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ORJİNAL ÇALIŞMA / *ORIGINAL ARTICLE*

MISSED THORACIC SPINAL FRACTURES IN MULTIPLE TRAUMA PATIENTS

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ÖZET:

ÇOKLU TRAVMALI HASTALARDA GÖZDEN KAÇAN TORAKAL OMURGA KIRIKLARI

Amaç: *Yoğun bakım ünitelerinde toraks travmalarının eşlik ettiği çoklu travmaya maruz kalmış hastalarda torakal omurganın komputerize tomografi (CT) veya tekrarlayan direkt grafiler ile değerlendirilmesinin önemini vurgulamak.*

Yöntem: *Acil servisten direkt olarak yoğun bakım ünitesine yatırılmış ve ortalama yaşı 37 (23- 54 yıl) olan 6 olgu ortalama 3 gün (2-6 gün) sonra konsülte edildi. Bu olguların acil servis başvuru formları ve ilk çekilen göğüs grafileri değerlendirildi. Nörolojik değerlendirme Frankel skalasına ve kırıkların sınıflandırılması Magerl'e göre yapıldı.*

Bulgular: *Acil serviste ilk çekilmiş göğüs grafilerinde torakal omurga kırıkları net olarak görülememişken tekrarlayan göğüs grafilerinde veya CT'lerde bu kırıklar gösterilmiştir. Olguların ortalama Injury Severity Skor'ları (ISS) 32,16 ± 4.30 idi. Omurga kırıklarına eşlik eden diğer travmalar ise akciğer kontüzyonu (2), akciğer laserasyonu (1), hemotoraks (6), çok sayıda kot kırığı (5), maksillofasial travma (1) ve ekstremite travmaları (3) idi. Ortalama entübasyon süresi 7,5 gün (2-18 gün) ve ortalama yoğun bakımda kalma süresi ise 13 gün (4-24 gün) idi. Torakal omurga kırıklarının 2'si Tip A3 (T6 ve T7), 1'i tip B1 (T4), 1'i tip B2 (T9), 1'i Tip C1 (T9) ve 1'i de ateşli silah yaralanması (T9) idi. İlk değerlendirilmeleri sırasında 5 olgunun nörolojik düzeyleri Frankel A ve 1 olgunun ise Frankel E idi. 6 olgunun 5 tanesi ameliyat edildi ve bu olgulardan 4'ü Frankel A ve 1'i Frankel E idi. Ameliyat edilen 4 Frankel A olgusundan 2'si Frankel E'ye ilerledi. Frankel A olan bir olgu ise konservatif olarak tedavi edildi ve nörolojik durumunda bir düzelme olmadı. 1 olgu takip döneminde pulmoner emboli nedeniyle kaybedildi.*

Sonuç: *Çoklu travmaya maruz kalmış olgularda tam ve sağlıklı bir nörolojik muayene yapılamayabilir ve ilk çekilen göğüs grafilerinde instabil torakal omurga kırıkları belirgin olmayabilir. Bu olgulara yoğun bakım şartlarında yapılacak uygun olmayan müdahaleler, ciddi spinal kord yaralanmalarıyla sonuçlanabilir. Tekrarlayan grafiler veya CT ile bu kırıkların erkenden tanınması önemlidir.*

Anahtar kelimeler: *torakal omurga, kırık, nörolojik yaralanma, görüntüleme*

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SUMMARY

Purpose: *To assess the need for repeated x-ray and computed tomography (CT) of the thoracic spine for routine clearance of multi-trauma cases in Intensive Care Unit (ICU).*

Methods: *Six cases were consulted by author at mean 3 days (range 2- 6 days) after admission to the ICU. The median age was 37 years (range 23-54). The charts and first chest radiographies of cases were reviewed. The neurological assessment was done using the Frankel scale and fractures were classified according to Magerl.*

Results: *Thoracic spine fractures were not shown on first chest radiographs. Repeated x-rays and CT of the thoracic spine showed fractures of the vertebrae. The average Injury Severity Score was 32,16 ± 4,30. Other injuries noted at the time of presentation included: Lung contusion(2), lung laceration(1), haemothorax(6), multiple rib fractures(5), maxillofacial trauma(1) and extremity trauma.*

The mean duration of artificial ventilation was 7,5 days (range 2-18 days) and of ICU treatment was 13 days (range 4-24 days). Missed thoracic fractures were consisted of type A3 in two cases (T6 and T7), type B1 and B2 in two cases (T4 and T9), type C1 in one case (T9) and gunshot injury in one (T9). Neurological lesions were Frankel A in 5 cases and Frankel E in 1 case at first evaluation. Five of 6 cases were operated, 4 presenting complete paraplegia and one neurologically intact, only two of 4 complete paraplegic cases made a neurological improvement from Frankel A to E and one case's status in whom neurologically intact remained normal. One case that had complete paraplegia was treated conservatively and there was no difference his neurological status at follow up. One case died at follow-up due to pulmonary emboli.

