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CASE REPORT

Extension type fracture of the ankylotic thoracic spine with gross displacement causing esophageal rupture

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Abstract
Purpose This study aimed at discussing the relevance of the type B3 fracture of the new AOSpine classification.
Methods Hyperextension fractures of the spine are rare in the general population, but common in the ankylotic spine. We present a case of a severe spinal fracture with concomitant esophageal rupture, which was diagnosed early and could be treated during the initial trauma care.
Results The spinal column was stabilized using a percutaneous technique after which the perforated esophagus was sutured through a thoracotomy. The spinal injury was classified a type B3 fracture using the new AOSpine classification.
Conclusion The B3 typification raised a lot of discussion during the development of the new classification system and may be controversial. This case, however, nicely illustrates the relevance of an intact posterior hinge as compared to C-type injuries where complete dissociation is present with inherent spinal cord damage.

Keywords Spine trauma · Extension injury · Esophageal rupture · AOSpine thoracolumbar spine injury classification system · Surgical treatment · Ankylotic spine

Introduction

A flexible spine can absorb the energy caused by most types of traumatic impacts. The ankylosed spine, however, is prone to fractures even with minor trauma [1]. Hyperextension type injuries, which are extremely rare in the general population, are commonly seen in ankylotic spine. In ankylosing spondylitis (AS) chronic inflammation of the sacroiliac joints, intervertebral discs and facet joints will eventually lead to a complete ankylotic spinal column [2]. Diffuse idiopathic skeletal hyperostosis (DISH) is another cause of spine stiffening that is considered a non-rheumatic degenerative condition that leads to ossification of ligaments and entheses. The etiology is unknown, but there is a strong relation between the appearance of DISH and western lifestyle diseases like hypertension, obesity and diabetes [3, 4]. Because these metabolic syndrome diseases became epidemic in the western world since 1990, it is likely that the incidence of DISH and associated hyperextension fractures will increase in this population [5–8]. We report a case of an extension fracture without spinal cord injury of Th4–Th6 in an ankylotic spine, with extensive anterior dislocation of the corpus of Th4 perforating the esophagus. By means of this case the new AOSpine classification is discussed.

Case

A 73-year-old male, a well-functioning ankylosing spondylitis patient, sustained a high-velocity rear impact accident while driving. He immediately complained of severe back pain and difficulty with swallowing and breathing. He did not lose consciousness and was neurologically intact. He was transferred to the local trauma

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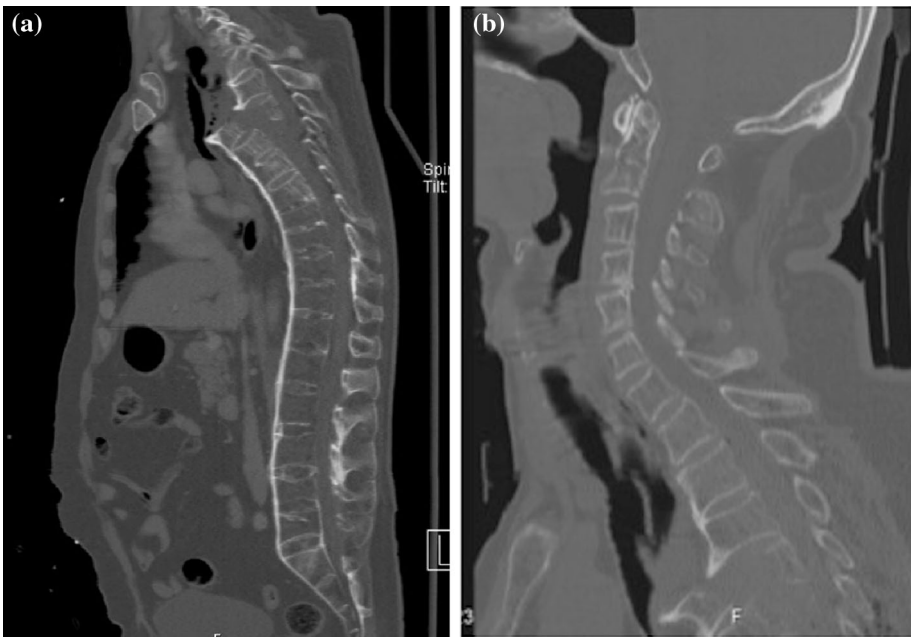

