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AJNR Am J Neuroradiol 1987, 8 (4) 724-726
http://www.ajnr.org/content/8/4/724.citation

Transdural Herniation of the Cervical Spinal Cord as a Complication of a Broken Fracture-Fixation Wire

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Herniation of the spinal cord through a dural rent is a rare occurrence. Although sporadic cases have been documented, the diagnosis has never been made preoperatively [1–3]. We report a case of a transdural cord herniation at the C1–C2 level. The dural tear was a result of penetration by a broken fracture-fixation wire and its subsequent complications. Transdural spinal cord herniation was demonstrated preoperatively by CT metrizamide myelography and MR imaging. Although conventional myelography did not demonstrate the hernia directly, it did reveal characteristic myelographic findings. To our knowledge, the complication of a broken fracture-fixation wire penetrating the dura has not been previously reported. Tears in the spinal dura require surgical closure to prevent nerve root entrapment, meningitis, or cord herniation.

Case Report

A 33-year-old man sustained an unstable odontoid fracture in a motor vehicle accident 15 years prior to admission. Posterior cervical wiring of C1 and C2 spinous processes was performed for stabilization. He was asymptomatic with no limitation of activities. A few months before admission he experienced the gradual onset of left arm pain, numbness, and weakness, which increased in severity and was exacerbated by turning his head to the left. Cervical spine radiographs demonstrated a broken wire at the C2 level. Myelography and CT metrizamide myelography showed that the tip of the wire penetrated the dura and came in contact with the cervical spinal cord (Fig. 1). At surgery, the wire was cut and the offending portion removed with attendant leakage of spinal fluid. The dura was not directly visualized or repaired.

Postoperatively, the patient improved for approximately 2 weeks, when previous symptoms recurred rather abruptly and eventually he was more symptomatic than before the operation. Myelography and CT metrizamide myelography were then repeated. Pantopaque myelography was used because the patient experienced severe nausea, vomiting, and headache with metrizamide. These studies demonstrated decreased sagittal diameter of the cervical cord with displacement to the left and posteriorly at C1–C2. Cord herniation was not demonstrated. He was referred to our hospital.

On admission, he complained of numbness and weakness in the left hand and leg and unsteadiness while walking. Neurologic examination revealed a left hemihypalgesia with decreased vibratory sense. Left arm dysesthesia, bilateral hyperreflexia, and left extensor plantar response were present. CT metrizamide myelography and MR imaging were performed to evaluate suspected syringomyelia or adhesions. CT metrizamide myelography showed herniation of the spinal cord through a tear in the dural sac at the C1–C2 interspace. A small amount of extravasated contrast material was seen posteriorly (Fig. 2). Sagittal MR imaging demonstrated posterior tethering of the cord and a region of abnormal signal intensity at the C2 level (Fig. 3A). Transverse and coronal MR images (Figs. 3B–3D) clearly showed the hernia. The diagnosis of transdural herniation of the cervical spinal cord was made preoperatively.

The imaging findings were confirmed at surgery after left C2 hemilaminectomy was performed and the inferior arch of C1 was removed. The cervical spinal cord herniated through a 10-mm dural opening into the extradural space accompanied by the left C2 nerve root. There was C1–C2 instability. Midline dural incision revealed arachnoiditis and constriction of the spinal cord at the site of herniation. The cord was then repositioned and arachnoid bands lysed. The arachnoidal opening was closed and a duraplasty performed. C1–C2–C3 interlaminar fusion was performed. The patient had complete resolution of his cervical myelopathy in the immediate postoperative period.

Discussion

This case is unique and instructional for several reasons. The complication of a fracture-fixation wire breaking and penetrating the dura has not been previously published. While herniation of the spinal cord through the dura has been reported, the herniation was not recognized before surgery [1–3]. We present the diagnostic findings on CT metrizamide myelography and MR imaging as well as the typical myelographic appearance of spinal cord herniation. The use of myelography, CT metrizamide myelography, and MR imaging in this case illustrates the relative strengths and weaknesses of each imaging technique and their complementary roles.

In a review of the radiology literature on cervical spine fusion, Foley et al. [4] reported a very low incidence of complications in posterior fusions with wire fixation. Although instability was the primary complication, the wire itself was the cause of neurologic symptoms in 3.4% of interlaminar fusions. Bowing of improperly tightened sublaminar surgical wires and hematomas around the wires led to myelopathy. The complication of a broken wire producing symptoms was

