

MRI findings in herniation of the spinal cord

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ABSTRACT

Herniation of the spinal cord is a rare condition that causes non specific neurological deficits that are often a diagnostic challenge to clinicians. Despite several reports in the neurosurgical literature, it is only recently that the imaging appearances of this condition have come to be recognised, due mainly to the widespread adoption of spinal MRI. It is important for radiologists to recognise the telltale MRI features of this condition, as several cases have undergone initial misdiagnosis, resulting in delayed treatment. We present a case with typical imaging features to familiarise radiologists with this condition, as it is likely that more cases will come to the fore, with more spinal MRIs being performed.

CASE REPORT

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A 56 year old woman presented with a 3 year history of upper thoracic back pain. There was no radiation of the pain, and she reported no bowel or bladder derangements. She worked as a carer looking after the elderly, and found her pain worse following physical manual handling. Physical examination revealed mild right lower extremity hypoaesthesia, but no objective motor deficit. There was no antecedent history of trauma or meningomyelitis.

Spinal MRI on a 1.5T scanner (GE Signa Excite) was performed. Sagittal sections demonstrated ventral displacement of the spinal cord at the level of T3, with a C-shaped kink (Figure 1). Axial sections showed a left antero-lateral displacement of the cord, with loss of the normal intervening CSF signal between vertebral body and cord (Figure 2). There was expansion of the dorsal subarachnoid space, with no evidence of any extra-dural masses or cyst. Further, the presence of normal CSF flow artefact dorsal to the cord was an important finding, as it implied there was no dorsal obstruction lesion. Based on the radiological findings, a diagnosis of herniation of the spinal cord was made. The patient is currently being followed up on conservative treatment, in view of the stable nature of her symptoms.

DISCUSSION

Herniation of the spinal cord is an unusual condition and can be defined as protrusion of the spinal cord beyond its dural sleeve. Review of the literature by the authors found a total of 140 reported cases. This condition has been increasingly recognised since the mid-90's and coincides with the growing application of routine MRI [1]. Most cases have been described in the Neurosurgical literature, and review of the imaging findings of these cases demonstrates a number of common features, that enable radiological diagnosis. Nevertheless, several of these reported cases were initially misdiagnosed, resulting in delay in correct management [2]. It is therefore important for Radiologists to recognise this condition, to guide management. We present a case with typical imaging features, to familiarise radiologists with herniation of the spinal cord.

Our case reflects many of the typical clinical and imaging features of herniation of the spinal cord. This condition mainly affects middle-aged patients (median age 50 years old), with a 2:1 female to male predominance [1]. There is a predisposition for the T3-T7 levels (80% of all patients), with all other cases also occurring in the thoracic spine (range of T2 to T9) [2]. It has been postulated that the negative pressure in the thoracic

extradural space and the proximity of the heart amplifying CSF pulsations accounts for the thoracic distribution of this condition [2]. However, this has not been proven.

A majority of cases reported (80%) had variable features of a Brown-Sequard syndrome (ipsilateral hemiparesis with loss of proprioception, and contralateral loss of pain and temperature sensation) [2]. This can be explained by the ventral herniation, especially if antero-lateral, compressing the lateral spinothalamic tracts initially, impairing contralateral pain and temperature sensation. As the herniation worsens, the corticospinal tracts are involved, resulting in ipsilateral limb weakness and spasticity. Other presentations included spastic paresis, bowel or bladder sphincter dysfunction, isolated motor or sensory disturbance (as in the case of our patient), and chest pain [3-6]. It is important to note that given the wide possible clinical presentations, specific diagnosis relies on MRI.

MRI findings are typical, with the herniation in all cases being in an antero-lateral or anterior position. It remains unknown why this occurs in an anterior rather than posterior direction. On sagittal sections, an anterior C-shaped kink of the cord can be seen, with secondary expansion of the dorsal subarachnoid space. The other telltale sign is that on axial sections, the herniated cord is attached to the ventral dura mater, with no intervening CSF. The herniated cord may be seen to be thinned due to atrophy, and may demonstrate signal changes [1]. The most common misdiagnosis in the literature has been to mistake the expanded dorsal subarachnoid space for an arachnoid cyst [3]. However, careful scrutiny of the images will reveal no intra-dural mass or cyst. The presence of normal CSF pulsation artefact is another important diagnostic feature, since it implies unimpeded CSF flow. In earlier reports, further imaging techniques were used to confirm the diagnosis, namely CT myelogram (to demonstrate attachment of the cord to the ventral dura with no intervening CSF, and absence of posterior subarachnoid lesion) and phase-contrast MRI (to demonstrate normal pulsatile CSF flow dorsally, and hence no cyst) [1, 7]. In our case, the imaging findings were so pathognomonic that no further imaging was necessary.