Fig. 1 Sagittal reconstruction of computed tomography of the spine. Hyperextension fracture of Th4–Th6 with extensive anterocranial position of the distal fragment, perforating the esophagus as indicated by air in the peri-esophageal tissues. The cervical spine shows minimal degenerative changes and seems relatively mobile when compared to the ankylotic thoracic and lumbar region

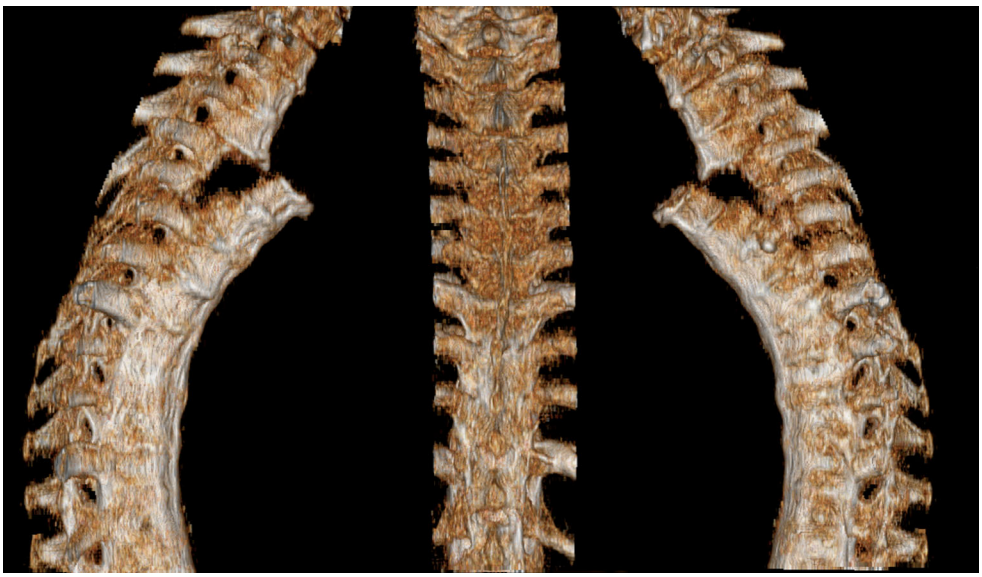

Fig. 2 3D reconstruction of computer tomography of the spine, sagittal and frontal view, showing a type B3 fracture with an intact posterior column

centre and intubated because of severe dyspnea. The initial radiogram of the thoracic spine, which was difficult to interpret due to the ankylosis, showed signs of a fracture with dislocation, but the extension of the trauma could not be seen. A computerized tomography (CT) scan showed a hyperextension type fracture at the level of Th4–Th6. The caudal segment of the fractured thoracic spine seemed to be pricking into surrounding soft tissues. Extraluminal air around this sharp bony edge was present as a sign of an esophagus rupture (Figs. 1, 2). This rupture was confirmed by gastroscopy and provisionally treated with a transnasal stomach tube. The patient received ceftriaxone and metronidazole antibiotics directly after discovering the esophagus rupture, which was continued during 6 weeks postoperatively. Besides the spine fractures and esophagus rupture, rib fractures Th2–Th9 on both sides and pneumato-hematothorax were diagnosed. After hemodynamic stabilization and insertion of a chest tube, he was transported to our centre for further treatment. We stabilized the spine percutaneously without attempting to reduce the fracture. Although difficult to visualize with fluoroscopy, it was possible to achieve good fixation of