Received April 18, 1985; accepted after revision July 3, 1985.
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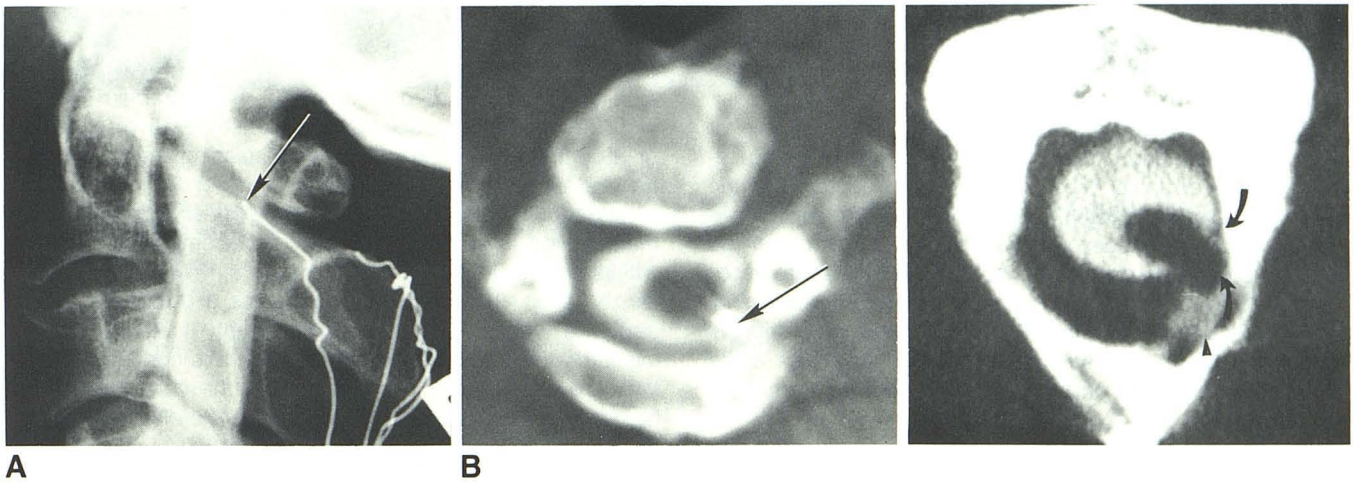
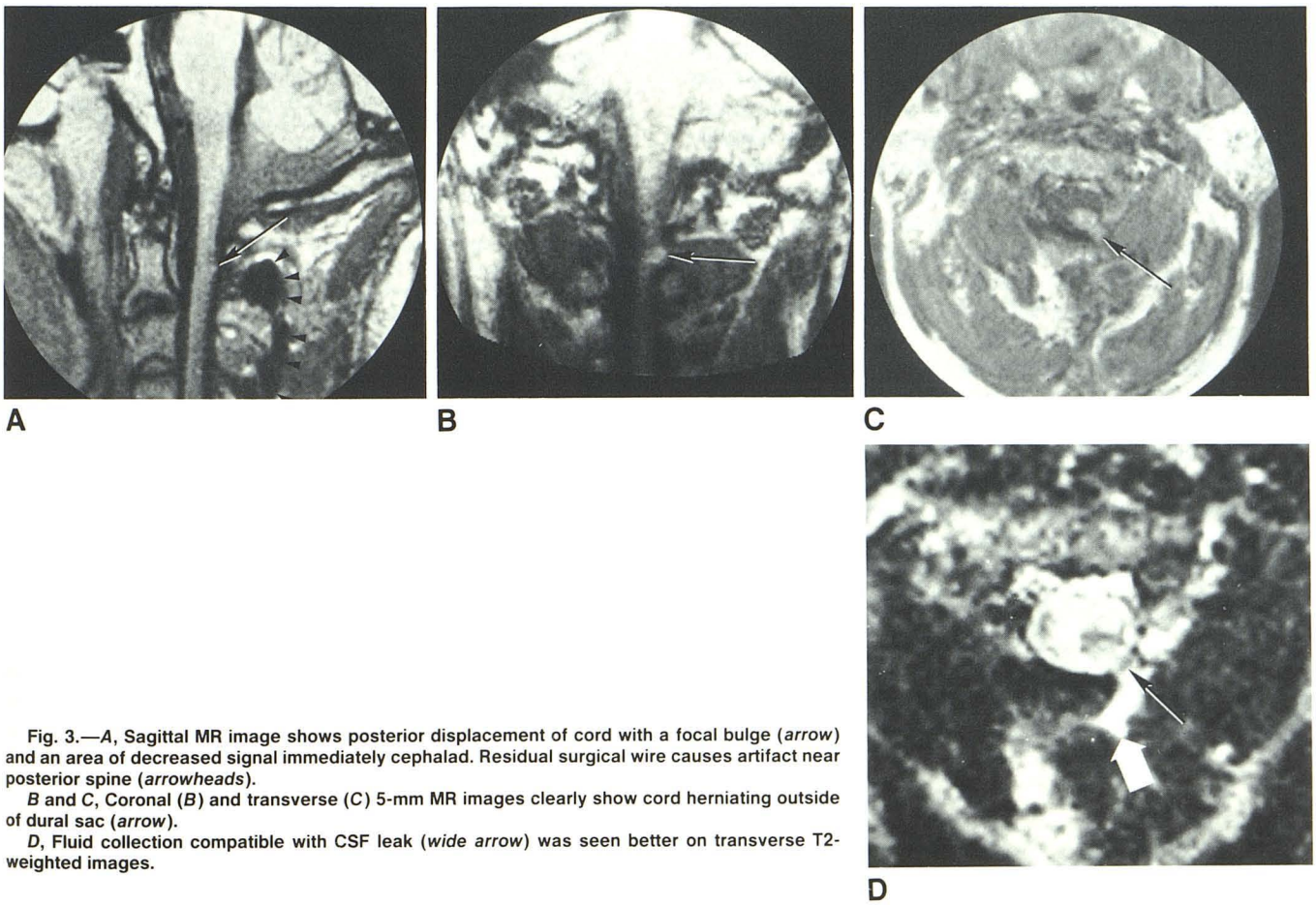


