ACUTE CERVICAL SPINE INJURIES: DIAGNOSIS AND MANAGEMENT

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ABSTRACT

Acute cervical spine injuries (CSI) are devastating types of injuries occurring largely in the economically productive population. CSI have been of major public health problems because of consumption of large amount of both personal and public resources in addition to giving rise to long-term disability for the patient. Over the years an effort has been made to develop ways to evaluate the cervical spine in the setting of trauma using reasonably fast and accurate methods. Similarly, refinement in the management of these patients has significantly improved the outcome. In this article an attempt has been made to review the pertinent literature and extract the information tailored to us regarding the diagnosis and management of cervical spine injuries, which can be used effectively in areas where even only x-ray facility is available.

Key Words: Trauma, spinal cord, cervical spine, stabilization.

INTRODUCTION

With the birth of human beings trauma has been the integral part of existence. Unfortunately parallel to the materialistic development, risk of injury has also gone high and every time a safe way is developed, a 'risk' is born. Spinal cord injuries occur approximately 14000 times per year in North America and most involve the cervical spine region. ¹ Though we do not have baseline data for Nepal, personal experience tells that the incidence is very high. Cervical trauma is caused in order of frequency by motor vehicle accidents (MVAs) followed by fall from heights, acts of violence, and to some extent from sports related injuries. ² About 20% of the multiple trauma victims have spine injury. Though trauma to spinal column anywhere is associated with the risk of neurological deficit, cervical trauma has especial importance for various reasons. First, cervical spinal injury has devastating consequences because of the tendency to involve all four limbs often with lasting deficit. Second, management involves a careful balance of early 'clearance' of cervical spine so that patient can be mobilized early versus operative/ conservative treatment of injuries so as to optimize the recovery and prevent neurological deterioration which may involve a longer period of bed rest. Development of a rapid system of evaluation and management of cervical spine is of utmost importance for obvious reasons. However, the diagnosis and management of these injuries have not been standardized and vary greatly from region to region and even between two institutions in the same place. ³ Careful review of literature by the author failed to find any literature regarding the diagnosis and management of cervical spine injuries from Nepal. Though a detailed description of the diagnosis and management of individual spinal injuries is beyond the scope of this article, an effort has been made to describe the rational way of handling the cervical spine in a trauma patient based on the available scientific evidence applicable to Nepalese context.

EPIDEMIOLOGY

The yearly incidence of spinal cord trauma in the United States is 28-50 patients per million with approximately 10000 new cases per year, with an estimated prevalence of 300,000 to 500,000 living victims.⁴ In the spinal cord injured population incidence of paraplegia and quadriplegia is roughly equal.² Only about 25% people are neurologically intact after cervical trauma with 25 percent of CSI resulting into quadriplegia.²

Address for correspondence : Dr. Mohan Raj Sharma Division of Neurological Surgery TU Teaching Hospital, Maharajgunj, Kathmandu, Nepal Email: mohan@healthnet.org.np Spinal injuries are seen mostly in young adult male with a male to female ratio of 4:1.⁵ Multisystem trauma commonly accompanies spinal cord injuries, the most common being long bone fractures. ² Associated head injury is common in a large proportion of patients with CSI. Approximately 20 % of all fatal victims of traffic accidents have associated severe cervical spine injuries.² When a cervical spine injury is associated with a fracture of the vertebral body or posterior elements, a 61% incidence of neurological deficit is observed.² Noncontiguous multiple spinal fractures occur in approximately 5% of cases.⁶

Lifetime direct medical cost is huge for the spinal cord injured person. It varies according to age at injury as well as severity of the injury. High quadriplegics consume 80% of the expenditures. The total annual cost to the society is estimated to be about \$ 5 Billion in the United States.⁷ Though we do not have similar data for Nepal, the cost for the management of such injuries would be about half a billion dollars a year extrapolating the same data from the United States. The devastating effects on the patient and family and "back log" of economically less productive population with a large cost of treatment has created an urgency for a cure and millions of dollars is spent each year for the research for a 'cure' which has unfortunately not been the case to date.

Predisposing factors for cervical spine injuries are driving under the influence of alcohol (alcohol not only increases the chance of accident, but also increases the severity of spinal cord injury by the potential chemical toxicity of ethanol on traumatized spinal cord²), seizure disorder and underlying diseases of spine (metastasis, spinal stenosis, ankylosing spondylitis to name a few). As the most common cause is motor vehicle accidents (MVAs), effort should be directed towards minimizing the injury in the MVA victims.