Conclusion: *The radiological signs may be minimal or absent during the first assessment of thoracic spinal fractures. Most importantly, a full neurological examination may not feasible at the time of injury in multi-traumatized patients. This fact has implications for the nursing care of such cases in the ICU. CT is warranted in these cases.*

Key words: *thoracic spine; fracture; neurological injury; imaging.*

INTRODUCTION

Unstable fractures of the upper and middle thoracic spine are a therapeutic challenge because of the high rate of associated injuries and frequent occurrence of spinal cord lesions. Thoracic spine fractures account for up to 30 % of all spine fractures, and significant neurological deficits may be seen in up to 62 % of the patients [2,9]. These patients often suffer from coexisting head injuries, have multiple extremities fractures and often sedated or on respiratory support when seen in Emergency Service (EC) or ICU. Because of the priorities of resuscitation, spinal injuries may escape early diagnosis and neurological evaluation is often unreliable. The initial portable chest films are usually inadequate for evaluating the thoracic spine. Plain films of the thoracic spine in the polytraumatized patient can be difficult to interpret or nondiagnostic [8,14] and findings may be extremely subtle and missed initially[7]. Plain films of the spine in patients with gunshot wounds may significantly underestimate the severity of injury. Patients are usually filmed on a backboard and have superimposed pulmonary contusions, chest tubes, and nasogastric tubes. The upper thoracic is especially difficult to assess because of technical difficulties and the presence of overlying structures that may obscure visualization of the vertebral bodies and posterior elements. Hence, these fractures usually not detected until later, which may lead to worsening of the neurological deficit [4].

The purpose of this study was to assess the need for repeated x-ray and CT of the thoracic spine for routine clearance of multi-trauma patients in ICU in whom conventional radiographs has revealed no spinal trauma on admission to emergency department and focused on the association between severe thorax injury and spinal cord lesions.

METHODS

Between 2000 and 2005, a series of 20 patients with thoracic spinal lesions (T-2 to T-10) were identified in our department. Of these patients, 6 were consulted first time at the ICU by author. Initially, the fractures had been missed in all 6 patients due to concomitant life-threatening injuries, resuscitation and intubations. The case records were reviewed to identify demographic features of patients (Table-1). Injury Severity Score (ISS) and abbreviated injury score was calculated for each patient. Neurological status were evaluated and recorded as soon as cooperating with the patient and graded using Frankel scale.

The initial chest radiographs obtained at the EC and ICU were reviewed and repeated thorax

Table-1: Demographic feature of the patients

Patient no	Age	Sex	Consultation (days)	ICU (days)	Respiratory support (days)	ISS
1	23	F	6	19	5	38
2	27	F	2	12	5	26
3	25	M	2	4	2	30
4	43	M	2	4	2	30
5	50	M	3	15	13	35
6	54	M	3	24	18	34

radiographies and CT were taken to better visualize the fractures. Magnetic resonance imaging was performed in one patient.

RESULTS

There were 4 male and 2 female and mean age was 37 years (range 23-54 years). The mechanism of the injury included 5 vehicular accidents and one gun shot injury. One was T-9 fracture detected 6 days after injury when she represented with paraplegia as soon as was extubated. From the patient's chart it was learnt that she was neurologically intact at first evaluation in the EC. The second was missed T-7 fracture initially that was seen on repeated x-rays of the patient who consulted for humeral fracture on the second days. The other patient had T-9 fracture that had been operated for thoracic gun shot injury in another hospital and subsequently transferred the ICU. He was consulted for paraplegia at the second days. His radiographies did not show major vertebral pathology but bilaterally pedicle fractures and retropulsion of some bone fragments to the spinal canal was seen at CT imaging. The other two patients who had T-9 and T-4 fractures were also operated at other hospitals for severe thoracic injuries and transferred to our hospital as intubated without any knowledge about their neurological status. Neurological deficits of those patients were also determined during the follow up period in the ICU at the 2nd and 3rd days, respectively. The last one was T6 burst fracture detected 3 days after injury. His neurological status had been normal at first evaluation in EC but paraplegia was developed at follow up period in ICU.

