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Cervical spine injury in child abuse: report of two cases

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Abstract Pediatric cervical spine injuries have rarely been reported in the setting of child abuse. We report two cases of unsuspected lower cervical spine fracture-dislocation in twin infant girls who had no physical examination findings to suggest cervical spine injury. Classic radiographic findings of child abuse were noted at multiple other sites in the axial and appendicular skeleton.

Magnetic resonance (MR) imaging proved to be valuable in both the initial evaluation of the extent of cervical spine injury and in following postoperative changes. The unexpected yet devastating findings in these two cases further substantiate the importance of routine evaluation of the cervical spine in cases of suspected child abuse.

Introduction

Cervical spine fractures have historically been considered rare in the setting of child abuse. We report two cases of unsuspected cervical spine fracture-dislocation in twin infant girls. Neither infant had signs of abuse on physical or neurological examination, yet both showed classic radiographic evidence of abuse at multiple sites in the axial and appendicular skeleton. While plain films adequately identified and characterized the fracture-dislocations, MR imaging proved to be valuable in identifying cord compression on both infants, and in preoperative planning and postoperative follow-up. Based upon the findings in these two cases, we further support inclusion of the cervical spine in the radiographic evaluation of child abuse.

Case report

Patient 1

A 3-month-old premature twin girl born at 33 weeks gestation was brought to the emergency room by her parents because of fever and upper respiratory symptoms. Physical exam revealed a small for gestational age infant who was irritable but consolable. There was no history or external sign of trauma. A chest radiograph was performed to rule out pneumonia, revealing multiple fractures.

The patient was admitted for suspected child abuse and a protocol to rule out sepsis. A skeletal survey revealed 20 fractures, including multiple rib fractures, fractures of the left distal radius and ulna, multiple metaphyseal fractures, and a sternal depression fracture. A cervical spine series demonstrated a compression fracture of the C5 vertebral body and anterior subluxation of C4 on C5. A technetium-99m bone scan corroborated the plain film findings.

A complete neurologic evaluation of the patient performed by a board-certified pediatric neurologist was normal. MR examination of the spine demonstrated mild cord compression secondary to the fracture-dislocation (Fig. 1). MR examination of the brain was within normal limits. The patient was placed in a total-body cast for stabilization of the cervical spine fracture-dislocation. Follow-up MR imaging demonstrated continued cord compression, and the child underwent a decompressive C4–6 laminectomy and C3–7 posterior cervical fusion. Postoperative MR imaging (Fig. 2) revealed near anatomic alignment of the spine, but also an area of high T2 signal within the cord consistent with myelomalacic and/or posttraumatic syrinx.

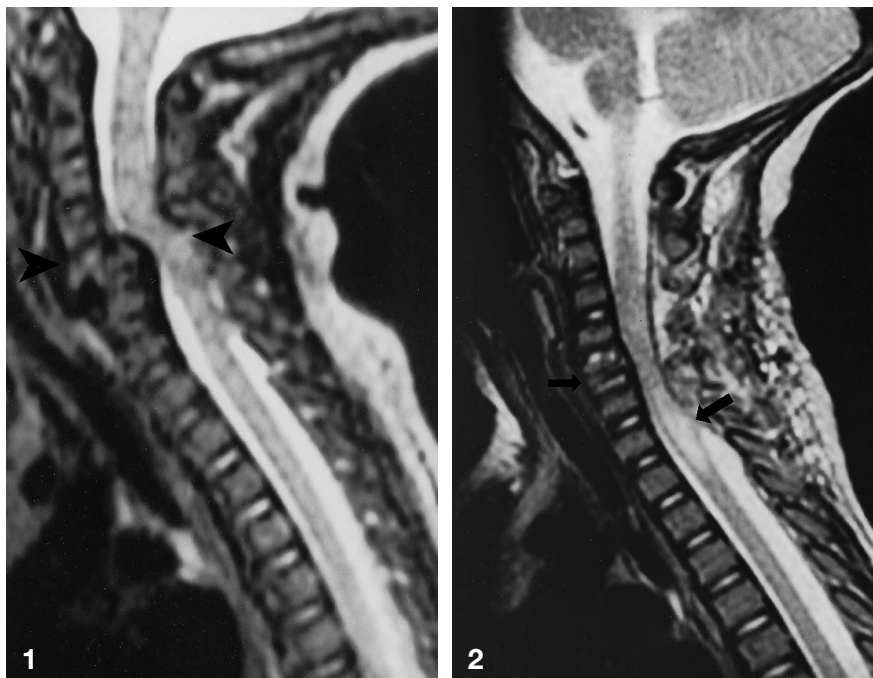
A voiding cystourethrogram performed for persistent urinary tract infections revealed a trabeculated bladder consistent with neurogenic dysfunction. Otherwise, the patient continues to be neurologically normal except for some decreased movement of her left arm.

