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Original Article

Evaluation of Non-contiguous Spine Fractures and Extraspinal Injuries in Spine Fracture Patients: A Prospective Study

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Abstract

Introduction: A prospective study undertaken at a tertiary level (level 1 trauma cent**er**) hospital in India.

Purpose: This study was undertaken with a view to evaluate patients of spine fractures (cervical, dorsal, **and** lumbar spine) and describe commonly occurring associated additional non-contiguous spine fractures and associated extraspinal injuries in these patients. Spine fractures commonly occur following significant trauma, and these patients present with other non-contiguous additional spine fractures at a different level and also with extraspinal injuries. This association is not well documented.

Materials and Methods: This ongoing prospective study involves all patients (*n* = 50) received at the casualty with traumatic spine fracture. These are evaluated with whole spine computed tomography (CT) scans with proper consent. The fractures were classified with AO classification, and neurological assessment was done. Extraspinal injuries and fractures (head, thoracic, abdominal/pelvic, and non-spinal orthopedic disorders) with the mechanism of injury were documented.

Results: A total of 50 patients were enrolled and their CT scan studied. The primary spine fractures were cervical = 26, lumbar = 12, and dorsal = 12. AO classification revealed type A = 19, type B = 16, and type C = 15. The number of patients with associated additional spine injuries was 12 with cervical-dorsal, dorsal-dorsal, and dorsal-lumbar having a common association. The number of patients with extraspinal (head, chest, abdominal, and other orthopedic) injuries was 20 (cervical 16/20 and lumbar 4/20). All cervical spine injuries (100%) presented with neurological involvement; however, 75% of lumbar and dorsal spine injuries were associated with neurological involvement. Twenty-seven patients had fall from height and 23 patients met with road traffic accident, 90% patients of fall from height had associated other spine and extraspinal involvement, while only 30% of road traffic accident patients presented with other injuries.

Conclusion: The study helps us to understand the associated spine and extraspinal injuries in traumatic spine fracture. This prompts for **a** thorough evaluation of spinal fracture patients for non-contiguous spine fractures and other extraspinal injuries. The results highlight the mechanism of injury as a predictor for associated injuries and that cervical spine fracture patients were commonly associated with extraspinal and additional non-contiguous spine injuries.

Key words: Extraspinal injuries, Mechanism of injury, Non-contiguous spine fracture, Spine fractures

INTRODUCTION

Spine injuries are a result of high-velocity trauma, in which high forces cause spine fractures with or without neurological involvement, these forces may also lead to multiple trauma.[1,2] The overall mortality in such cases is around 17%. Most common mechanism of injury in these cases is road traffic accidents and fall from height though uncommon causes such as sports injuries and gunshot injuries also have been reported.[3-5]

Non-contiguous spine fractures and extraspinal injuries are commonly associated with spine injuries.[1,2] In the emergency department, diagnosis of associated injuries becomes difficult and challenging due to reduced level of consciousness and sensory impairment due to of neurological deficit. These injuries get overlooked.

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Cervical injuries are accompanied by non-contiguous thoracolumbar spine fractures or other extraspinal injuries, namely, extremities, intrathoracic, intra-abdominal, pelvic, oral maxillofacial, and intracranial.[6] The incidence of non-contiguous spinal fractures varies from 1.6% to 16.7%, ranging from 3% to 8%,[7-14] and that of extraspinal injuries in almost 30%-52%.[15,16]

Thorough evaluation of patients in the emergency department with a spine fracture is mandatory for early detection and treatment, and also evaluation for associated non-contiguous spine and extraspinal injuries in terms of examination for crepitus, wound, hematomas, deformity, neurological charting, and appropriate diagnostic imaging such as trauma series radiographs, computed tomography (CT) scan, and magnetic resonance imaging (MRI).

We undertook this study to understand the association of non-contiguous multiple level spine fractures and extraspinal injuries (extremity fractures, head, thoracic, abdominal, and pelvic) in spine fracture patients at a level 1 trauma center, with an aim to sensitize the trauma team to not miss any associated fractures in a spine fracture patient (depending on the location, type, and mechanism of injury). Missing such an injury may result in major neurological complications or subsequent pain, instability, and/or deformity.