A B

Fig. 1.—Initial metrizamide myelogram (*A*) and CT metrizamide myelogram (*B*) show broken surgical wire (*arrow*) with its tip extending anteriorly to enter dura at C1–C2 interspace and abut cervical spinal cord. Size of cord appears normal although it is positioned slightly to the left and posteriorly.

Fig. 2.—CT metrizamide myelogram shows herniation of spinal cord through posterolateral dura (*arrows*) associated with extravasation of metrizamide (*arrowhead*).



A B C D

Fig. 3.—*A*, Sagittal MR image shows posterior displacement of cord with a focal bulge (*arrow*) and an area of decreased signal immediately cephalad. Residual surgical wire causes artifact near posterior spine (*arrowheads*).

B and *C*, Coronal (*B*) and transverse (*C*) 5-mm MR images clearly show cord herniating outside of dural sac (*arrow*).

D, Fluid collection compatible with CSF leak (*wide arrow*) was seen better on transverse T2-weighted images.

not mentioned. Broken wire sutures are a recognized complication in the chest and other areas of the body [5]. As this case illustrates, broken wires should be considered as a potential cause of neurologic symptoms after spinal fusion.

Spinal cord herniation into an iatrogenic meningocele or pseudocyst has been described [1–3]. There are also reported cases of spinal cord herniation that occurred in the absence of surgery or trauma [2]. Several authors emphasize the importance of proper closure of tears or defects in the spinal dura [1, 2]. In contrast to intracranial dural tears associated with CSF leak, spontaneous healing of the spinal dura should not be awaited. Prompt surgical correction is recommended to prevent complications such as cord herniation, nerve root entrapment, meningocele formation, and meningitis.

CT metrizamide myelography has been advocated as the method of choice for detecting cranial CSF leaks as well as for evaluating traumatic lacerations of the spinal dura [6, 7]. MR may prove equally effective and less invasive. Typically, there is no clinical evidence of CSF leakage from spinal dural tears. Neurologic deficits after spinal trauma or surgery may be produced or aggravated by herniation and entrapment of the nerve roots or spinal cord [1–3]. Nerve root entrapment is more common than cord herniation, presumably because of the size of the dural opening and the tension to which the cord is normally subject. In the case presented, the dural rent is linked to surgical removal of the wire. Initial improvement of symptoms followed by a dramatic reversal and progressive complaints suggests that herniation may not have occurred for several days after removal of the wire and laceration of the dura. Although spinal fluid leakage was not clinically apparent, both CT metrizamide myelography and MR imaging demonstrated extravasation confined to a small epidural space (pseudomeningocele). We feel that all tears of the spinal dura should be surgically closed when possible. CSF dynamics change in the upright position and clots near a dural rent undergo lysis. Delayed herniation of nerve roots or spinal cord may occur and produce symptoms.

In all previous cases of spinal cord herniation, the diagnosis was not made until surgery despite evidence on myelography and, in one case, on CT metrizamide myelography that was "pathognomonic" [2]. The myelogram typically demonstrates spinal cord deviation within the dural sac and obliteration of subarachnoid space at the site of herniation. The herniated cord itself may appear as an extradural mass on the same side to which the cord is deviated. Myelographic findings alone are probably not specific, since postoperative adhesions or a contralateral intradural mass displacing the cord could have a similar appearance. MR imaging or CT metrizamide myelography may be required to establish the diagnosis. CT metrizamide myelography shows displacement of the cord within the thecal sac, and transdural herniation of the cord can be seen. The cord may appear as a dumbbell-shaped structure with an extradural component. It should not be mistaken for an extradural mass, since it is continuous with the cord and there is displacement of the cord toward the hernia rather than away from the mass. The disadvantage of studies requiring metrizamide is exemplified by this patient who became very ill with metrizamide on two occasions. MR imaging should be an ideal method of demonstrating spinal cord herniation because it is noninvasive and does not require contrast. The cord may be seen directly in three planes by MR imaging, not just seen as a filling defect in the column of myelographic contrast. Sagittal MR imaging was not diagnostic in this case. Thin-section (5-mm) MR images in coronal and transverse planes were required.

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