The patients were consulted by author at mean 3 days (range 2- 6 days) after admission to the ICU. At the first orthopaedic evaluation, neurological lesions were Frankel A in 5 patients and Frankel E in 1 patient. Thoracic spine fractures were not shown initially on chest radiographs. Repeated frontal and lateral x-rays of the thoracic spine and CT showed fractures of the vertebrae. The average Injury Severity Score was 32,16 ± 4,30. All six patients with thoracic spinal trauma had also coexisting trauma consisted of lung contusion [(2)], lung laceration [(1)], haemothorax and / or pneumothorax [(6)], multiple rib fractures [(5)], maxillofacial trauma [(1)] and extremity trauma [(3)]. The fracture type, neurological level and type and, concomitant injuries are presented in Table-2.

Thoracopulmonary lesions were observed in all patients. Chest drainage and ventilatory support were required in all patients presenting hemothorax and /or pneumothorax, bilateral in 2 cases. The mean duration of artificial ventilation was 7,5 days (range 2-18 days) and of intensive care treatment was 13 days (range 4-24 days). Extra-vertebral orthopedic lesions concerned in 3 patients. One patient sustained right humeral fracture, one patient had bilaterally clavicle fractures and one had right wrist transscaphoid perilunate fracture-dislocation. All fractures were treated surgically.

Five of 6 patients were operated at mean 4 days after injury. Open reduction, posterior stabilization and posterolateral grafting was performed in 4 patients and anterior decompression, grafting and posterior stabilization and posterolateral grafting was performed in one. Before the operation 4 of 5 patients were presenting complete paraplegia (Frankel A) and one was neurologically intact (Frankel E). After the operation, two of 4 patients made a neurological improvement from Frankel A to E and other 2 patients' neurological status unchanged and remained as Frankel A. One patient with Frankel A was treated bed resting and brace and there was no difference on his neurological status at follow up period.

Although anticoagulant therapy was administered and other preventive measures were taken,

Table 2: Summary of findings in six patients with thoracic spinal fractures or dislocations

Patient	Concomitant injuries	Thoracic fracture Level	Injury Type	Neurological examination Initial follow up
1	Maxillofacial fracture; multiple extremity fractures; multiple rib fractures; haemothorax; respiratory support	T-9	Type C1	A E
2	Extremity and multiple rib fractures; hemothorax; respiratory support	T-7	Type A3	E E
3	multiple rib fractures; haemothorax; respiratory support	T-9	Type B2	A A
4	Lung laceration; haemothorax; respiratory support	T-9	Gun-shot	A A
5	Intraabdominal haemorrhage; multiple rib fractures; hemothorax; respiratory support	T-4	Type B1	A A
6	Head trauma; Haemothorax; multiple rib fractures; extremity fracture; respiratory support	T-6	Type A3	A E

one patient underwent early surgery died on the 7th day due to pulmonary emboli.

DISCUSSION

Fractures of the thoracic spine are a common cause of morbidity and even mortality in the trauma patient, accounting for 25% to 30% of all spine fractures[11]. Only 12% of the patients with fracture dislocations of the thoracic spine are neurologically intact, and 62% of patients with thoracic spine fracture-dislocations have complete neurological deficits. Thus, early and accurate diagnosis is of the upmost importance.

