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The Prevalence Non-Adjacent Cervical Cord Injury in an Irish Population

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Abstract

Objective: To analyze the prevalence of non-contiguous injury of spinal cord using MRI with a focus on cervical spinal injury patients.

Methods: 60 cervical spinal injury patients were reviewed using the NIMIS (National Integrated Medical Imaging System) system. The MR imaging and imaging reports for cervical spinal injury were reviewed in a University Teaching Hospital in West Ireland (45 male and 15 female). The mean age of patients in this population group was 42. They were divided into three groups based on the mechanism of injury; hyperflexion, hyperextension and axial injury as per ASIA guidelines. The presence or absence of non-contiguous spinal injury was confirmed as to whether there was marrow contusion, herniation, or fracture at any area along the spine. During evaluation of spinal injury the cervical spine is often prioritized, however the importance of surveying the entire spine is essential. It has been emphasized that the whole cervical spine including the cervicothoracic junction (CTJ)

Results: A total of 9 cases (15%) showed CTJ or upper thoracic spinal injuries defined as C7-L1 injury. 2 of 21 cases revealed obvious fractures in the CTJs or upper thoracic spines. Ligamentous injury in these regions was found in only one case, Traumatic disc herniation in four cases and spinal cord injury in five cases. Nerve impingement was observed in two cases. The incidence of non-contiguous spinal injuries was higher in the axial compression injury group (25%) than in the hyperflexion injury group (21%) or the hyperextension (20%) injury group, highlighting the importance of injury mechanism.

Conclusion: Cervical spinal MR showed non-contiguous CTJ or upper thoracic spinal injuries in 28% of the patients with cervical spinal injury. The mechanism of cervical spinal injury did not significantly affect the incidence of the non-contiguous CTJ or upper thoracic spinal injury. Physicians in Ireland should consider imaging other areas of the spine when a cervical spinal injury is suspected.

Keywords: MR imaging; Cervicothoracic junction; Spinal cord injuries

Introduction

Spinal fractures are among the most common injuries musculoskeletal injuries, with an estimated 1.4 million fractures of the vertebral column worldwide every year. Spinal injury is also associated with significant disease morbidity, over 76% of the 1600 people with spinal cord injuries (SCI) in Ireland are out of work.

Multi-level non-adjacent spinal injury is an injury divided by at least one normal vertebra from the cervical spine injury [1]. Previous studies have shown this figure to be approximately 15% [2]. After a serious traumatic injury, the cervical spine is made a priority given the risk of spinal cord injury and permanent paralysis and disability [3]. It has been observed that sometimes physicians focus wholly on the cervical spine and that injuries of the thoracic or lumbar cord can be disregarded [4,5]. There is significant differences in the prevalence of non-adjacent fractures from previous studies which ranged from 5%-33% of cases [6,7]. There has been no previous such research that we could find from a review of the literature in the Irish population. The Irish population may be at increased risk of such injuries given the higher prevalence of vitamin D deficiency and road traffic accidents compared to international standards [8,9]. MRI has an important role in the evaluation of the spine but given the time required for evaluation of the spine, unless specified, a full spinal study may not be undertaken which can lead to missed injuries [10]. Missed injuries can lead to significant morbidity and increased costs and length of stay [11].

Aim

The aim of our study was to investigate the prevalence of non-adjacent spinal injury as a prospective study and to assess which spinal injuries are most prone to non-adjacent injury.

Materials and Methods

This was a prospective study which includes a consecutive series of patients collected from January 2018 to July 2019 from patients presenting with spinal trauma in the A&E of a busy hospital in the west of Ireland. In total 73 patients were identified in the study using the 'filter' mechanism using the hospital's National Integrated Medical Imaging System (NIMIS)

system. There were 45 males and 28 females included. The mean age of patients in this population group was 42. All data collected on patients was anonymized and processed in a way that was secure and did not allow for the identification of patients. The average waiting time to obtain an MRI for these patients was 6 days. Most of the injuries were the result of motor vehicle accidents (n=36), this was followed by falls from a height (n=14), sports injury (n=7) and assault (n=3). The MR images were obtained by using Signa HD (Philips: model intera 1T Omni). The standard protocol included both T1 and T2-weighted sequences. The section thickness was 4 mm with a slice spacing of 1.5 mm. Disc herniation was defined as a change in signal intensity due to a protruding nucleus pulposus. Spinal cord injury was defined as signal changes within the spinal cord. Informed consent was obtained from patients with permission sought by contacting them via telephone for their images to be used. Patients who declined or were non contactable were excluded from the study. In total 15 patients were excluded. Ethics approval was obtained from the ethics committee of university hospital limerick.