MATERIALS AND METHODS

This prospective study was undertaken at a level 1 trauma center from June 2015 to May 2016 (1 year). Ethical approval was taken at the commencement of the study. The study enrolled all the patients in the emergency department with a primary spine fracture. Diagnoses were made with plain radiograph using the lateral and anteroposterior views.

All patients underwent plain radiograph (trauma series), CT scan of whole spine, neurological charting, and classification as per the AO classification.

Patient data included age, sex, mechanism of injury, primary spine fracture, non-contiguous spine fracture, and extraspinal injury (head and intracranial injury, intrathoracic, intra-abdominal, pelvic, and orthopedic extremity injury). Number of patients enrolled were 50.

For the purpose of this study, primary spine fracture was the fracture with which patient presented and the neurological deficit could be attributed to it. The secondary or the non-contiguous spine injury was one which was evident on CT scan or MRI, the one to which neurological deficit could not be attributed completely and separated by at least three normal intervening vertebra from the primary spine fracture or subluxation/dislocation.

The mechanism of injury was grouped into road traffic accident, fall from height, and others. All spine fractures were classified as per the AO classification, and neurological charting was done in all patients. Extraspinal injuries were head and intracranial, intrathoracic, intra-abdominal, pelvic, and extremity orthopedic fractures. This study forms part of the larger ongoing study to understand the association.

RESULTS

A total of 50 patients were enrolled and their CT scan studied. The primary spine fractures were cervical = 26, lumbar = 12, and dorsal = 12. AO classification revealed type A = 19, type B = 16, and type C = 15 (Figure 1). The number of patients with associated additional -non-contiguous spine injuries was 12 with cervical-dorsal and dorsal-dorsal, having a common association. Only one case of lumbar with sacral association was found (Figure 2). The number of patients with extraspinal (head, thoracic, abdominal, and other orthopedic extremity) injuries was 20 (cervical 16/20 and lumbar 4/20) (Figure 3). All cervical spine injuries (100%) presented with neurological involvement; however, 75% of lumbar and dorsal spine injuries were associated with neurological involvement. Twenty-seven patients had fall from height and 23 patients met with road traffic accident, 90% patients of fall from height had associated other spine and extraspinal involvement, while only 30% of road traffic accident patients presented with other injuries (Figure 4). Statistical test applied was Chi-square test, and no significance ($P > 0.05$) was found between non-contiguous spine injury or extraspinal injury vis-a-vis primary spine fracture or mechanism of injury.

DISCUSSION

Saboe *et al.*[2] in their series of 508 spine trauma patients classified associated injuries by anatomic site and its content. Associated injuries were 248 (head [26%], chest [24%], and long bone [23%]). Motor vehicle accidents and occupational injuries (falls account for a substantial portion) were the most common etiology of injury. Persons with thoracic and lumbar fractures had more associated injuries compared with those having cervical fractures. Age, gender, and type of neurological deficit were not significantly related to the occurrence of associated injuries. Motor vehicle accidents lead to high-velocity trauma and impacts thus posing greater risks for associated injuries.[3]