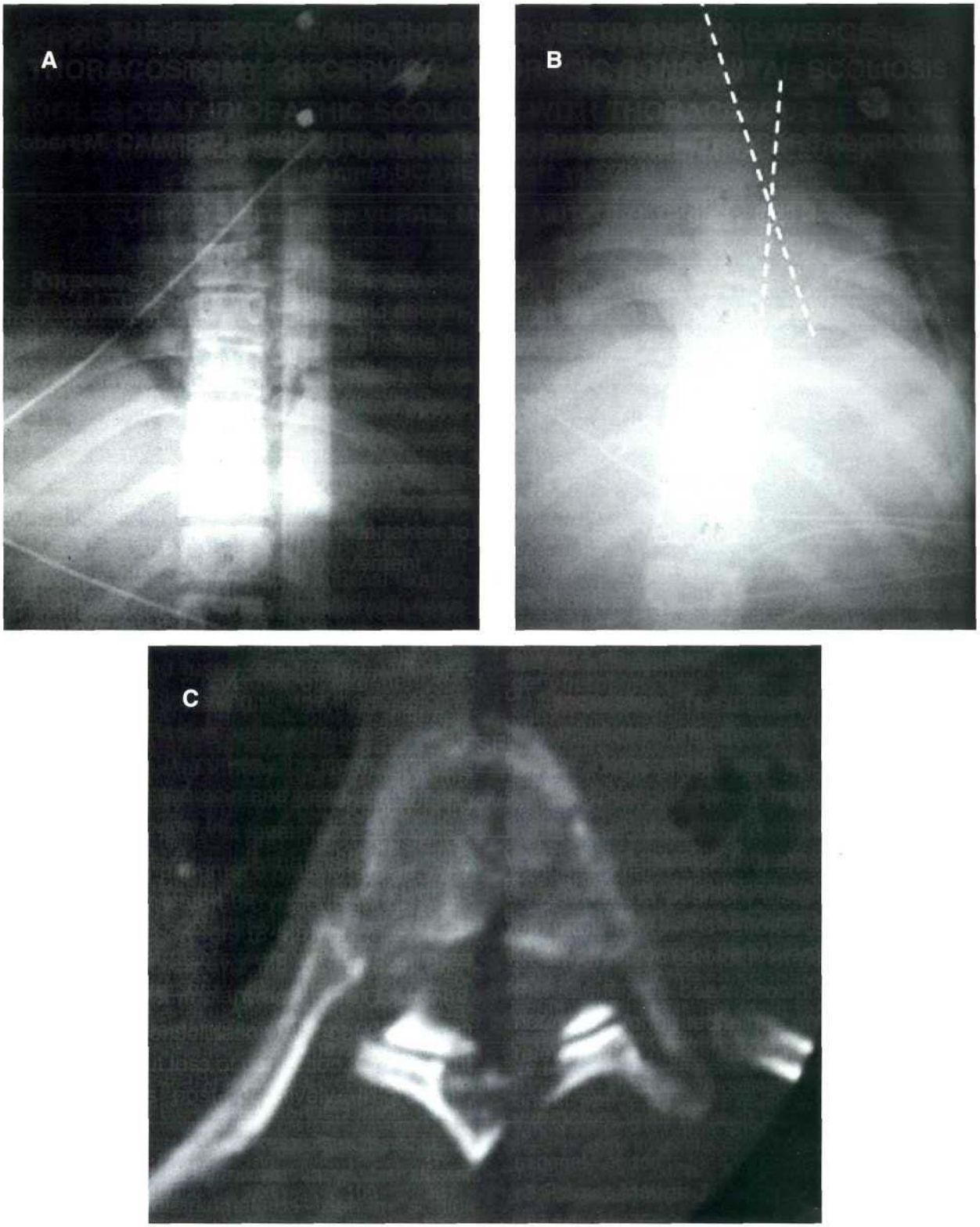

Figure 1. Initial supine chest radiograph of a 27-year-old woman who had blunt chest trauma in a motor vehicle accident; she was neurologically intact (A). Control radiography and CT demonstrates right lateral displacement of the T7 vertebral body with acute angulation of the pedicle lines at the T7-8 level indicating a T7-8 fracture (B and C).