Non-adjacent injuries are those separated by at least one normal vertebra from the cervical spinal injury site. These non-adjacent injuries were assessed in terms of marrow contusion, ligament injury, and fracture and disc herniation.

Result

Twenty-nine of 73 cases (39.7%) showed either non-adjacent marrow contusions (n=16) or fractures (n=6) or a ligament injury (n=4), separated from the cervical spinal injury site on cervical spinal MR by at least one vertebral level. The types of spinal injury were as follows; flexion injury (n=29), axial compression (AC) injury group (n=7), and extension (n=37) group. The flexion injury group (n=29) consisted 9 flexion dens fractures and 11 distractive flexion injuries and 9 compressive injuries. The extension injury group (n=37) included 8 fractures of the pars interarticularis of the axis vertebra (C2), 8 extension teardrop axis fractures, 13 compressive extension injuries and 8 distractive injuries of the cervical spines. The compression injury group of 7 patients included 3 fractures of the anterior and posterior arches of the C1 vertebra (Jefferson fractures), one of which was combined with a dens fracture, and 4 vertical compression injuries.

The mean number of vertebrae between the two injuries was 3. Traumatic disc herniation was observed in one case only.

Discussion

A high percentage of patients in our study were shown to have another injury along their spine (35.7%). Non-adjacent spinal injuries are particularly associated with compression injury of the cervical spine than with other injuries of the cervical spine. This highlights the importance of including the mechanism of injury when requesting specific MRI imaging. This result is higher than many of the previous studies which used radiograph to diagnose non-adjacent injury. Hadden and Gillespie reported an incidence of 24% in Scotland while Henderson et al. reported that 15% from a study in Canada

[12,13]. Gupta et al. observed that non-adjacent injuries observed on radiographs are most often involved the cervical (C5-C7) and cervicothoracic levels [14]. This is also a higher incidence than had previously been observed by Schmidt et al. and Ryan et al. which used MRI imaging and quoted a figure of 21.2% [15,16]. There may be several reasons for this finding which we will discuss. Firstly, MR imaging is providing greater sensitivity concerning the marrow contusion, which could not be depicted on plain radiographs or CT as used in previous studies. In our study a wide FOV of 40 cm was used. The FOV of most cervical spinal MR imaging is smaller at 24 cm. A large FOV meant the upper thoracic spines were included in the FOV; this was particularly useful for sagittal MR images. Thoracic vertebrae were individually included on sagittal MR image from T4 to T7 in this study (mean level: 4.5). Thirdly, it may be that the Irish population in our study is at a higher risk of non-adjacent injury especially those in west Ireland which may be more prone to agricultural and industrial accidents. There is an argument thus for a wider FOV to be included in spinal studies, however a future study would be necessary considering the costs associated with such FOVs. However, our study supports the use of a higher field of view especially in cases where the requesting physician specifies a specific spinal level. There are many studies which discussed mechanisms for non-adjacent spinal lesion associated with a cervical spine fracture [5,12,17]. Calenoff et al. highlighted the importance of recognizing non-adjacent spinal injury early in order to optimize neurological and physical outcomes[18].

Conclusion

In conclusion, being mindful of non-adjacent spinal injuries in the thoracic spine is important. However, fractures of the posterior aspect of the spine, leading to osseous instability can be difficult to evaluate on MRI alone. In such unstable spine cases are found additional imaging using CT may be an important investigation. A future study concerning the mechanism of injury with a larger population will be needed. However, from our results we can appreciate that the occurrence of the cervical spinal injury combined with non-adjacent thoracic spinal injury is common on cervical spine MR. Radiologists and physicians should broaden the scope of the MR exam especially in cases where specific spinal levels are requested. This would help improve costs in terms of patient's length of stay and avoid future imaging should an injury be missed on the first study.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (University Hospital Limerick) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with human participants performed by any of the authors.

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