Spinal fractures in patients with ankylosing spondylitis and neoplastic disease (primary and metastatic)

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Abstract

Ankylosing spondylitis (AS), bony tumours affecting the spinal column and rheumatoid arthritis all predispose to a risk of pathological fracture. These conditions are all associated with increased bony fragility due to loss of the mineral content of affected bone. Spinal fractutres associated with AS are usually of a highly unstable pattern. Plain radiography may be falsely reassuring and a high index of suspicion and low threshold for axial imaging is required. Surgical stabilization is often, but not invariably, required. Primary and secondary bony tumours are often associated with osteolysis and consequent spinal fracture. The treatment of such fractures requires careful consideration of the prognosis for the patient's malignant disease as determined by tumour biology and the extent of neoplastic spread. Clinical and radiological parameters may help decision-making but management of these patients is often difficult and confounded by uncertainty about the disease prognosis. Rheumatoid arthritis is associated with bony erosions and osteoporosis both as a direct consequence of the disease and of pharmacological treatments. The most common fractures in rheumatoid arthritis are insufficiency fractures which can lead to debilitating pain and occasionally to spinal deformity. Cement augmentation and bisphosphonate infusion are useful strategies in the treatment of these common fractures.

Keywords ankylosing spondylitis; pathological fracture; rheumatoid arthritis; spinal tumours; spine

Ankylosing spondylitis

Introduction

Ankylosing spondylitis (AS) is part of the spectrum of inflammatory spondyloarthropathies and the advanced stages of the disease are characterized by bony ankylosis of the intervertebral discs, ligamentum flavum, interspinous/supraspinous ligaments and facet joints. This results in increased vertebral fragility and sagittal imbalance secondary to thoracolumbar kyphosis.[1] Affected individuals are more than three times as likely to sustain a spinal fracture compared with the normal population. These patients present to the orthopaedic surgeon with fragility fractures of the hip or spine or with marked spinal deformity and associated loss of forward gaze.[2]

Afflicted individuals are at increased risk of pathological spinal fracture (fracture associated with minimal or low-energy trauma). The presence of significant spinal fracture is frequently not recognized given a history of seemingly insignificant trauma in combination with often normal plain radiographic findings.[3] Where present, plain X-ray changes can be very subtle.

Untreated spinal fractures are at high-risk of progression to non-union given the disadvantageous biomechanic environment for fracture healing. In addition, spinal fractures in the patient with AS are associated with a high incidence of spinal cord injury and subsequent mortality.[4,5] The fracture is the only mobile segment in an otherwise ankylosed spinal column with a resultant long lever arm acting across the fractured segment.

A high index of suspicion for spinal fracture is required in patients with AS who present with axial pain following trauma of any magnitude. Axial imaging including computerized tomography (CT) or magnetic resonance imaging (MRI) is the investigation of choice. Surgical stabilization often requires long-segment anterior, posterior or circumferential fixation and fusion.

Pathophysiology

The exact aetiology of AS remains unclear. Historically, authors hypothesized an infective aetiology, noted the prevalence of the disease in the young male and "the tendency [of the disease] to attack robust and virile types rather than the weakly".[6] The current concept of osteo-immunology suggests an autoimmune mediated enthesitis and spondylodiscitis which result from the interaction of the immune and skeletal systems.[7] The receptor activator of nuclear factor-kappa-B ligand (RANKL) has been shown to be crucial in the coupling of osteoblast and osteoclast activities. RANKL is produced by activated T lymphocytes and other inflammatory cells and the activity of these cells is postulated to lead to a disruption of the fine balance that exists between osteoblast and osteoclast activities.

In rheumatoid arthritis (RA), immune cell mediated bone resorption (erosion) is associated with peri-inflammatory bone loss (osteoclastic activity) whilst in AS surrounding bone formation is increased (osteoblastic activity). This is believed to be the aetiology of the ankylosis of the intervertebral disc and spinal ligaments associated with AS. Impaired bone remodelling in the context of abnormal biomechanical forces acting across the spinal units results in osteoporosis and a predilection to pathological fracture.

Prehospital care after trauma

Suspected spinal injury in the community is ordinarily treated by cervical immobilization in a rigid collar and supine positioning on a spinal board with the spine in a neutral position. In the patient with AS however, there is a risk of spinal cord injury if the spine is placed into a "normal" alignment as the typical spinal posture is one of cervico-thoracic kyphosis. The cervico-thoracic junction should therefore not be forced into neutral

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alignment by a cervical collar. Pillows and rolls should be used to maintain the patient's normal kyphotic posture during transfer to the hospital.