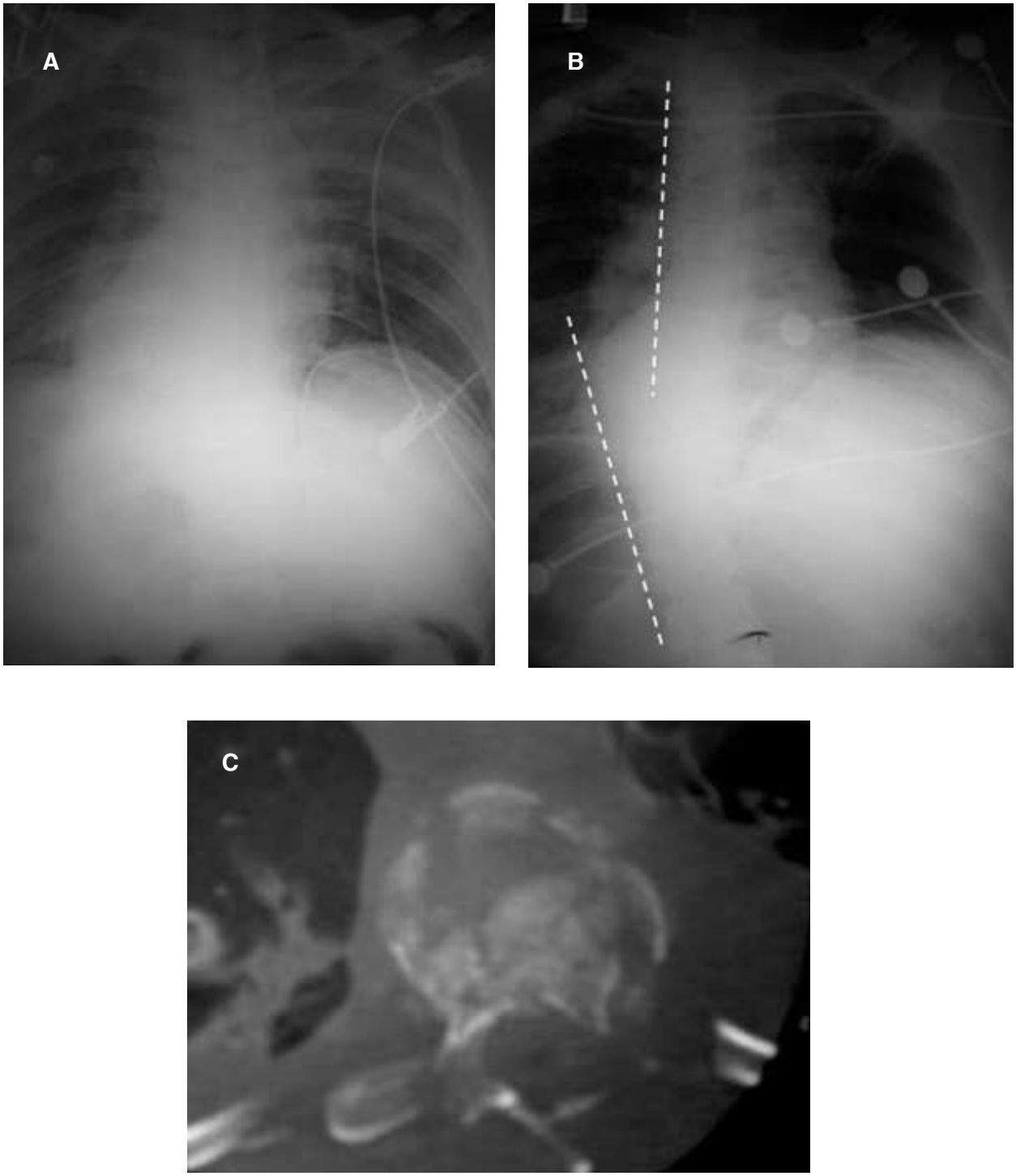

Figure 2. Initial supine chest radiograph (A) of a 23-year-old woman who had blunt chest trauma in a motor vehicle accident; the patient was neurologically intact at the EC evaluation but her neurologic status was deteriorated in ICU and she demonstrated T9 paraplegia. Control radiography demonstrates acute angulation of the T9 with displacement of vertebral body fragments producing a ''widened '' T9 body. Computed tomography confirms a fracture of T9 with lateral translation (B and C).

One of the difficult and time-consuming tasks in evaluation of the trauma patient is the complete evaluation of the spine. While life-threating injuries are being addressed, it is possible to overlook spine injuries.