Patient 2

The 3-month-old twin infant sister of patient 1 was admitted for child abuse evaluation the same day as her sibling. She had recently been discharged following a 3-day hospitalization for viral men-

Fig. 1 Case 1. Sagittal MR T2-weighted image (TR 3000/TE 85) demonstrates almost complete subluxation of C4 on C5. Decreased CSF space is noted surrounding the spinal cord consistent with spinal cord compression (arrowheads)

Fig. 2 Case 1. Postoperative T2-weighted MR image (TR 2500/TE 85) demonstrates near-anatomic alignment of the vertebral bodies. Decreased vertebral body height of C5 is noted (small arrow). The spinal canal remains significantly narrowed at this level. High signal is noted within the central cord just inferior to this level (large arrow), probably representing myelomalacic changes or post-traumatic syrinx



ingitis. Spinal fluid analysis during the previous admission had revealed slightly elevated protein, 40 white blood cells per mm^3 , 50 red blood cells per mm^3 and no xanthochromic cells. No evidence of child abuse was noted during the previous hospitalization. Physical examination, which included a complete neurologic examination by a board-certified pediatric neurologist, was normal at the time of this second hospitalization. However, a skeletal survey revealed a total of 14 fractures of various ages, including multiple rib fractures not visualized on a chest X-ray performed 3 months earlier. Multiple metaphyseal fractures were also noted. In addition, plain films of the cervical spine revealed a fracture-dislocation of C5 on C6 (Fig. 3). Technetium-99m bone scan again corroborated the plain film findings.

Cervical spine MR examination confirmed the C5–6 fracture-dislocation and revealed mild cord compression without any cord signal abnormality (Fig. 4). Brain MR examination was within normal limits. The patient was placed in a cervical spine cast and traction device and discharged to foster care. Follow-up MR imaging 4 months later revealed increasing C5–6 subluxation and cord compression but continued normal cord signal (Fig. 5). The patient underwent a total of three surgeries to reduce the subluxation and stabilize the spine and continues to have spinal canal compromise.

Discussion

Child abuse is a continually perplexing subject for the clinician and radiologist. The frequent lack of external signs of trauma can make the diagnosis difficult. These cases underscore the point: despite the extreme range of injuries sustained by these twin infants, including many classically associated with child abuse, the physical examinations were initially unremarkable.

The spectrum of radiographic abnormalities in child abuse is well documented in the literature. Injury patterns which correlate highly with abuse include multiple fractures, bilateral fractures, fractures in different stages of healing, and vertebral body fractures and subluxations [1]. These injury patterns become almost pathognomonic when a compatible trauma history is absent, particularly in a child too young to ambulate.

Injuries of the thoracic and lumbar spine in the setting of child abuse have been documented in the pediatric and radiologic literature, but reports of cervical spine injury are rare [2]. Most spinal injuries compatible with abuse are noted as “incidental” findings on skeletal surveys or on films obtained for evaluation of long-standing spinal deformity, and are seldom associated with neurological injury [3]. The few reports that have documented cervical spine injury in child abuse have noted concomitant physical examination findings that pointed to cervical spinal cord injury [4]. However, not all cases with physical examination evidence of cord injury have radiographic findings of spinal injury. An abused child who sustained injuries resulting in quadriplegia had findings of cord contusion on MR, but a normal-appearing cervical spine on plain film examination [5].