The pathogenesis of spinal cord herniation remains unresolved. A number of theories have been put forward, including congenital deficiency of the dura, remote history of trauma, duplication of the ventral dura mater and pressure erosion of the dura [4, 8-10]. Several authors have postulated that, irrespective of the aetiology, the initial defect of the dura is blocked by the spinal cord. Further pressure from CSF pulsations is likely to then cause transdural herniation of the cord, thereby plugging the flow of CSF through the defect [4, 11, 7].

The majority of cord herniation cases have been treated surgically. Most cases of cord herniation have been published in the Neurosurgical literature, and there is maybe a bias towards surgical treatment. The stated aim of surgical treatment is to reduce the herniation and prevent recurrence, either by using a patch or widening the defect to prevent strangulation of the cord [12-14]. Surgery is generally offered if there progressive myelopathy; patients presenting with Brown-Sequard syndrome were felt to have better outcome

than those with spastic paraparesis [2, 15]. Watchful waiting is recognised as valid management in patients with stable symptoms, especially in view of the reported complications of surgical treatment [3]. This is the current management strategy adopted for our patient.

TEACHING POINT

Imaging findings of spinal cord herniation on axial images include protrusion through the dura in an antero-lateral or anterior position. On sagittal images, an anterior C-shaped kink of cord and secondary expansion of the dorsal subarachnoid space can be seen.

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FIGURES



Figure 1: 56 year old woman with anterior herniation of spinal cord at the level of T3. Sequential sagittal T2 images demonstrate anterior displacement of the cord, with a C-shaped kink at T3 (arrows). The dorsal arachnoid space is expanded and normal CSF flow artifact can be seen (arrowheads). This indicates that there is no dorsal arachnoid lesion causing anterior displacement of the cord. (Protocol: 1.5 Tesla MRI (GE Signa Excite), TR/TE: 4420/120, 4mm slice thickness, non-contrast).