The initial diagnosis of thoracic spinal fractures based on clinical awareness and plain films. Clinical examination has been the indicator for further spinal investigation as chest x-rays have been shown to have a low sensitivity for thoracic injuries in patients with significant chest trauma[8]. In spite of the careful inspection and palpation of the back, great difficulty may be encountered in obtaining the correct diagnosis in patients in whom a neurological assessment can not be made for unconsciousness, respiratory support or multiple traumas[3]. In our case series, a potentially unstable fracture might initially go undetected for the potential life-threatening associated lesions or absence of neurological impairment (Figure 1 and 2). The patients with trauma were intubated and sedated in the EC after the initial assessment, which remains the only available record of the neurological status on arrival. If detailed assesment could not be done, it was more appropriate to state that the limited examination did not reveal any gross neurological deficit, was normal and the patient should be assessed again. We did not know the neurological status of the 3 patients on admission and 3 was neurologically normal but neurologic deficit was developed two of them subsequently. Spinal fracture was clinically suspected in 5 patients because of paraplegia at follow up evaluation. However, in the one patient who was neurologically intact a spinal fracture was not clinically suspected. As our study has shown, when the patient is found to be paraplegic a spinal injury will be suspected. However, when the patient is neurologically intact, a potentially unstable spinal fracture may initially go undetected on clinical grounds.

Woodring et al. reported that in a serious of 100 consecutive patients with mediastinal hemorrhage following blunt chest trauma, fractures and dislocations of the lower cervical, thoracic and upper lumbar spine were causative of the mediastinal hemorrhage in nine patients. Spinal injury was clinically suspected in seven patients because of quadriplegia or paraplegia. However, in the two patients who were neurologically intact a spinal injury was not clinically suspected[15]. The multiple trauma rates in another study of 253 spinal injuries with neurological damage, which needed admission to the ICU, was of 55%. Blunt chest trauma was found in 86% of the multiple trauma groups, especially in combination with fractures of the upper and middle thoracic spine. Haemopneumothorax was diagnosed in 88%, pulmonary contusion in 48 % of the cases[5]. Van Beek et al found that the fractures of five (22%) patients were initially missed in 23 patients with known thoracic spine fractures[14]. Murphey et al noted that 10% to 30% of spine fractures are not shown on spine radiographs[10].

According to ATLS (Advanced Trauma Life Support) guideline, during initial assessment and management, roentgenograms should be used judiciously and should not delay patient resuscitation. In the patient with blunt trauma, three roentgenograms should be obtained- cervical spine, anteroposterior (AP) chest, and AP pelvis. These films can be taken in the resuscitation area, usually with a portable x-ray unit, but should not interrupt the resuscitation process. During the secondary survey, open-mouth odontoid and anteroposterior thoracolumbar films may be obtained with a portable x-ray unit if the patient's care is not compromised, and if the mechanism of injury suggests the possibility of spinal injury. After all life-threatening injuries are identified and treated, complete cervical spine, thoracic, and lumbar spine films should be obtained. In the patient with penetrating injuries, an AP chest film

and films pertinent to the site of wounding should be obtained[1].

In patients with many injuries, often a CT scan of the chest, abdomen and pelvis is also done to rule out visceral injuries and frequently minor spinal fractures are better recognized in these CT scans than on the plain radiographs[6,13]. Rhea et al. reviewed 329 trauma patients who had the thoracic and lumbar spines evaluated by plain films or CT. They found 38 patients in that group who had undergone both chest CT and thoracic spine plain films. There were 13 fractures detected in eight patients. Chest CT had detected all the fractures; however, thoracic spine plain films failed to detect five (38%) fractures. They concluded that helical CT of the chest is superior to plain films of the thoracic spine in fracture detection and characterization, and that plain films may be unnecessary in those patients undergoing helical CT of the chest[12]. When we evaluated the initial x-rays of the patients they were suboptimal quality and there was failure to obtain adequate series of thoracic spine radiographs. In our cases additional diagnostic computed tomography or magnetic resonance imaging initially might not be possible due to pressing interventions for life-threatening complications initially. Secondary surveys might not be carried out because resuscitated patients were sent to the intensive care units. Limited clinical impressions obtained during the primary survey might be deemed adequate for several days. This practice could be lead to failure to recognize the underlying spinal column or spinal cord injury.

In conclusion a delay in the diagnosis of thoracic fractures in hospitalized trauma patients is frequently associated with an unstable patient condition that necessitates higher-priority procedures than emergency department thoracic spine radiographs. Such patients should receive spinal precautions until more complete evaluation can be performed. Diagnosis of thoracic spine fractures in patients with multiple traumas requires careful evaluation of the chest radiograph. Emergent chest computed tomography should be obligatory in thoracic spine fractures if helical- CT is not suitable. Early diagnosis and intervention may prevent a catastrophic neurological event.

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