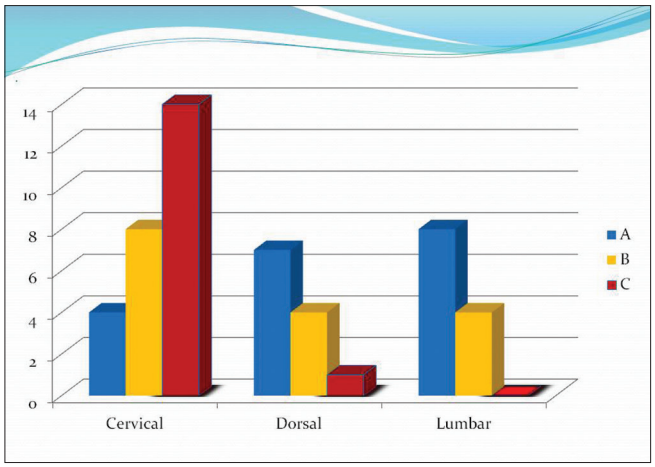

Figure 1: Primary spine fracture data

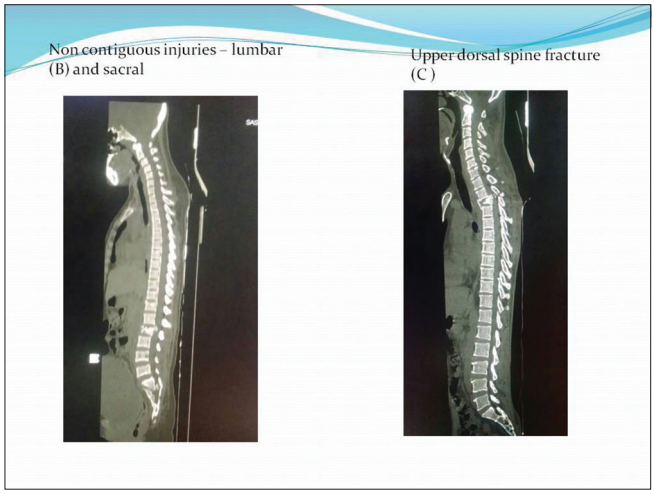

Figure 2: Computed tomography scan images in our patient

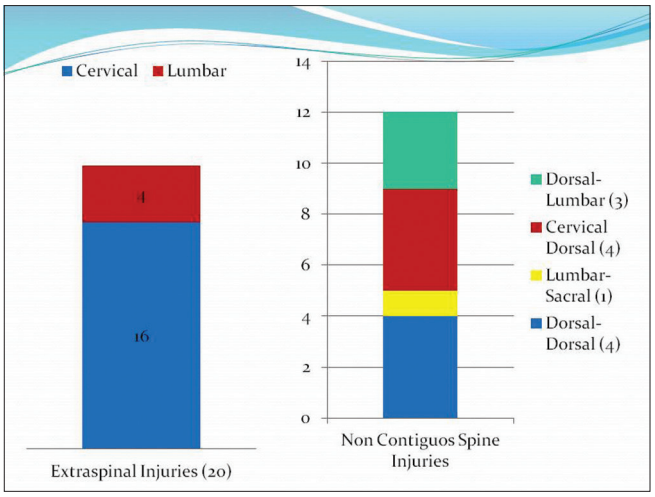

Figure 3: The number of patients with associated non-contiguous spine injuries and extraspinal injuries

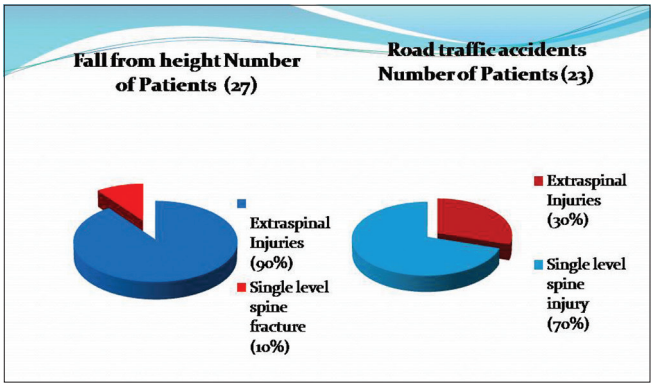

Figure 4: Mechanism of injury in our patients

When the vehicle decelerates, the inertia of the body continues to move the body forward; the chest impacts the steering wheel, the head impacts the windshield, and the legs hit the dashboard, which leads to multiple injuries. Falls from a height, the second leading cause of associated fractures, often involve a feet first landing. This axial loading contributes to lumbar spine, long bone, and pelvic injuries.