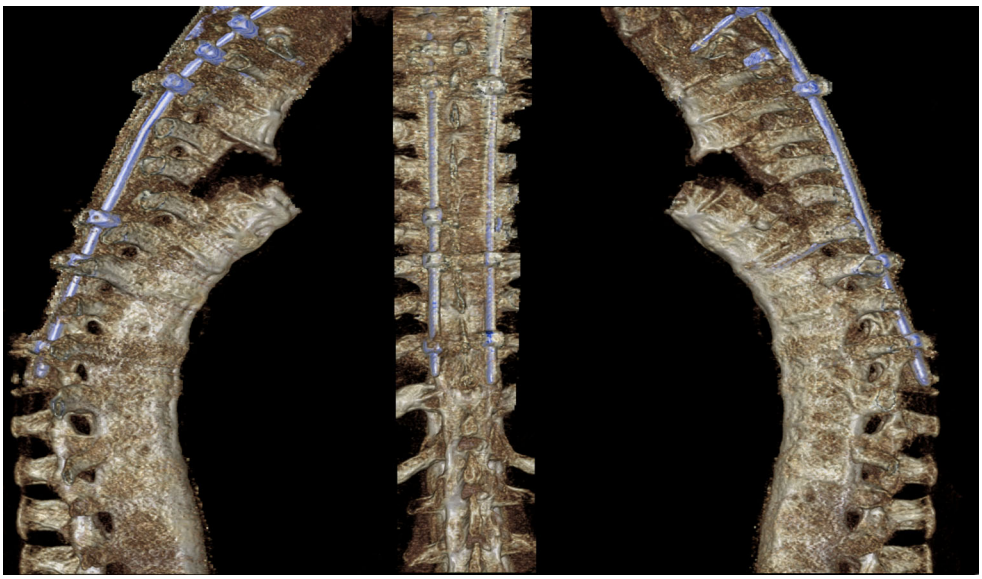

Fig. 3 Postoperative 3D reconstruction of computer tomography, sagittal and frontal view, shows adequate screw position after which unrestricted mobilization was allowed

the spine using the percutaneous technique (Longitude, Medtronic). Contrary to our usual strategy to insert the rods from proximal to distal, we had to use a distal entry point of the rods due to the large kyphosis and position of the head. After the spinal stabilization the patient was turned to a right decubitus position for a left-sided thoracotomy to resect the prominent Th4 spike and to suture the esophagus rupture. Postoperatively, the neurological status was unchanged. Two days later, the rib fractures were stabilized using MatrixRib fixation plates (Synthes). After 7 days ICU the patient was discharged to the medium care unit (MCU), where he developed a high fever 10 days after the trauma. Blood samples identified coagulase negative staphylococcus (CNS). The esophagus was re-evaluated through contrast fluoroscopy and gastroscopy, which did not show recurrence of leakage. The subclavia line was changed and meropenem and vancomycin were added. After 3 days on MCU the infection parameters attenuated, but on day 16 he was again admitted to the ICU due to respiratory problems caused by mucus and a delirium. The mucus could be removed by bronchoscopy and adequate respiration recovered. On day 21 he was discharged from the ICU and had an uncomplicated recovery. Post-operative CT scans showed adequate position of the instrumentation to allow unrestricted weight bearing (Fig. 3). He was discharged to home 32 days after the accident. At 1 year follow up, he had recovered completely and was able to walk, ride a bicycle and drive without limitations. Control radiograms showed unchanged position of the spinal column and intact hardware (Fig. 4a, b).

Discussion

In general, hyperextension fractures of the spine are uncommon. Magerl et al. calculated a percentage of 0.2 % of 1445 spine fractures [9]. When the spine becomes ankylotic, this percentage can rise to 45.5 and 64.3 % [2]. There is a strong relation with appearance of DISH and hyperextension fractures [2]. Because DISH is strongly related to obesity and type 2 diabetes, it is likely that the incidence of DISH and related hyperextension fractures will continue to increase [2]. In the previous Magerl/AO classification spinal fractures were pathomorphologically divided into compression (A), distraction (B) and rotational injuries (C). In some fractures, however, this pathomorphological system fails creating overlap between the categories. For example, a compression fracture with slight rotational deformities may be considered a type C injury. To address these shortcomings, the new AOSpine thoracolumbar spine injury classification system was developed. It is based on three basic parameters: (1) morphological classification of the fracture, (2) neurological status and (3) clinical modifiers. Type A fractures are compression injuries; type B fractures are due to failure of either the anterior or the posterior tension band, without evidence of gross translation or dislocation. The type C fractures are defined as failure of all stabilizing elements, resulting in the absence of any hinge, which allows displacement in any plane.

In the current case, there was obvious hyperextension position of the cranial fragment. However, the posterior soft tissue hinge (PLC) remained intact as well as the spinal

