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ORIGINAL ARTICLE

Evaluation of spinal trauma by multi detector computed tomography and magnetic resonance imaging

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KEYWORDS

Spine trauma;
Magnetic resonance imaging;
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Abstract *Aim of work:* The aim of this work is to assess the role of multi-detector computed tomography (MDCT) and magnetic resonance imaging (MRI) in evaluation of spinal trauma.
Patients and methods: Between January 2013 and April 2014, 98 patients (78 males and 20 females) with spinal injuries were investigated by MDCT and MRI. Assessment of the radiological findings of spinal injury was performed and the following were investigated: vertebral compression fractures, bursts and dislocations, posterior element fractures, C1 and C2 lesions, vertebral listhesis, bone marrow edema, spinal canal compression, disk herniation, extradural hematoma, spinal cord contusions, spinal cord swelling and posterior ligamentous complex injuries.
Result: A total of 271 lesions were diagnosed as follows: 217 lesions were diagnosed using MRI alone, 1 54 lesions were diagnosed using MDCT alone and 100 lesions were diagnosed using MRI and MDCT conjointly. By using MRI 117 more lesions were detected than using MDCT. MRI was significantly superior to MDCT in the diagnosis of bone marrow edema, posterior ligamentous complex injuries, disk herniations, spinal canal compressions, and spinal cord contusions and edema. In cervical spine injuries, MRI was useful for the evaluation of the supporting ligaments and the spinal cord after the patient has been stabilized. The average times required to perform CT and MRI were 1.38 ± 19.83 and 2.00 ± 19.58 days, respectively; this difference was significant ($p\backslash 0.05$) according to the Mann–Whitney test.
Conclusion: MRI was significantly superior to MDCT in the diagnosis of bone marrow edema, posterior ligamentous complex injuries, disk herniations, spinal canal compressions, and spinal cord contusions and edema. In cervical spine injuries, MRI was useful for the evaluation of the supporting ligaments and the spinal cord after the patient has been stabilized.
MDCT and MRI are complementary to each other in evaluation of spine injuries.

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1. Introduction

Spine injuries are frequently seen in multi-trauma patients and can be devastating injuries, particularly if not identified in a timely manner (1).

Most spine injuries follow motor vehicle accidents, falls, and sports injuries. Injuries in this region may produce neurologic deficit, often severe and sometimes fatal (2). MDCT and MRI are frequently complementary studies in trauma (3).

At many trauma centers, MDCT is the preferred initial imaging modality in spine trauma patients. Besides its higher sensitivity in detecting fractures, hematomas involving the paravertebral soft tissues, subcutaneous soft tissue trauma, MDCT may detect epidural and subdural hematomas (3).However, compared to the non ionizing radiation of MRI, MDCT increases radiation by 50% and may, therefore, increase the potential risk of cancer, a particularly important consideration for children younger than 5 years and who have a long life expectancy (4).

MRI has an inherent superior contrast resolution with higher sensitivity for soft tissue injuries. Therefore, MRI is the imaging modality of choice in assessing soft tissue injuries, spinal cord injury and injury to intervertebral disks and ligaments. It is the only method of directly visualizing and differentiating spinal cord hemorrhage and edema, which can have a significant prognostic significance (5).

MRI typically serves as a problem-solving technique when MDCT is unable to adequately assess the cause of neurological deficits, determine acuity of a fracture, and assess for presence of ligamentous injury. When neurological findings are present that are not adequately explained by MDCT, the typical clinical questions remaining to be answered are whether spinal cord injury has occurred and whether an extra–axial lesion e.g. epidural hematoma or intervertebral disk herniation is present (6).

In addition, coronal and sagittal images of MRI allow for better identification of soft tissue and ligament injuries. Given its multiplanar capacity, lack of ionizing radiation, rapid image acquisition, ability to assess soft tissues and ligaments, and importance in the diagnosis of bone lesions, the use of MRI in patients with spine injuries should improve the diagnostic precision, particularly with regard to the extension, localization, and severity of lesions diagnosed (or not) by MDCT (7).

MRI is recommended in cases of incomplete neurological injuries, a lack of correlation between the levels of bone injury and neurological impairment, persistent pain with no radiographic findings, the presence of disks before reduction of dislocation, spinal cord injuries without radiologic abnormalities, differentiation of pathological fractures, neoplasm infiltration, infection, and in the prognostic assessment of spinal cord injury (8).

The aim of the present study is to evaluate spinal trauma by MDCT and MRI (see Fig. 1).

2. Patients and methods

This study was conducted according to the guidelines of the Research ethics committee approval and informed consent was obtained from all patients.

It was conducted at a trauma center from January 2013 to April 2014. A total of 321 patients with spine injuries were investigated.

Of the total sample, 98 (30.5%) patients were subjected to clinical assessments and management according to the guidelines in Advanced Trauma Life Support (ATLS), followed by neurological assessments and initial CT imaging that suggested spinal trauma.

The inclusion criteria for the initial clinical and radiological assessment were as follows: a reduced level of consciousness, multiple injuries, chest trauma, mild trauma in older adults, backache (neck or dorsal pain, crepitus, muscle contracture), spinal cord complaints (numbness, limb motor or sensitive deficit), complaints of instability (aggravated by mechanical stress in the upright position), autonomic dysfunction (bowel or bladder incontinence), and the results of neurological examinations (altered sensitive, motor, or reflex activity).

Patients who exhibited normal amplitudes of motion, normal levels of consciousness, lack of pain, intoxication with alcohol or drugs, or no neurological deficits were excluded from the study.

The following conditions were considered to be indications for performing spine MDCT and MRI: any suspicious image on the X-rays, inappropriate radiographic exams, backaches, and persistent sensory, motor, and autonomic deficits. MRI was not performed in patients who were gunshot victims; needed immediate neurosurgery; exhibited cardiovascular, respiratory, and neurological instabilities; or used devices such as pacemakers, intraocular prostheses, and/or surgical clamps.

MDCT and MRI reports were written by radiologists.

Spine MDCT exams were performed using a 16-detector row CT scanner (Toshiba Aqyiliem 60 Tokyo,Japan) with the patients in dorsal decubitus on a table. The protocol included high spatial resolution thin section, in 2 mm of the affected segments and reconstruction in the axial, coronal, and sagittal planes.

MRI was performed using a 1.5 Tesla (Magnetom Avanto, Siemens Medical Systems, PA, USA) with the patient in dorsal decubitus on a table. The protocol included image acquisitions in the following sequences: axial T2 and multiplanar gradient recalled (MPGR) T2*; sagittal T1, T2, T2 selective partial inversion recovery (SPIR)/FAT; and coronal proton density (PD). Cervical spine coils are employed for imaging the cervical spine.

Patients who were agitated or in a coma were given sedation or subjected to anesthetic induction for the purpose of image acquisition.

To determine the clinical relevance of diagnostic imaging exams (CT and MRI) in the diagnosis of patients with spinal injuries, the following variables were considered: age, gender, etiology, level of neurological impairment, and type of diagnostic imaging (CT and MRI). The following spinal injury radiological findings were investigated: vertebral compression fractures, bursts and dislocations, C1 and C2 lesions, posterior element fractures (pedicle, articular facets, lamina, spinous and transverse processes and lateral mass, arch, and joint capsules), vertebral listhesis, bone swelling, spinal canal compressions, disk herniations, extradural hematomas, spinal cord contusions, spinal cord swelling, and posterior ligamentous complex (PLC), comprising the supraspinous and interspinous ligaments, ligamentum flavum, and facet joint capsule injuries.

Data were analyzed and the lesions detected via MDCT and MRI were compared using McNemar's test.