The Contribution of Imaging in Traumatic Lesions of the Spine

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ABSTRACT

Spinal cord injuries are a major cause of morbidity and mortality. Early identification of spinal lesions reduce long-term negative effects of these traumas. This paper proposes an algorithm for x-ray and imaging in trauma patients with cervical, thoracic or lumbar depending on neurological assessment and compliance neurological patient in a class given the ACR criteria. Radio-imaging evaluation of the spine is the method of choice for assessing the existence, location, extent and type of spinal cord lesions and / or the vertebral body. Application of appropriate imaging means for assessing spine trauma, requires knowledge of indications and limitations of methods.

KEY WORDS cervical spine, dorsal spine, lumbar spine, trauma, CT, IRM

Introduction

Spinal cord injuries and their immediate or long-term consequences represent a condition of morbidity with pathological implications on physical, mental life and social integration of the patient.[1,22]

Therefore, it requires a specific management to approach a patient with acute trauma to the spine. The clinical examination and the neurological assessment of the patient belonging to a certain class, has an important role, depending on the neurological deficit. [5]

Thorough clinical examination combined with appropriate anamnesis and causes of the trauma, have a crucial role, as key indicators, predictors of patient's risk of having actually posttraumatic spinal injury.[10,24]

Material and Method

We have conducted a study in the Radiology laboratory of Clinical Emergency Hospital of Brasov County, extended over a period of five years, during 01.01.2005-31.12.2010, on a total of 348 patients aged 18 to 80 years hospitalized as a result of an injury to the spine with clinical signs suggestive for cervical, thoracic or lumbar lesion, without taking into consideration patients not presenting posttraumatic clinical signs of spine trauma.

Radioimagistic diagnostic methods used were standard radiography, CT.

Conventional radiographs were obtained using a Siemens type conventional radiography, with printing on standard film and exposure was carried out in at least two incidents - anterior-posterior and profile.

CT images were acquired using a sequentially device (single-slice) and a spiral machine (8 coils) using standard protocols for evaluation of the cervical spine, thoracic or lumbar and multiplanar reconstructions in sagittal and coronal, or 3D reconstructions. Section thickness of 1.25 mm was chosen on spiral device, 3 mm on cervical spine device, 5 mm on thoraco-lumbar spine on single-slice device and 2.5 mm on spiral type device.

Results

The total number of patients with acute thoraco-lumbar spine trauma taken into account in the study is of 348 patients. Of these, the majority is hold about males, about 74%, while the females are in a percentage of approximately 26%. Distribution of patients from the group with acute spinal trauma, on age levels, show a numerical majority in the age range between 40-50 years - 81 patients, followed by 50-60 years age range - 54 patients, then age range between 20-30 years-49 patients. The causes of cervical spine injuries are dominated by road accidents - 154 patients, followed by falls from height - 96 patients.

From 2005 until 2010 there were hospitalized in the Neurosurgery Department of Clinical Emergency Hospital of Brașov County 614 patients with acute trauma to the spine, on different spinal segments. Among these, traumatic lesion involving in the cervical spine segment was represented by 318 cases. Thoracic spine showed a number of 97 cases with acute traumatic pathology and lumbo-sacral level, 138 cases (including sacral injuries at a number of just 21 cases) and 61 patients with lesions associated with multiple spinal levels.

Study sample consists of patients with spinal injury who were hospitalized to the Department of Neurosurgery of Brasov County Emergency Clinic.
Hospital for a proper diagnosis and to benefit from a therapeutic adequate and appropriate approach to their case.

The number of patients in the sample studied is of 348 cases which have recourse to the Neurosurgery Department of the Hospital for diagnosis and treatment.

Patients in the study are adults with acute traumatic injuries to the spine, as a sole diagnosis or associated with multiple trauma, with consequences on several areas of the body (in which case the spinal pathology may be the main cause of morbidity or it can represent just a secondary diagnostic association).

Radio-imaging examinations were performed, stored and retrieved in Radiology Lab of the Clinical Emergency Hospital of Brasov County.

Distribution of acute trauma depending on the spinal location

Thus, from the total amount of patients, acute injuries located on the cervical spine segment are represented by a percentage of 43% as compared to those involving the lumbo-sacral segment of the spine, with 32%. In our study, trauma strictly localized at sacred level are outnumbered - 4 cases.

By order of their frequency, to the patients taking part in the study, the traumatic implication of the thoracic spine, is of 18%, followed by the one which is localized and affects several segments (levels) of the spine (7%).

