

Pitfalls in the clinical diagnosis of vertebral fractures: a case series in which posterior midline tenderness was absent

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Objective: There is widespread belief among doctors that posterior midline tenderness is virtually a prerequisite for spinal fracture in alert, sober patients without any painful distracting injury or neurological deficit. This paper examines and challenges this belief.

Methods and results: We present three patients in whom significant thoracic and lumbar vertebral fractures were missed, or were thought to be "old", because of lack of posterior midline tenderness. We also present two further patients, one with a lumbar spine fracture and one with a cervical spine fracture, in whom posterior midline tenderness was absent but in whom the correct diagnosis was made. All these patients were sober and fully alert and none had a neurological deficit or a painful distracting injury.

Conclusion: The absence of posterior midline tenderness does not exclude significant spinal injury. We suggest that patients should satisfy both the Canadian and British guidelines before it is decided that imaging of the cervical spine is unnecessary.

A preliminary study from the USA, designed to determine the need for imaging after cervical spine injury, described 27 patients with cervical spine fracture.¹ Of these, 19 were fully alert at the time of examination. All but two of the 19 alert patients had posterior midline tenderness. Of the two patients who were not tender, one had a severely painful distracting injury and the other had a blood alcohol level of 200 mg/dl. A decision rule was subsequently derived from a much larger number of patients, of whom 818 had a significant cervical spine injury. In this group of patients, more than 99% of significant cervical spine injuries could be ruled out by the exclusion of each of the following: posterior midline tenderness, intoxication, depressed conscious level, painful distracting injury, and neurological deficit. It was concluded that if the rule were applied with care, the exclusion of these five criteria would safely reduce the requirement for *x* rays (the National Emergency X-radiography Utilization Study; NEXUS).² It seems likely that the belief that posterior midline tenderness is an important factor in the detection of significant spinal injury is based on this work.

The Canadian Cervical Spine Radiography Rule for alert, stable trauma patients was published the following year (2001).³ This rule was derived from data on 8924 patients, of whom 151 had a significant cervical spine injury. Three high risk factors were identified, any of which mandates radiography: age ≥ 65 years, dangerous mechanism, or paraesthesiae in the extremities. When these high risk factors are absent, the presence of any of the following low risk factors allows safe assessment of the range of motion: simple rear end shunt, sitting position in the emergency department (ED), ambulatory at any time, delayed onset of neck pain, or the absence of midline cervical spine tenderness. If the high risk factors have been eliminated and if at least one of the low risk criteria is satisfied, it is deemed to be safe to ask the patient to rotate the neck actively through 45° to the left and right. If this is achieved, *x* rays are said to be unnecessary. The Canadian rule has been compared with clinical judgement and was reported to be better than physicians' subjective probability estimates.⁴

The British Trauma Society has also published guidelines for the initial management and assessment of spinal injury.⁵

These are based on an extensive review of the literature. There is some similarity with the NEXUS guidelines in that, in order to clear the cervical spine, the patient must be fully alert and orientated, and there must be no head injury, no drugs or alcohol, no abnormal neurology, and no significant "distracting" pain from an injury in a separate body region. However, unlike the NEXUS guidelines, there should be no neck pain. If all these criteria are satisfied, the neck should be examined, and the cervical spine can be clinically cleared provided that there is no bruising or deformity, no tenderness, and a pain free range of active movement.

While the British guidelines take account of neck pain, including neck pain during active movement, the Canadian guidelines only consider pain to be relevant if it is immediate. In contrast to the Canadian guidelines, the British guidelines state that the mechanism of injury does not determine the need for imaging. This is because the mechanism is subsumed by the other parameters.