In-hospital clinical assessment

Major trauma mandates assessment by the ATLS protocol but spinal fracture in AS is frequently the consequence of a low-energy injury. Detailed examination and documentation of the patient's neurological status is always required as the risk of spinal cord trauma is significant, as is the risk of epidural haematoma. An ASIA chart should be completed and regular re-assessment of neurological status performed. Non-contiguous spinal fractures need to be excluded by careful assessment for spinal tenderness following log roll. If any suspicion of multiple level spinal fractures exists, whole spine MRI with sagittal fat-saturated T2 sequences is required with dedicated sagittal and axial imaging of any site of abnormality.

Imaging

Plain radiography of the fractured spine in AS is frequently misinterpreted as normal.[8] The cervical spine is commonly inadequately assessed on plain imaging with a failure to visualize the cervico-thoracic junction (Figure 1). The thoracic spine is a common site of fracture and visualization of the spinal column is made difficult by the overlying lung and rib shadows (lateral projection) and by the cardiac silhouette (AP projection). The bony outline of individual vertebrae is often normal with the fracture line propagating through a fused disc space. Displacement of the spinal fracture may be minimal with a small cortical breach or soft-tissue swelling being the only evidence of injury to the spinal column (Figure 2).

High-resolution spiral CT scanning is often the best means of identifying disruption of the spinal column in AS (Figure 3). The bony anatomy is well demonstrated and reconstruction in all three planes (coronal, sagittal and axial) makes it unlikely the fracture will not be identified. There is a theoretical risk that the

Figure 1 Plain radiograph of cervical spine in an AS patient presenting 3 weeks after a minor fall. The X-ray is inadequate and was interpreted as normal. CT scan of the same patient showing three-column fracture of C7.

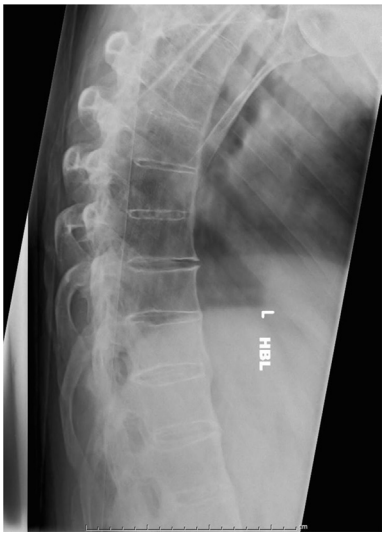

Figure 2 Plain radiograph of thoracic spine showing subtle but significant breach in calcified anterior longitudinal ligament.

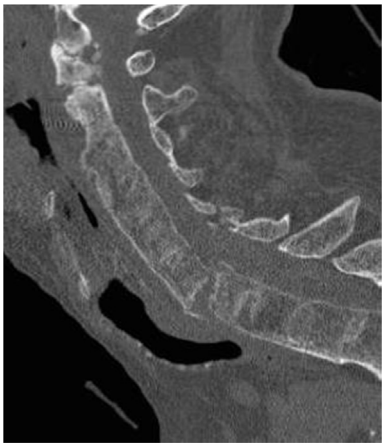

Figure 3 Three-column fracture/dislocation at cervico-thoracic junction ("chalk-stick" fracture) demonstrated on CT.

CT sections may fall to either side of the fracture line thus rendering it invisible on CT images but this is improbable with CT reconstructions in all three anatomical planes. Nevertheless, the presence of a normal CT scan in a patient with AS who presents with axial pain following any trauma should prompt further investigation with MRI.

MRI imaging should include the whole spine (to assess for the presence of non-contiguous fractures) and fat-saturated T2 images should be performed to exclude bony oedema and ligamentous disruption (Figure 4).[9] MRI is mandated in patients presenting with spinal cord injury unless a specific contraindication exists (metallic intra-ocular foreign body and ferromagnetic intra-cranial or cardiac implants). Fractures in AS are associated with a higher incidence of epidural haematoma and this is best quantified by MRI scan.

Non-operative treatment

Non-operative management of spinal fracture in AS may be indicated in patients in whom the spine is anatomically aligned and who have minimal pain with no neurological symptoms or

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