Wang *et al.*[16] in their study showed that among the younger patients, the most common region suffering multiple level non-contiguous spine fracture (MLNSF) was the thoracic + lumbar region (35.9%), followed by the cervical + thoracic region (23.9%), whereas among the elderly patients, the thoracic + lumbar region (52.9%) followed by the thoracic + thoracic region (35.7%) were the most commonly injured. Fall from high heights were the most common accident mechanism in their study.

Korres *et al.*[11] noted that the cervical + cervical region was the main region suffering MLNSF (28.4%), followed by the thoracic + lumbar region (24.7%); these regions are the most commonly affected, most likely because motor vehicle accidents were the main mechanism of these fractures (58.0%).

Hadden and Gillespie[13] reported an incidence of 24% and Henderson *et al.*[12] have reported that 15.2% of multilevel spinal fractures of the entire column contained non-contiguous injuries. Qaiyum *et al.*[17] have reported a high incidence of non-contiguous spinal injuries (18 in a group of 110 spinal injury patients). Gupta and el Masri[9] have found that multilevel injuries most commonly involved the lower cervical and cervicothoracic levels.

Chu *et al.*[15] stated that the prevalence of associated injuries was as follows: Head trauma, 17.2%; chest injury, 2.9%; abdominal trauma, 1.5%; pelvic injury or fracture, 2.5%; upper limb fracture, 4.4%; and lower limb fracture, 5.9%.

Martin *et al.*[18] showed that risk factors for the presence of cord injury in the pediatric trauma population are

RTC, presence of head, chest, or multiple injuries, and depressed level of consciousness. The prevalence of multilevel fractures (7.4% of all fractures) is sufficiently high to warrant whole spine radiography in the presence of a fracture. Clinicians from all specialties involved in the care of the injured child should be aware of these findings to reinforce the need for careful assessment in the management of those at highest risk of spinal injury.

Choi *et al.*[19] reported that 28% patients of cervical spinal injuries were accompanied with non-contiguous cervicothoracic junction or upper thoracic spinal injuries. The most common mechanism of injury in these patients was axial compression injury. Shear *et al.*,[20] Ryan and Henderson,[21] and Qaiyum *et al.*[17] also reported a higher incidence of non-contiguous thoracic spine injuries in patients with cervical spine injuries.

In our study, patients with cervical spine injuries were associated with a maximum number of non-contiguous spine injury (dorsal, 4) and extraspinal injury (16 out of 20), the most common injury was fall from height, and these were associated with non-contiguous spine and extraspinal injury, which was similar to findings of Miller *et al.*[22]

Limitations of our study were that the study had 50 enrolled patients of spine injury, which may be small number. However, this forms part of the continuous ongoing study in our center, enrolling more patients.

In the emergency trauma unit, management of patients of spine injury mandates thorough quick assessment for A, B, and C and search for all possible spine and extraspinal injuries. After initial resuscitation, all potentially injured extremities need to be splinted to immobilize the limb and prevent further complications. All potentially fractured area should be screened by imaging including the adjacent proximal and distal joints. Patients should be monitored in the intensive care trauma unit closely for blood loss, respiratory compromise, and pulmonary contusion may not be apparent on initial examination but may become evident within a few hours of rib and/or sternum fractures. Similarly, subdural or epidural bleeding may evolve after an initially lucid interval. Spine injuries and dislocations of hip and knee demand priority treatments as any delay can affect the management and overall rehabilitation of the patient. An unrecognized secondary fracture may result in pain or extension of the neurological deficit, if distal to a primary fracture, causing an incomplete neurological deficit. High suspicion of such fractures, in patients with spinal fractures, particularly those with an impaired level of consciousness is warranted and should ensure detailed clinical and radiographic examination of the entire spine. Knowledge of mechanism of injury, type of primary spine fracture may be useful predictors in early recognition of multiple-level non-contiguous spine and extraspinal injuries, and possible prevention of their complication.

CONCLUSION

The study helps us to understand the associated non-contiguous spine and extraspinal injuries in traumatic spine fracture. This prompts for a thorough evaluation of spinal fracture patients for non-contiguous spine fractures and other extraspinal injuries. Mechanism of injury and level of spine fracture (cervical spine) are certain predictors for associated injuries.

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