Spinal cord herniation as a complication of en bloc, multilevel, anterior thoracic vertebrectomy for a giant cell tumor: success of posterior cord reduction and dural repair

Case report


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Iatrogenic spinal cord herniation is a rare complication following spinal stabilization surgery. The authors present a case of circumferential thoracic tumor decompression and fixation by anterior instrumentation complicated by delayed anterior spinal cord herniation. This complication resulted in progressive paraparesis 5 years after the original procedure. The patient underwent reexploration and repair of the dural defect, resulting in the reduction of the spinal cord to its normal position. The patient’s paraparesis improved significantly after dural repair. Although progression of neurological deficit can be very slow, repair of the dural defect can restore normal spinal cord alignment and improve neurological deficit. To the best of the authors’ knowledge, this is the first reported case of spinal cord herniation following an anterior thoracic vertebrectomy. (http://thejns.org/doi/abs/10.3171/2014.8.SPINE13933)

KEY WORDS • spinal cord hernia • vertebrectomy • spinal cord reduction • dural repair • technique

EXTRADURAL herniation of the thoracic spinal cord is an uncommon clinical entity that presents with progressive sensorimotor dysfunction of the lower extremities. The diagnosis of spinal cord herniation is usually made based on characteristic MRI and/or CT myelography appearances. Progression of the patient’s neurological deficits can be prevented and most neurological function recovered after surgical reduction of the herniated spinal cord and dural repair.1 In this paper we describe a case of thoracic spinal cord herniation through an anterior dural defect following en bloc resection of a giant cell tumor of the thoracic spine. Spinal cord herniation can be posttraumatic, iatrogenic, or spontaneous, but this is the first reported iatrogenic case following anterior vertebrectomy for tumor resection.

Case Report

History and Examination. A 44-year-old woman underwent en bloc resection of a giant cell tumor from the spine at the T6–8 level with insertion of an anterior Moss cage and plate. For completion of resection, a T-5 vertebrectomy was also performed, followed by stabilization using posterior pedicle screw insertion in vertebrae T-2, T-3, and T-4, and T-9, T-10, and T-11. Intraoperatively, the anterior vertebrectomy was complicated by the durotomy, which was repaired using an onlay dural substitute and tissue glue. Postoperatively, the patient experienced a good recovery with no neurological deficits. She underwent adjuvant chemotherapy but not radiation therapy. For surveillance purposes, after resection of the tumor, MRI was performed 6 months after the first operation to review the extent of surgery and to ascertain residual tumor.

Five years later, at follow-up surveillance, she complained of new-onset slowly progressive weakness of her left lower limb and associated gait deterioration over the preceding 6 months. Her neurological examination was remarkable for decreased strength in her left lower limb, with motor function of 4/5 in the iliopectos and quadriceps, 4/5 in the hamstrings, and 3/5 in dorsiflexion and plantar flexion of the ankle on the left side. Deep tendon reflexes were exaggerated in the lower limbs with upgoing plantar response on the left side. Sensory examination revealed mild left lower-extremity hypesthesia and diminished temperature sensation with a level from which she could not feel the sensation downwards, just above the umbilicus.
Dorsal spine radiography showed the cage and pedicle screws to be correctly in situ (Fig. 1). MRI revealed ventral herniation of the cord at the midportion of the vertebrectomy, not present on previous surveillance imaging (Fig. 2). Axial MRI clearly revealed a portion of the cord that had herniated through the defect (Fig. 3).

Operative Course. Exploration and repair of the dural defect was planned. A posterior approach through the previous midline scar for surgical reduction of the herniated cord was performed. Intraoperatively, there were severe posterior adhesions, which were separated carefully to avoid dural injury. The dorsal dura was opened and the dentate ligament incised on both sides. Herniation of the ventrolateral aspect of the spinal cord through a ventral dural defect was identified. Adhesions between the margins of the dural defect and a ventral nerve rootlet tethered the cord to the dura. Following dissection of these adhesions, the cord herniation was reduced. A 2 × 2-cm ventral dural defect was found, and it was closed using an artificial dura (Durepair, Medtronic) anteriorly to the cord. The edges of the artificial dura were inside the spinal dural edge, entirely covering the defect in an inside-out fashion. The dorsal durotomy defect was closed using a dural substitute as an inlay patch placed inside the dural defect. Throughout the process, no sling was made for the cord, and it was maintained intradurally.