ANATOMY OF CERVICAL SPINE

Fundamental to the proper diagnosis and management of cervical spine injuries is the good understanding of normal anatomy of cervical spine. Detail description of this area has been described elsewhere.⁸ Cervical spine is divided into two areas distinct in terms of anatomy and function- upper cervical spine and subaxial spine.

Upper cervical spine consists of foramen magnum, paired occipital condyles, atlas and axis and a number of ligaments and membranes critical for function and serves as a transition zone between the rigid calvarium above and mobile subaxial spine below. This part is often called cervicocranium and encloses lower medulla and upper spinal cord, lower cranial nerves and paired vertebral arteries. It is also a complex area both morphologically and physiologically. Injuries of relevance in this area include occipital condyles fracture, atlanto-occipital dislocation (AOD), fracture of arch of atlas, fractures of axis (Hangman's fracture, fracture of odontoid and fracture of the vertebral body) and atlanto-axial subluxations.

Subaxial cervical spine consists of third through seventh cervical vertebrae. Though they are grossly uniform in configuration, there is gradual increase in the size. With the help of intervertebral discs and ligaments, the subaxial spine helps in the protection of spinal cord and mobility of spine. Clinically important injuries in this area include fracture of vertebral bodies and fracture-subluxations/ dislocations due to various mechanisms such as axial loading, rotational injuries etc.

IMAGING OF CERVICAL SPINE

The most important factor in the optimal management of CSI is an accurate assessment of the lesions radiographically. It is to be noted that not every patient with polytrauma needs imaging. Radiographic assessment of cervical spine is not recommended in trauma patients who are alert and neurologically normal; not intoxicated; do not have other distracting injuries, and have no neck pain and who do not have midline neck tenderness on physical examination.^{9,10} All other trauma patients require radiographic assessment to rule out spinal injuries.¹¹ Among different modalities available for the present day physician managing cervical trauma, tests described below singly or in combination can be used to accurately identify the abnormalities.

PLAIN X-RAYS

A lateral plain x-ray of the cervical spine encompassing the area between the C1 and T1 is probably the most important initial investigation to evaluate a suspected cervical spine injury and has a 75% to 85% accuracy in detecting an injury.² This figure can be increased to almost 100% when an open mouth odontoid, antero-posterior and flexion- extension (probably later in the management) views are added.² Suboptimal visualization is equal to not getting at all; as missing a spinal injury may result into permanent neurological sequels.¹² Every effort should be made to visualize C7, T1 area with downward pull on the arms or by obtaining a "Swimmer's View" especially in the obese patients. Figure 1 shows an anteroposterior (A), lateral (B) and open mouth odontoid (C) view of the normal cervical spine as seen in the plain x-rays. A detailed note should be made of normal anatomic relationship of different elements of cervical spine. Any prevertebral soft tissue swelling should be noted. Normal width of the soft tissue at the inferior aspect of C3 is less than 5mm.² Any fracture or subluxation (Figure 2) should be noted. In situation when 'neutral' plain x-rays are normal dynamic (flexion/extension)

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Fig. 1 : Plain Roentgenogram of the cervical spine Anteroposterior (A), Lateral (B) and Open mouth odontoid view showing normal anatomy of the region. White arrow shows the adontoid process of second vertebra. C 1 - First Cervical vertebra, C2 - Second cervical vertebra.



Fig. 2 : Plain Roentgenogram lateral view showing subluxation of C5 over C6 causing angular deformity of more than 11°

views (with at least 30 degree excursion in each direction) should be obtained which will detect " occult" injuries not identified on 'neutral' plain x-rays. It is worth-mentioning at this point that there are a small group of patients especially children who demonstrate spinal cord injury without radiographic abnormality (SCIWORA). This was defined originally by Pang and Wilberger in 1982 as objective signs of myelopathy as a result of trauma with no evidence of fracture or ligamentous instability on plain spine x-rays and tomography.¹³ The concept of SCIWORA was developed when MRI was not available for imaging. With the advent of high-resolution magnetic resonance techniques, more and more patients have been detected to have structural injuries who would have, otherwise, thought to have SCIWORA in the past.