There is less evidence as to the indications for imaging the thoracolumbar spine. Nevertheless, we have noticed that doctors commonly believe that the absence of the five NEXUS criteria, in particular the lack of posterior midline tenderness, reliably excludes spinal fractures not only in the cervical spine but in the thoracolumbar spine also. The British guidelines are more exacting. While acknowledging that a history of alcohol or drugs or a painful distracting injury are significant factors, the British guidelines state that "imaging is clearly indicated if there is pain, bruising, swelling, deformity or abnormal neurological findings attributable to a thoracic or lumbar spinal injury".⁵ Furthermore, it has been reported elsewhere that pain may be the sole predictor of thoracolumbar spinal injury.⁶

CASE SERIES

We present three patients in whom significant thoracic and lumbar vertebral fractures were missed, or were thought to be "old", because of lack of posterior midline tenderness. We also present two further patients, one with a lumbar spine fracture and one with a cervical spine fracture, in whom

Abbreviations: ED, emergency department; NEXUS, National Emergency X-radiography Utilization Study



Figure 1 (A) Lateral radiograph of the thoracic spine showing a crush fracture of the third thoracic vertebra. (B) Axial CT scan of the 11th thoracic vertebra showing a complex but stable fracture of the vertebral body (the apparent incongruity of the left pedicle is projectional). (C) Lateral radiograph of the thoracolumbar junction showing a minor wedge fracture of the 12th thoracic vertebra and a severe wedge fracture of the first lumbar vertebra. There is a kyphosis at L1-L2.

posterior midline tenderness was absent but in whom the correct diagnosis was made. All these patients were sober and fully alert and none had a neurological deficit or a painful distracting injury. We discuss the application of the NEXUS, Canadian, and British rules to our patients and make clinical recommendations.

Case 1

A 26 year old woman fell from her horse in a point to point horse race. She complained of severe pain between her shoulder blades, but had no other complaints of injury. She was transported to the ED, where she was assessed by an experienced middle grade doctor. She was log rolled, and her spine was examined according to ATLS teaching. Posterior midline tenderness was absent. Notwithstanding this, radiographs were taken, which showed a severe crush fracture of her third thoracic vertebra (fig 1A). She had no previous history of spinal injury, but it was thought that the fracture was old because of the lack of local tenderness. She was discharged home with analgesia. After leaving the department, she reported that she was in great pain and had developed numbness under one arm. A CT scan showed the crush fracture of T3 to be unstable. Moreover, there were small bone fragments in the spinal canal, narrowing the anteroposterior diameter by 25%. She was seen by a neurosurgeon, who recommended immobilisation in a spinal jacket, and she was subsequently seen by a spinal surgeon, who stated that he would have considered surgical stabilisation if he had seen her at an earlier stage.

Case 2

An 18 year old woman fell from a bucking horse and landed on her back. Back pain prevented her from standing. She was

transported to the ED where her spine was examined by an senior house officer supervised by a consultant. She had right sided paravertebral muscle tenderness but no posterior midline tenderness. Palpation of her abdomen increased her back pain and there was diffuse abdominal tenderness. She was investigated with a CT scan of her abdomen, which showed a stable fracture of T11 (fig 1B). No other cause was found for her abdominal tenderness. She was given analgesia and allowed to mobilise.

Case 3

A 70 year old man fell 8 feet from a ladder. He complained of severe upper lumbar pain and was unable to stand. He had no previous history of spinal injury or back pain. He was transported to the ED, but radiographs were not taken because posterior midline tenderness was absent. There was some paravertebral muscle tenderness. He was subsequently in severe pain, requiring daily visits from his general practitioner. He was therefore recalled and radiographs were taken of his lumbar spine. These showed severe wedging of the vertebral body of L1 and minor wedging of T12 (fig 1C). He was admitted to hospital for bed rest and analgesia, and subsequently mobilised in a thoracolumbar brace.

Case 4

A 63 year old woman slipped and fell against the boundary netting while playing tennis. She complained of back and abdominal pain and required opiate analgesia. There was no posterior midline tenderness. Radiographs showed a wedge fracture of the first lumbar vertebra (fig 2A). This was shown to be stable on CT and she was treated with bed rest and analgesia followed by mobilisation in a spinal brace.