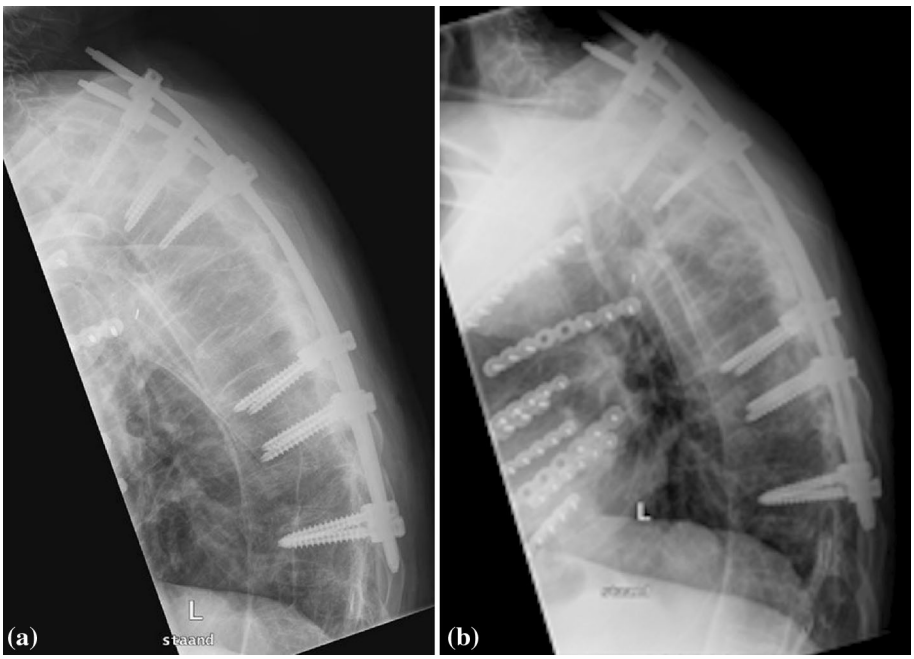

Fig. 4 **a** Direct postoperative sagittal view, **b** sagittal view after 12 months shows intact hardware and no cervical interference of the screws

cord. Therefore this fracture is morphologically best classified as type B3 according the new AO classification. When the hinge is also disrupted and there is a displacement between the cranial and caudal parts of the spinal column, in any plane, it should be classified as type C. The question remains whether this distinction is meaningful. In the initial version of the new AOSpine classification these type of hyperextension injuries were considered type C, calling them C1 injuries [10]. However, as there is still a mechanically functioning bridge/hinge between the cranial and caudal parts, there is by definition no frank dislocation. Therefore, it was finally decided to regard these fractures as type B3 and reserve the C type for complete dislocations. Because there was no neurological deficit in this case it was classified as NO. The ankylotic spine of our patient is the origin of the immense extension injury, which is an important case-specific modifier and therefore classified as M2.

Associated injuries with flexion distraction injuries are well described. In thoracolumbar type B injuries Chapman et al. report an incidence of 30 % concomitant intra-abdominal injuries [11]. In ankylotic spine trauma patients the incidence for associated injuries is much higher. In the systematic review of Westerveld et al. 67.2 % of the patient with AS and 40 % of the DISH patients had a neurologic deficit (ASIA A-D) [1]. Furthermore, they also presented uncommon complications such as aorta dissections or tracheal rupture [1].

The esophagus is in close contact to the anterior spine between C4 and Th4 [12]. Damage to the esophagus could be caused by direct contact, entrapment or severe distraction; it could also be secondary to an ischemic lesion due to disturbed perfusion. The free air around the fractured vertebrae Th4 on the initial CT scan, strongly suggest esophageal perforation due to damage by the sharp bony edge during the initial impact. Because symptoms of mediastinitis will not appear immediately and the amount of free air can be subtle, esophageal perforation can be easily overlooked. Cherveniakov et al. report a delayed diagnosis of 55 % due to failure to recognize the clinical symptoms and another 25 % because of misinterpretation of the radiograms in their series of 147 patients [13]. After 24 h delay, mediastinitis with sepsis typically occurs, which increases the mortality up to 50 % [14]. Recently, Tjardes et al. report a case where an esophageal rupture due to a thoracic spine fracture was discovered postoperatively [15]. This was treated conservatively with an esophageal stent and antibiotic therapy. Traditionally, conservative treatment is advised for perforations diagnosed after 24 h. Since we discovered the perforation by the initial trauma examination we chose to treat it surgically.

Conclusion

An ankylotic spine is more vulnerable for extension type fractures of the spine. The mechanical changes result in different fracture types with more displacement and instability. When looking at the amount of displacement it can be confusing to classify these fractures according to the new AOSpine thoracolumbar spine injury classification

system. Since the hyperextension is the origin of the injury and there was a hinge preventing further displacement we classified this fracture as type B3. Esophageal rupture is a rare concomitant injury with upper thoracic spine fracture that needs high degree of suspicion for early diagnosis.

Compliance with ethical standards

Conflict of interest None of the authors has any potential conflict of interest.

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