Patient distribution by age limit of 60 years:

The age reference (adapting also data provided by the speciality literature), 60 years is regarded as an aggravating factor in the evolution and prognosis of patients with acute spine trauma if age exceeds this age limit.

In the study, most patients are aged under 60 years.

Also, considering each spinal segment and the group of patients with associated injuries, on several levels, we can found the same predominance on patients younger than 60 years.

In the group of patients with acute cervical trauma, a total of 127 are under or even 60 years and 23 patients are over 60 years.

There are 51 patients aged 60 years or younger with acute trauma to the thoracic spine and 12 patients over 60 years old.

Lumbo-sacral location of injuries is to be found to 91 patients aged under or even 60 years and 20 patients which are over this age limit.

In the group of patients with associated injuries on several levels of the spine, 14 patients didn’t grow older than 60, while 10 patients were able to pass beyond this age limit.

Patient distribution by neurological deficit (ASIA):

Patients were classified according to the presence or absence of a neurological deficit, and its severity, according to ASIA in 5 groups: A, B, C, D and E (without neurological deficit). We have grouped as a major neurological impairment, the patients enrolled ASIA A, B or C, and as minor damage, patients classified as ASIA D or E.

It was observed that localized injuries on each vertebral segment and on multiple levels are associated mainly with ASIA D or E grades as follows: Group ASIA E -59%, in Group ASIA D - 11%, ASIA C -12 % ASIA B - 4% and ASIA A - 14%.

Results based on the adaptation of the lot on ACR criteria:

By applying the criteria ACR (American College of Radiology Appropriateness Criteria) I distributed the lot studied in two groups:

Group 1 - includes patients with acute trauma which meet the conditions for radio-imaging evaluation, with or without locating signs and without a definite pathological suspicion on initial examination - about 71% (247 patients), among which 103 patients perform CT only, 144 patients perform radiography and CT scan.

Group 2 - includes patients with acute trauma which meet the conditions for radio-imaging evaluation, with pathological deficit and suspected myelopathy - approximately 29% (101 patients), among which 57 patients perform CT and MRI, 18 patients perform CT only, 3 patients perform MRI only and 23 patients perform radiography, CT and MRI.

Fig. 1 MRI sequences T1 and T2 sagittal and axial neck pain CT-C5 vertebral body fracture
radiographs. From the group 2 - 57 patients meet the ACR criteria and 44 patients don’t meet the ACR criteria.

Imaging evaluation of acute spine trauma is controversial regarding optimal imaging means for ensuring accurate and timely diagnosis.

**Discussions**

Radio-imaging evaluation of the spine is the method of assortment for assessing the existence, location, extent and type of spinal cord lesion and/or the vertebrae. Application of appropriate imaging means for assessing spine trauma requires knowledge of indications for each method and their limitations.

Sectional imaging is the method of assortment in evaluating patients enrolled in the increased group risk for fracture.[13]

As compared with radiographic film, CT offers superior quality visualization of the fractures, of the evaluation of cervico-thoracic and cranio-cervical junctions.[26]

According to ACR (2003), screening CT cervical spine trauma assessment, using images and sagittal and coronal reconstruction, apply to:

1. conscious patients with pain / discomfort cervical, thoracic or lumbar, upper or lower limb paresthesia (additional indication - magnetic resonance).

2. Unconscious patients.

3. In case of intoxication with alcohol, drugs.

4. Patients with neurological deficit, according to sensory impaired (alcohol and drugs) (additional indication - MRI). [2]

   Additional cases, indicating CT evaluation:

1. classic radiographic images if inconclusive, indicate that CT segment with sagittal and coronal reconstruction.

2. If the radiographic film shows a bone injuries, indicate the entire cervical spine CT with sagittal and coronal reconstructions for a detailed description of the lesion and plan the interventional procedure.

3. For exact location of foreign bodies and bone fragments and to specify their relationship to nerve elements are fully practice the cervical spine CT with reconstruction in the coronal plane and sagittal images.

4. Patients at increased risk of cervical spine injury [11], which are also found associated injuries - pelvic, cranial or multiple fractures of extremities, indicate evaluation of the entire cervical spine CT with coronal and sagittal reconstruction plan and radiographs the incidence profile.
5. In patients with neurological deficit (suspected spinal nerve root lesion) but no obvious lesions on radiographic film and CT native and that MRI can not be performed, CT myelography is indicated. [26] 

There is still no investigation standard, uniform algorithm. This reflects the complexity of spinal injuries and the continued development of probing imaging methods.