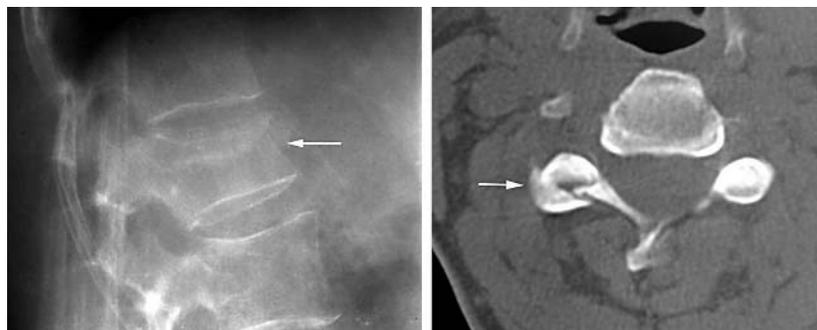


Figure 2 (A) Lateral radiograph of the lumbar spine showing a wedge fracture of the first lumbar vertebra. (B) Axial CT scan of the cervical spine showing a fracture through the right cervical 3-4 facet joint (the fracture through the fourth cervical vertebral body is not seen on this image).

Case 5

A 44 year old woman, restrained in a seatbelt, lost control of her car, veered off the road and rolled over into a ditch at an estimated 30 miles/hour. She had aching in her neck but no other symptoms. She was fully alert and passed a routine breath test for alcohol. She was transported to the ED, where her cervical spine was examined by a consultant. There was no posterior midline tenderness and she was readily able to turn her head to left and right through 45 degrees. Cervical spine radiographs, taken to reassure her, showed a fracture of the C4 vertebral body, and a CT scan also showed a fracture through the right C3–4 facet joint (fig 2B). She was admitted to hospital and was subsequently mobilised in a rigid collar.

DISCUSSION

When a fracture is in a superficial position, there is focal tenderness on direct palpation. Palpation at a distance from the fracture does not cause tenderness. Furthermore, focal tenderness is difficult to elicit in fractures that occur in well muscled areas, presumably because the muscle cushions the fracture site. Direct palpation of a vertebral body is impossible and this may explain why palpation in the posterior midline (often at a considerable distance from a vertebral fracture) may fail to elicit focal tenderness. The smaller, more mobile cervical vertebrae might perhaps allow better transmission of pressure to a fracture site, thus accounting for the findings from the USA, where posterior midline tenderness apparently had a very high sensitivity for significant cervical spine injury in selected patients.^{1,2} However, it is worth noting that posterior midline tenderness only had an 86% sensitivity for cervical spine injury in the study that underpinned the more stringent Canadian cervical spine radiography rule.³ In our own patient with fractures of the C4 vertebral body and right C3–4 facet joint (case 5), radiographs were not indicated according to the USA guidelines, except that the authors had stated "as with any other clinical tool, it should be applied with great care and should not replace clinical judgment in the care of individual patients".² According to the Canadian cervical spine radiology rule,³ radiographs were indicated solely on the basis of dangerous mechanism. If the "aching" of which our patient complained had been interpreted as "pain", radiographs would also have been required according to the British guidelines.⁵

The potential for neurological injury means that the accurate and timely diagnosis of spinal injuries is essential. We therefore recommend that patients should be asked if they have any spinal pain, and if so, at what level. Patients with lower thoracic and upper lumbar fractures may also have abdominal pain. We recommend that any patient who

has spinal pain, and whose mechanism of injury was significant in relation to his or her age, should be imaged regardless of whether or not there is demonstrable spinal tenderness. It can be difficult to evaluate the age of spinal fractures and sometimes to distinguish fractures from degenerative change on plain x ray films. When fractures are identified in non-tender patients, their age and extent can be evaluated on CT scanning. CT scanning is more sensitive and accurate than plain radiographs in demonstrating spinal injuries, and some authors advocate that CT should replace plain radiographs at initial screening.^{7,8} It should be noted that there is a legal obligation to minimise exposure to radiation in the UK and Europe.

CONCLUSIONS

The absence of posterior midline tenderness does not exclude significant spinal injury. We suggest that patients should satisfy both the Canadian and British guidelines before it is decided that imaging of the cervical spine is unnecessary. The British guidelines identified the need for imaging for all the thoracolumbar spinal injuries in this series.

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