) is recommended for evaluation.^{11,12}

Instability

"The loss of the ability of the spine under physiological loads to maintain its pattern of displacement, so that there is no initial or additional neurological deficit, no major deformity and no incapacitating pain".¹

Imaging Studies include plain Cervical Spine X-Rays, CT scan and MRI of Cervical spine. Plain X-rays should include A/P and we should be able to see the Spinous processes of the second cervical through the first thoracic vertebra. Lateral X-rays should show from Base of the Occiput and must include C7-T1 junction. Odontoid Open Mouth View is for suspected C2 fracture and should show lateral masses of the first

cervical vertebra and entire odontoid process.^{7,13,14}

Oblique view is required in facet pathology and Tract down Shoulder or Swimmer's or Twinning view is for seeing C7-T1 injuries. Flexion-extension X-ray may be done in patients' with Neck pain with normal neurological exam and normal plain X-ray. It is important to do them under supervision with pain free movements of neck.

Indication of CT scan (X-rays if CT is not available)

CT scan is indicated in all alert patients who have neck pain or tenderness, patients with neurological deficits or Poly-trauma or Cranio-facial injuries or unconscious patients with trauma. X-ray is only indicated if CT scan is not available or there is delay in acquiring images.^{1,10}

Canadian C-Spine Rule-3 Main Questions

High-risk factor mandates radiography in patients with age ≥ 65 years, dangerous mechanism of injury and paresthesias in extremities. Missed cervical spine injury is as high as 33% in some studies. It can have devastating long-term consequences and must therefore be presumed until it is excluded. Usually attributed to failure to suspect an injury to the cervical spine, or to inadequate cervical spine radiology and incorrect interpretation of radiographs.^{10,11}

CT Scan

According to new guidelines from CNS/ AANS,¹ CT scan should be performed in all cases of suspected cervical spine & head injury. X-rays should be done when CT is unavailable as it depicts fracture or displacement where as CT with Sagittal Reconstruction provides better visualization of the extent and displacement of the fracture.^{10,11,15}

MRI of Cervical spine may be performed in cases where there is urgent MRI available to evaluate injury to soft tissues, ligaments, discs, intrinsic cord damage (oedema, haematoma or contusion) and Para vertebral soft tissues. It is also very helpful in assessment of brachial plexus injury and in obtunded or unconscious patients.^{2,9,11,16} Patients with a normal X-ray and fine slice CT scan have a 98% chance of no significant spinal injury, particularly unstable injuries or subluxation. MR scanning does not give a 100% clearance and the recommended advice is that if plain X-ray and CT or MRI are normal then the intensive care staff should be instructed that there is

only a very low chance of a potential instability in the spinal column, and that they should continue to use a lightweight orthosis and to log roll.¹⁶⁻¹⁸

Paediatric Cervical Spinal Cord Injury

As we know it is very difficult to immobilize a child adequately. Distress and discomfort may require that Manual In-Line Stabilization is used instead of a semi-rigid collar, blocks and tape. Collar sizing is difficult and there is shortage of collars that adequately fit infants aged 6 and below. So we may have to improvise re immobilization and make a custom made collar from a paediatric collar.⁴ Due to the paediatric patients' larger head size, Pseudosubluxation of C2 on C3, and anterior translations may appear as injuries rather than as consequences of mild flexion.^{1,14,15,19}

Classification of Cervical Spine Trauma

CSISS (Cervical Spine Injury Severity Score) — Anderson Spine Trauma Study Group in 2007, suggested a classification of cervical spine to assess, compare and follow.

The degree of discoligamentous injury is scored by the degree of skeletal displacement or osseous displacement on computed tomography. Cervical spine motion segment is divided into 4 columns: vertebral body, including ALL, annulus and PLL; right facet joint and capsule; left facet joint and capsule; and lamina including the Spinous processes, pedicles, interspinous and supraspinous ligaments (Figure-1).²⁰

Vaccaro and the Spine Trauma Study Group introduced SLIC in 2007. The objective behind this classification was to quantify stability and a weighted score given to 3 parameters of morphology, discoligamentous complex (DLC) and neurological examination (Figure-2).^{21,22}

SLIC is overall reliable with overall intraclass correlation coefficient of 0.71 and has internal consistency indicated by