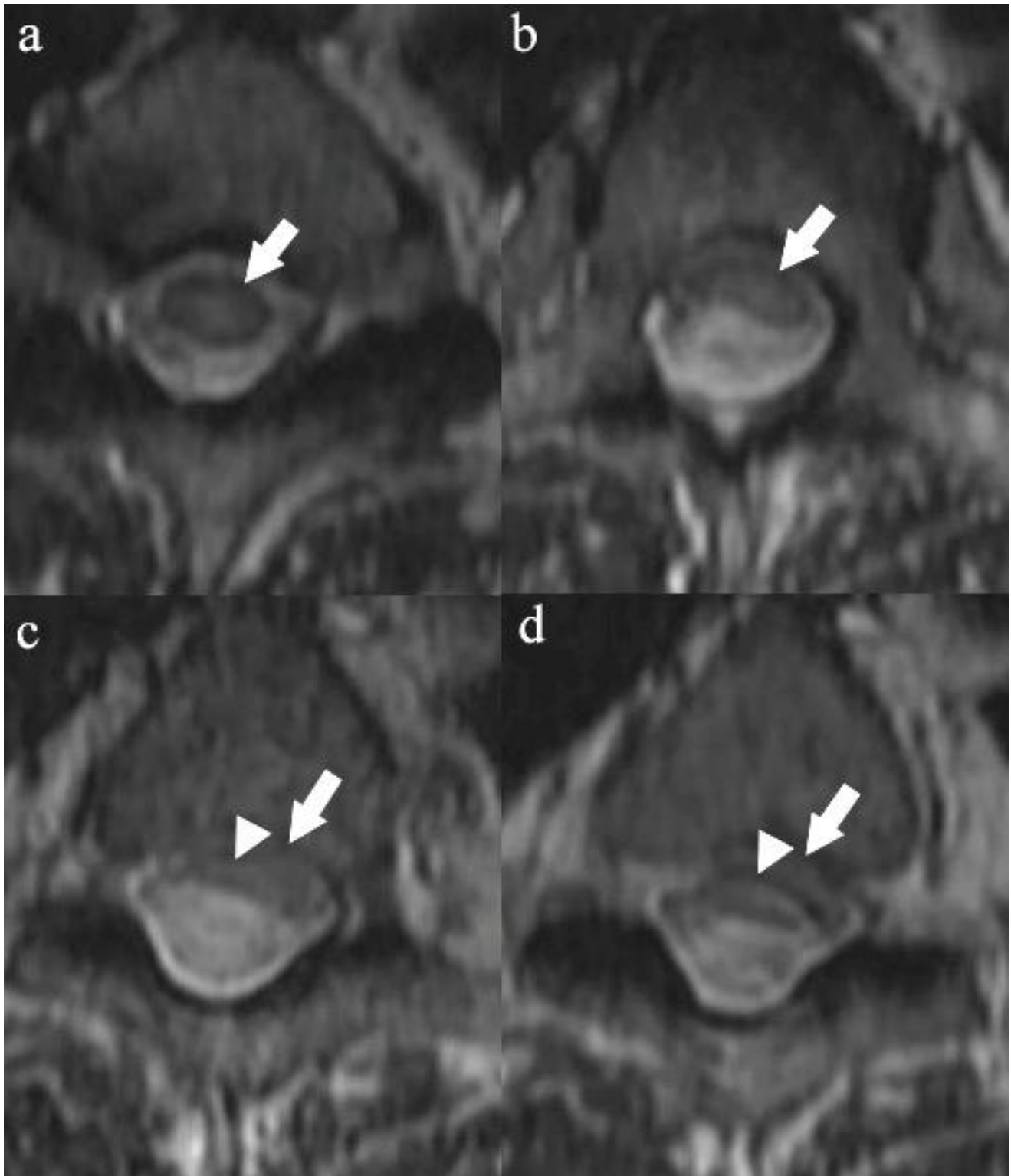


Figure 2: (a-d) 56 year old woman with antero-lateral herniation of spinal cord. Sequential axial T2 images at the level of T3 show left antero-lateral herniation of the cord (arrows). On Figures c and d, the cord herniates through the ventral dura mater (arrowheads). No CSF is seen ventral to the herniation, and there are no intra-dural lesions. (Protocol: 1.5 Tesla MRI (GE Signa Excite), TR/TE: 4420/120, 4mm slice thickness, non-contrast).

Etiology	Unknown but the following have been postulated: congenital deficiency of the dura, remote history of trauma, duplication of the ventral dura mater and pressure erosion of the dura.
Incidence	Total of 140 cases have been reported in the literature.
Gender ratio	Female/male = 2/1
Age predilection	Middle age (median age 50 years old).
Risk factors	Unknown
Treatment	Controversial as not many cases have been reported. Treatment options include non-operative treatment or surgery by using a patch or widening the defect to prevent strangulation of the cord.
Prognosis	Patients presenting with Brown-Sequard syndrome have better outcome than those with spastic paraparesis. However, a small number of patients have worse symptoms following surgery.
Findings on imaging	MRI T2 – axial: herniation in antero-lateral or anterior position; herniated cord attached to ventral dura mater, with no intervening CSF. Sagittal: anterior C-shaped kink of cord; secondary expansion of the dorsal subarachnoid space.

Table 1: Summary table of spinal cord herniation

	CT myelogram	MRI - T1	MRI - T2
Cord herniation	Contrast seen posterior to herniated cord	Poorly seen	Herniation in antero-lateral or anterior position; herniated cord attached to ventral dura mater, with no intervening CSF. Sagittal: anterior C-shaped kink of cord; secondary expansion of the dorsal subarachnoid space.
Arachnoid cyst	No contrast posterior to cord	Poorly seen	Intradural mass; absence of normal CSF flow artifacts; phase contrast imaging demonstrates absence of pulsatile CSF flow.

Table 2: Differential diagnosis table of spinal cord herniation

ABBREVIATIONS

CT: Computerised Tomography
MRI: Magnetic Resonance imaging

KEYWORDS

Hernia, Magnetic Resonance Imaging, MRI, Spinal Cord Diseases, Thoracic Vertebrae

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