The mechanism involved in fracture-dislocation of the spinal column has been well studied [6, 7]. During hyperflexion or hyperextension, fractures of the posterior elements and/or disruption of the posterior ligamentous complexes may allow anterior or posterior dislocation of vertebrae with spinal cord compression. Infants are at greater risk from these forces due to their

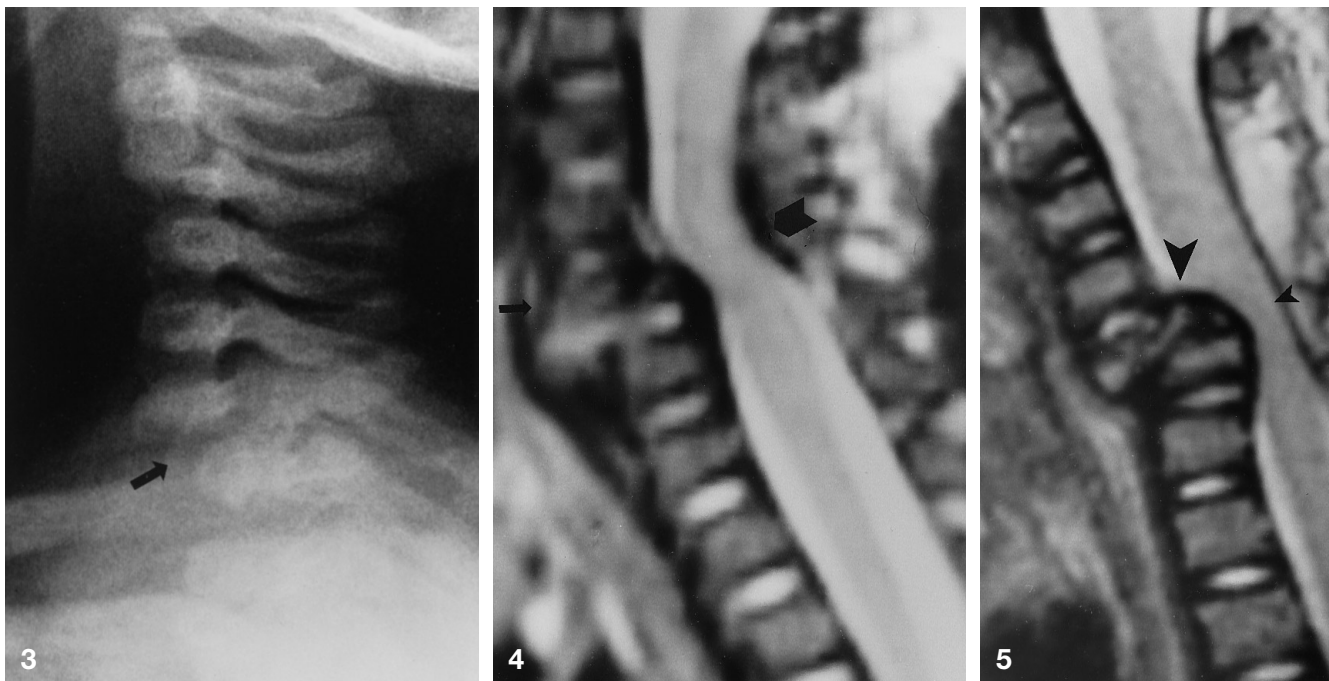


Fig. 3 Case 2. Lateral cervical spine demonstrates anterior subluxation of C5 on C6 (arrow)

Fig. 4 Case 2. T2-weighted MR image (TR 3000/TE 85) demonstrates almost complete anterior subluxation of C5 on C6 (small arrow) with resultant spinal canal stenosis and cord compression (large arrow)

Fig. 5 Case 2. Follow-up weighted MR image (TR 3000/TE 85) prior to surgery, 4 months after initial imaging, demonstrates increased subluxation and cord compression (large arrowhead) but continued normal cord signal (small arrowhead)

relatively large head size, elastic underdeveloped ligaments and neck muscles, and incompletely ossified vertebrae with shallow and horizontally oriented cervical facet joints. Given these factors, hyperflexion or hyperextension forces are more likely to result in compression fractures and/or subluxation in infants than in older children or adults. In the cases of the two infants described

in the report, the likely mechanism of injuries is severe hyperflexion compression insult from violent shaking.

The value of MR in assessing cervical spinal injuries is clearly demonstrated in these two cases. The unexpected postoperative finding of myelomalacic changes in the spinal cord of patient 1 correlated with subsequent development of neurological deficits. Interestingly, patient 2 continues to be neurologically normal in spite of continued malalignment and cord compression.

These two cases of unsuspected life-threatening injuries of the cervical spine underscore the importance of routine radiographic evaluation of the cervical spine in the setting of child abuse. The use of plain film for the initial detection of the lesion is important, as well as consideration of MR imaging for spinal cord evaluation if indicated. As with other traumatic lesions encountered in this process, cervical spine injury may be unsuspected by the clinician, and the responsibility for its detection may rest with the radiologist.

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