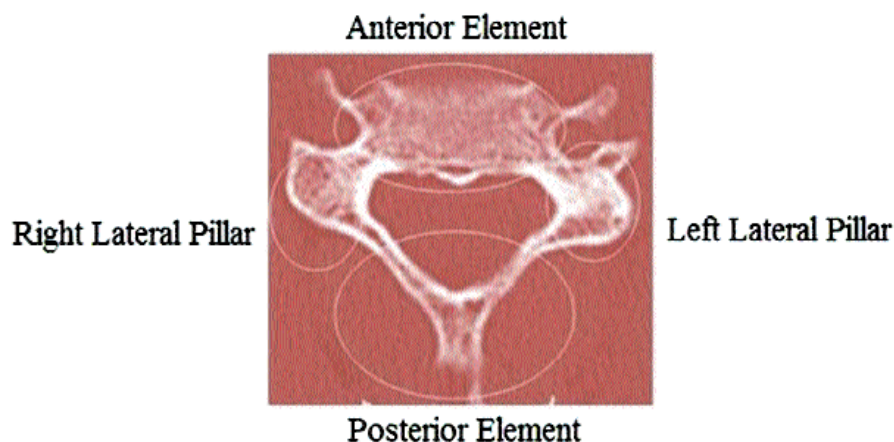


Figure-1: Classification of subaxial injuries according to CSISS (Cervical Spine Injury Severity Score).²⁰

Sub-Axial Injury Classification		Points
Morphology		
No Abnormality		0
Compression		1
Burst		+1 = 2
Distraction (facet perch, hyperextension)		3
Rotation/ translation (facet dislocation, unstable teardrop or advanced stage flexion compression injury)		4
Disco-Ligamentous Complex (DLC)		
Intact		0
Indeterminate (isolated interspinous widening, magnetic resonance imaging signal change (only))		1
Disrupted (widening of disc space, facet perch or dislocation)		2
Neurological Status		
Intact		0
Root Injury		1
Complete cord injury		2
Incomplete cord injury		3
Continuous cord compression in setting of neurological deficit (NeuroModifier)		+1 = 1

Figure-2: Level I SLIC (Subaxial Injury of Cervical Spine) and CSISS.²¹

worsening of score reflecting worse injury.^{22,23}

Cervical Spine Guidelines

Level 1 Evidence

The Spinal Cord Independence Measure is recommended as the preferred functional outcome assessment tool for clinicians involved in the assessment, care, and follow-up of patients with SCIs.

Self-care [sub score 0 - 2]), respiration and sphincter management (0 - 40) and mobility [0 - 40].^{24,25}

Cervical Spine Guidelines

Level 1 Evidence

Clinical assessment: pain.

The International Spinal Cord Injury Basic Pain Data Set is recommended as the preferred means to assess pain, including pain severity, physical functioning, and emotional functioning, among SCI patients.^{6,11,24,25}

Cervical Spine Guidelines

Level 1 Evidence

Radiographic assessment: Asymptomatic patient

In the awake, asymptomatic patient who is without neck pain or tenderness, who has a normal neurological examination, who is without an injury detracting from an accurate evaluation, and who is able to complete a functional range of motion examination, radiographic evaluation of the cervical spine is not recommended.^{2-4,7,11,26} Discontinuance of cervical immobilization for these patients is recommended without cervical spinal imaging.

In the awake, symptomatic patient, high-quality CT imaging of the cervical spine is recommended. If high-quality CT imaging is available, routine 3-view cervical spine radiographs are not recommended. If high-quality CT imaging is not available, a 3-view cervical spine series (antero-posterior, lateral, and odontoid views) is recommended.^{2-4,7,9-11,17,26} This should be supplemented with CT (when it becomes available) if necessary to further

define areas that are suspicious or not well visualized on the plain cervical x-rays.

Radiographic evaluation in obtunded (or Un-evaluable) patients

In the obtunded or un-evaluable patient, high-quality CT imaging is recommended as the initial imaging modality of choice. If CT imaging is available, routine 3-view cervical spine radiographs are not recommended.

If high-quality CT imaging is not available, a 3-view cervical spine series (antero-posterior, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available) if necessary to further define areas that are suspicious or not well visualized on the plain cervical X-rays.^{2-4,7,9-11,17,26}

Methylprednisolone

Treatment options for acute, traumatic non-penetrating spinal cord injuries include the administration of a high dose of an anti-inflammatory agent, methylprednisolone, within 8 hours of injury. However, in a third study, methylprednisolone failed to demonstrate an effect in comparison to placebo. Additionally, due to increased risk of infections, its use is no longer recommended.²⁷⁻³¹

As Edward Benzel and his colleagues said in 2000, "The reporting of the results of National Acute Spinal Cord Injury Studies II and III has been incomplete, leaving clinicians in the spinal cord injury community to use or

avoid using methylprednisolone in acute SCI on the basis of FAITH rather than a publicly developed scientific consensus".²⁷⁻³⁵

Administration of methylprednisolone for the treatment of acute SCI is not recommended as the FDA does not approve it and there is no Class I or Class II medical evidence supporting it. Contrary to it there is Class I, II, and III evidence exists that high-dose steroids are associated with harmful side effects, including death.²⁷⁻³⁴

CT angiography for suspected vertebral artery injury

CT angiography is recommended as a screening tool in selected patients after blunt cervical trauma that meet the modified Denver Screening Criteria for suspected VAI (Figure-3).^{7,17,26,36-38}

Injuries which can be treated on traction: (Figure-4)

- ♦ Displaced Jefferson fracture
- ♦ Hangman's fracture
- ♦ Type II/ Type III odontoid peg fracture
- ♦ Displaced sub axial fracture and
- ♦ Sub axial subluxation and dislocations.