A large number of centers perform as minimum imaging investigation (accessible to them) - radiography of the entire spine in the case of fracture certainty in order to exclude associated fractures.[15]

Associated injuries may be located adjacent to the primary fracture (continuous) or remote (discontinued)[23], and of these about 3/4 occur in the transition cervico-thoracic and lumbo-sacral zones. [14]

CT examination, particularly multidetector CT (MD-CT) allows superior assessment of bone structures and by reconstructing images can highlight very important elements for spacially describing the fracture (3D image post-traumatic lesions); it is appreciated the vertebral alignment (it removes the adder we face in the classic radiology), the shifting of bone fragments.[15]

Frequently, patients with spinal cord injuries have politraumatisms with associated visceral injuries so that the investigation CT / MD-CT of the chest, abdomen, pelvis is recommended. In this context, spine images can be obtained by reconstructing data from basic aquisition, for visceral examination. The resulting images, multiplanar, with fine sections, reconstructed,[3,12] as well as the 3D-s,[16] have a superior quality as compared to standard radiographic assessment,[20,21,25] which will be done at the express request of the clinician.[4]

MRI is complementary to CT examination, especially in the case of minimum fractures, which cannot be identified with certainty by CT examination (MRI may reveal bone edema in acute trauma). In spinal injuries associated with the alteration of the vertebral alignment, MRI is the method that identifies and quantifies soft tissue injury, including that of spinal cord.[15]

The main advantage of MRI examination is accurate visualization of the intervertebral discs, ligament structures and, most importantly, the status of post-traumatic spinal cord and nerve structures. MRI can reveal extra-and intra-ductal lesions.[15]

The neurological assessment plays an important role in the management of the patient with spinal trauma. To classify patients in a particular class function of their neurological status, one can be use ASIA scale.[1,18]

The quantification of neurological deficit in the spine can be adapted to this scale, processed and assimilated by Frankel (1969): Grade A - "complete paralysis" - complete loss of sensory and motor function below the lesion. Grade B - "sensory function" - no motor function, minimum sensory function preserved in the sacred segment. Grade C - "incomplete motor function" - motor function barely preserved below the lesion, but having no practical use. Grade D – fair to good motor function – with practical applicability below the level of the lesion ("Everybody can mobilize their legs and some may move with or without support"). Grade E - "recovered" - the patient without neurological symptoms (some abnormal reflexes may however be present). [9,18]

Neurological deficit grade A and B won’t get recovered. C and D grades can register an improvement in at least one motor level with or without treatment.[17,19]

In our study, we found that most patients were classified within the degrees of neurological deficit ASIA D or without neurological deficit ASIA E. In patients with acute spinal trauma, most patients are without neurological deficit, but those with neurological impairment are especially with complete neurological deficit (ASIA A).

There have been a number of studies to establish clearer criteria for the indication of spinal trauma imaging evaluation. Radiographic evaluation indication, however, remains controversial. [9,19]

The authors Holmes JF et al., established that if patients meet any of the following criteria, they can be grouped into increased group risk of post-traumatic spinal injury:

1. Manifests of thoraco-lumbar pain
2. Obvious discontinuities of the thoraco-lumbar alignment
3. Reduced consciousness
4. Pathological results on examination of peripheral nerves
5. Obvious painful lesion
6. Ethanol intoxication or drugs.[9]

These criteria provide the indication for imaging evaluation of the spine. They found a sensitivity of 100% and only a 3.9% specificity, showing that the use of these clinical criteria has little value in excluding fractures at this level. [7,9]

CT has the advantage of spiral technique, as well as the multi-planar reconstruction and three-dimensional images ability. In this way, the
diagnosis of posttraumatic bone lesions at the cervico-thoraco-lumbar level is much easier and more accurate. Another reason that supports the CT evaluation of these patients is the need of screening imaging for other associated injuries - thoracic, abdominal, pelvic. That is why, in the same interval one can obtain also CT image of thoracic, lumbar or sacral spine, thus renouncing the conventional radiographic examination and saving time. [6,22]

Authors Carl J. Hauser et al. concluded that CT scans should replace conventional radiography in patients with acute trauma, classified in the high-risk group lesion, which require imaging evaluation. [8,24]

Conclusions:
Study results led to the following conclusions:
1. Imaging management imposed by a neurological assessment leads to a correct diagnosis.
2. Correct and prompt diagnosis leads to a correct therapeutic decision.
3. Diagnostic efficiency reduces the time to implement appropriate treatment.

References
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