COMPUTERIZED TOMOGRAPHY (CT) SCAN

CT scan of the neck (axial cuts with sagittal reconstruction views) provides exquisite details of the bony anatomy of the cervical spine. Areas of suspected injury identified on plain films should be studied with thin section CT.¹⁴ In addition it will show the abnormality missed or suspicious on the plain x-ray. Sometimes some fractures can be missed if only axial cuts are obtained; hence it is extremely important to get the sagittal reformats.



Figure 3 shows the CT scan of the cervical spine with sagittal reconstruction view showing the burst fracture of fifth cervical vertebra.



MAGNETIC RESONANCE IMAGING (MRI) SCAN

MRI has been rapidly established as an important imaging modality especially when the plain x-rays and CT scans are normal in potential cervical spine injuries.¹⁵ A major advantage of MRI is its ability to provide superior soft tissue contrast resolution. It shows details of acute disc herniations, ligamentous rupture and intrinsic cord contusions or hematoma, which will differentiate operative from nonoperative lesions. Figure 4 shows the MRI of cervical spine with evidence of cord contusion.

TREATMENT STRATEGY

It is assumed in the subsequent discussion that the patient has been stabilized or stable from other life threatening injuries (heart, lung or great vessels injuries), if any. Basic trauma algorithm emphasizing establishment of airway, breathing and circulation should be implemented.¹⁶

Aim of the treatment of patients with cervical spine injury is to minimize the potential for further injuries and to provide an environment that will maximize the recovery of spinal cord and neural elements. In addition, it also involves prevention, early detection and treatment of potential complications. General management includes prevention of hypovolemia and hypotension; prevention and early treatment of chest infection¹⁷, good nutritional support as these patients have accelerated nitrogen losses and increased energy requirements¹⁸; prevention of bed sores; prevention of deep vein thrombosis (DVT) and thromboembolism together with the implementation of good bowel and bladder program.^{19,20} Of special importance is the avoidance of systemic hypotension (by keeping the mean arterial pressure (MAP) of 85-90%)²¹ in the first 7 days, as these patients tend to be hypotensive due to hypovolemia and systemic vasodilatation. Patients who are treated aggressively in terms of blood pressure and oxygenation

have been found to have improved outcome.²² For specific management, the patient with a potential spine injury typically goes through the following steps-

- Prehospital care and transport
- Emergency triage and early treatment
- Definitive treatment
- Continued treatment and rehabilitation

PREHOSPITAL CARE AND TRANSPORT

Unfortunately in Nepal there is no trauma squad comprising of medical personnel that reaches the accident scene. Most of the time it is the family members, friends, bystanders or security personnel who transport the patient from the scene to the hospital. Optimal care of spinal injury patients demands initial resuscitation, immobilization and early transport to a medical facility with the capability for diagnosis and treatment. Much relies on the common sense and education about the danger of cervical spine injury and ways to prevent additional neurological deterioration. Even minor movements may irreparably damage the spinal cord. There is no other injury in which meticulous, correct handling and emergency care are more important. Immobilizing the neck with some kind of hard cervical color or sand bags with the patient secured on a rigid backboard is the optimum way of transport of persons with spinal injuries. Sometimes even a Towel or "PATUKA" (linen used to wrap around the waist in Nepal) around the neck may at least make everybody aware that cervical spine has not been cleared yet if not preventing the mobility completely. Incorporating a chapter on spinal injury in the high school curriculum will go a long way in minimizing the spinal injury. A hard 'spine bed' is used to transfer the patient from one bed to other utilizing at least 5 persons.

EMERGENCY TRIAGE AND EARLY TREATMENT

In our set up emergency clinicians are usually the first to see the polytrauma patients. Every patient with polytrauma should be assumed to have a cervical spine injury unless the cervical spine is cleared radiographically or clinically. In one of the largest series of fracture dislocation of the cervical spine involving 300 patients, gross disability of one third of the patient resulted from either error or lack of suspicion on the part of the examining physician.²³ A hard cervical color should be immediately put around the neck pending radiological assessment. Guidelines have been developed as to how to manage the cervical spine in the polytrauma patients.^{1,3} A typical cervical spine clearance protocol adopted by the University of Washington, Seattle, USA is shown in Table I. Patient should be rapidly evaluated to detect any life threatening injuries and treated appropriately. No neck movement is allowed however. If the patient needs intubation, nasal