In the Hangman's type, II A fracture traction may displace

The Denver criteria showing risk factors for blunt vertebral and carotid injuries and the Denver Radiological Criteria for Cerebrovascular Injury.
Denver screening criteria for blunt cerebrovascular injury (Cothren et al.)
Any Cervical spine fracture
Unexplained neurological deficit incongruous with imaging
Basilar cranial fracture into carotid canal
Leforte II or III fracture
Cervical Haematoma
Horner Syndrome
Cervical Bruit
Ischaemic stroke
Head Injury with Glasgow Coma Scale score < 6
Hanging with anoxic injury
Denver radiological scale of blunt cerebrovascular injury (Cothren et al.) ^[32]
Grade I – Irregularity of vessel wall or dissection/ intramural hematoma with <25% stenosis
Grade II – Intramural thrombus or raised intimal flap or dissection/ intramural haematoma with >25% stenosis
Grade III – Pseudoaneurysm
Grade IV – Vessel occlusion
Grade V – Vessel Transaction

Figure-3: Denver Modification of Screening Criteria for BCVI adapted from Cothren et al.³⁶⁻³⁸



Figure-4: Application of gardner tongs.

the fracture and adds dramatically to the risk of spinal cord injury and subsequent death (Figure-4).

Indication for Emergent Surgery

Closed reduction of the fracture/dislocation injuries of the cervical spine by traction-reduction is safe and effective for the reduction of acute traumatic spinal deformity in awake patients. Approximately 80% of patients will have their cervical fracture dislocation injuries reduced with this technique. The overall permanent neurological complication rate of closed reduction is approximately 1%. Closed traction-reduction appears to be safer than manipulation under anaesthesia (MUA). Emergency surgery may be indicated in patients with cervical spine injury with progressive neurological deterioration with irreducible canal compromise.

A Randomized controlled trial published in 1997 showed no benefit of early (<72 h) decompression. The study can be criticized as it included early surgery patients operated within 72 hours, which is a long time with neural compromise.³⁹

A recent prospective series suggest that early decompression (<12 h) can be performed safely and may improve neurological outcome. There is evidence that a surgical decompression and stabilization within 6 hours of a partial spinal cord injury will lead to 70% of patients improving by one or more ASIA IMSOP grades. If, such surgery is delayed beyond 6 hours than there is only a 12% chance of such improvement.^{39,40}

Stascis

A multicenter, international, prospective cohort study in adults aged 16-80 with cervical SCI concluded that decompression prior to 24 hours after SCI can be performed safely and is associated with improved neurologic outcome, defined as at least a 2 grade Asia impairment scale improvement at six months follow-up.^{39,40}

In a recent prospective study conducted at our institution, we also showed that patients who were operated within 24

hours had 23% improvement by 2 Asia impairment scale versus 8% in patients who had surgery after 24 hours.⁴⁰

Conclusion

Emergency ambulance personnel and ER doctor should be trained in dealing with all kinds of cervical spine trauma. In our local setting it is observed that pre hospital immobilization is almost nonexistent, even in most hospitals there is no judicious use of steroids and they are in rampant use, cervical and spinal immobilization is not used routinely, and not removed timely when not required. Traction is not used in routine as a means of reduction and stabilization of spine. Emergency physicians should be aware of recent guidelines and should refrain from using steroids routinely. By following guidelines, large numbers of cervical spine injury patients can benefit.^{2,9,11}

The initial management always starts with ABC and immobilization of cervical spine. It should be followed by adequate exposure and secondary survey to check for disability.^{1,5,18} The use of steroids is controversial and should be used as per institutional policy however evidence is of little benefit and more side effects.^{27,30,33} Hypotension should be avoided. If intubation is required proceed with in line or fiber optic intubation.

Spinal surgeons, including neurosurgeons, must work hard and deliberate for finding the best possible management for patients. We should look at best evidence to support the treatment plan and recommendations. This article is written specifically to continue improving our emergency spine care, and provide quick reference and insight to the junior doctors. It was not possible to discuss the various controversies and unsettled issues like timing of surgeries, stem cell, ICU stay etc in detail in order to keep it concise, however we feel that the above information will help the caring physicians to make better decisions on issues like steroid use, imaging, timing of surgery etc.

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Declaration of Consent: The manuscript has been read and approved by all authors.

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