Postoperative Course. The patient had an uneventful postoperative course, with gradual restoration of neurological function and minimal residual weakness (motor function 4+/5 in the iliopsoas and in the hamstrings) at the 24-month follow-up examination. Postoperative MRI was conducted 6 months later, revealing a reduced spinal cord (Fig. 4).

Discussion

Herniation of the spinal cord through a dural defect is a rare entity and, from an etiological point of view, can

![Fig. 1. Lateral radiographic view of the dorsal spine showing the cage between T-5 and T-8 and pedicle screws inserted in T2–4 and T9–11.](image1)

![Fig. 2. Sagittal MR images. Left: Postoperative image following en bloc resection of a giant cell tumor and cage in situ with pedicle screws above and below, but without any spinal cord herniation. Right: Spinal cord herniation demonstrated on an image obtained 5 years later.](image2)
Iatrogenic spinal cord hernia

be posttraumatic, iatrogenic, or spontaneous,\textsuperscript{1,2,7} the latter being the rarest form. The first paper on the topic was published by Cobb and Ehni in 1973, addressing a case of spinal cord herniation resulting in iatrogenic meningocele.\textsuperscript{1} According to the meta-analysis of 126 case reports by Groen et al., a number of theories to explain the occurrence of a ventral thoracic dural defect have been postulated, such as a history of trauma, pressure erosion of the ventral thoracic dura mater, thoracic disc herniation, congenital disorder (preexisting ventral meningocele), a duplication of the ventral dura mater, a congenital extradural arachnoid cyst, or an inflammatory process.\textsuperscript{3} But no cases of anterior cord herniation following removal of multilevel vertebrectomy and anterior stabilization, such as this case, have been reported.

Clinically, Watters et al. described iatrogenic hernias presenting with myeloradiculopathy.\textsuperscript{7} Najjar et al. showed in their series of patients with idiopathic spinal cord herniation that the most common clinical presentation was that of a Brown-Séquard syndrome, which slowly progresses into a spastic monoparesis, suggesting a predominant involvement of the anterolateral funiculus.\textsuperscript{4}

MRI characteristically shows the cord appearing small, rotated, and displaced, with an apparently dilated CSF space opposite to the direction of cord displacement. This dilated CSF space represents the void left by the herniated cord. In such cases, the CSF space would be delineated well with intrathecal contrast material. Axial images may be helpful in distinguishing a compressed cord from a herniated cord, especially if the dural defect has allowed only the lateral portion of the cord to herniate into bone defects or notches.\textsuperscript{7}

Prada et al. described a series of 12 patients in which all patients underwent surgical correction via a posterior approach, with reduction of the herniated spinal cord, positioning of a muscular autograft to fill the anterior cavity, and closure of the dural defect with an artificial dural patch.\textsuperscript{5} In this case, a possible reason why the initial dural repair failed in the initial vertebrectomy when the durotomy occurred was that the dural substitute was placed over the durotomy, i.e., on the outside of the thecal sac. This placement allows for pulsation of CSF or cord to push the patch away from the defect, and increases the risk of CSF leak and/or cord herniation (rarely). Subsequent repair of the defect, if feasible, should be from inside the theca where the applied patch will be pushed against the defect, sealing it off.

In the majority of cases reported, the patients’ neurological deficits resolved or improved.\textsuperscript{2} Closure of the dural defect has a beneficial effect, as unanimously reported in the literature, even in cases in which the cord is remarkably atrophic on MRI. Postoperative improvement can also be expected in cases in which intramedullary signal disturbances are present.\textsuperscript{7} Based on the literature review, surgery is the management option of choice for this rare entity, and duraplasty is a most widely performed method.\textsuperscript{6}

Conclusions

Iatrogenic spinal cord herniation is a rare entity that is now increasingly recognized and reported. Compared with other cases in the literature, this is the first iatrogenic case after anterior vertebrectomy and stabilization. Therefore, this complication must be borne in mind while performing this approach. Minimal manipulation of the cord and proper duraplasty is the preferable approach. Early recognition and treatment can improve the function of the patient completely.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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