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Analysis of hard thoracic herniated discs: review of 18 cases operated by thoracoscopy

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Abstract The authors retrospectively reviewed a series of 18 hard thoracic herniated discs (HTHD) operated by thoracoscopy. Isolated cases of HTHD have been reported in the literature, but no series describing these lesions has been published. Seventy-two percent of the herniated discs were situated between T8 and T12. Fifty-six percent of the patients had radiographic sequelae of Scheuermann's disease. Postoperatively, 83% had neurological improvement. In seven cases (39%), a plane separating the herniated disc and the dura mater was found surgically. In 11 patients, no separating plane was found during

surgery. The lesion was intradural in three patients (17%) and adherent to the dura mater in eight (44%). Among these 11 patients, surgery was complicated by a dural tear in the first seven that led to a high risk of cerebrospinal fluid fistula: four of these seven patients had required surgical revision. In the last four, the zone of adhesion of the HTHD to the dura mater was preserved, successfully preventing dural tear

Keywords Calcified thoracic disc herniation · MRI · Scheuermann · Thoracic spine · Thoracoscopy

Introduction

The techniques of modern imaging, particularly magnetic resonance imaging, have shown the high frequency of thoracic herniated discs. One or more thoracic herniated discs have been reported from 11% to 37% of asymptomatic subjects [3, 34, 36]. In contrast, symptomatic forms are rare. Carson et al. [10] estimated the annual incidence of symptomatic thoracic herniated discs to be one case in a million. Other authors have reported less than 0.5% of surgical procedures for herniated discs involving a thoracic disc [2, 20]. The sequelae of Scheuermann's disease probably contribute to the development of symptoms [8, 13, 18, 33]. Clinical signs vary widely. Anand and Regan recently proposed a clinical classification taking into account spinal pain, nerve root pain, and symptomatic spinal-cord compression [1].

Among symptomatic thoracic herniated discs, some are calcified or ossified, impinging on the anterior aspect of the thecal sac. These hard herniated discs are often voluminous and adherent to the thecal sac, rendering their surgical resection particularly difficult [5, 16, 24, 26].

In a review of the literature of 263 thoracic herniated discs, Stillerman [30] reported that 22% were hard and 6% were intradural. Anatomically, this form corresponds to the penetration of calcified disc material into the subarachnoid space through a tear in the posterior longitudinal ligament (PLL) and dura mater [14, 30, 31]. To the best of our knowledge, nevertheless, no study specifically involving hard forms of thoracic herniated discs has been reported in the literature. The goal of this study is to analyze the clinical, radiological, and surgical features of these hard thoracic herniated discs (HTHD).

Materials and methods

We collected 52 thoracic herniated discs operated by thoracoscopy between 1996 and 2003. There were 18 (35%) HTHD. The surgical technique for soft thoracic herniated discs has been well described by Rosenthal [27]. For HTHD specific additional steps are important: initial resection of the rib head and of the underlying vertebral pedicle exposes a healthy area of the dura mater. A cone-shaped access is then burred out of the overlying and underlying vertebrae. The disc herniation is exposed by removal of the posterior wall with a rongeur. A small nerve retractor is used to find the anatomic plane separating the disc herniation from the dura mater while applying gentle anterior traction to the herniation with a pituitary rongeur. The lesion is then removed.

The average age for surgery was 50.7 years (range, 25–78 years). There were 12 women and six men. Among these 18 patients, four had previously been operated through a posterior approach in another center for an unsuccessful attempt to resect the disc herniation. All 18 patients had symptoms of nerve-root or spinal-cord compression, or both. None of the HTHD was operated for isolated spinal pain. Twenty-two percent of the patients had radicular pain and 78% had spinal-cord compression. Frankel's classification was used to assess the neurologic deficit preoperatively and at follow-up (Table 1). The average follow-up was 45 months (range, 6–102 months).

Preoperative radiographic examinations were reviewed. All patients had preoperative computed tomography (CT) with contrast injection. Sixteen patients had MRI. In six cases, injection of paramagnetic contrast medium was used. The size of each herniated disc was measured as a percentage of the area of the spinal canal. On the axial CT slices the area of the herniated disc was determined in terms of the ratio to the area of the bony canal measured at the level adjacent to the lesion. The criteria of Sorensen [29] were used (three adjacent vertebrae exhibiting an angle between the endplates of at least 5°) for the diagnosis of Scheuermann's disease.

Surgical observations were collected, including existence or absence of a plane separating the HTHD and the thecal sac, presence of adhesions, intradural lesions and dural tear during the resection of the lesion. Pathologic examination was performed on eight of the 18 resected herniated discs.

Results

Seventy-two percent of the HTHD in the present series were situated between T8 and T12. Ten patients (56%) had sequelae of Scheuermann's disease, including six women and four men, the average age being 46 years. The herniated disc accounted for an average of 65% of the spinal-canal space (range, 25–90%). In the canal, the herniated disc was central in 14 cases and posterolateral in four cases.

Fig. 1 Enhancement by contrast of the interface between CTHD and thecal sac in T1-weighted sequences with injection of contrast medium, corresponding to granulation tissue surrounding the hernia

Table 1 Course of neurological compromise (Frankel's score)

Preoperative neurological deficit	Follow-up neurologic deficit				
	A	B	C	D	E
A					
B	1	1		1	
C				3	3
D					5
E					4

Computed tomography scan and MRI showed an ossified herniation in ten cases and calcified herniation in eight. Pathologic examination of the lesion performed in eight cases showed either a bony lamellar bone organized in trabeculae containing predominantly fatty marrow, or the presence of calcium deposits. Intravenous injection of gadolinium, which was used in six cases, modified the signal of the lesions in two, resulting in enhancement of the signal of the interface between the hernia and the dura (Fig. 1).

The mean operative time was 190 mn (85–330) and the mean blood loss was 800 ml (100–2,500). In three cases blood loss was superior to 1,500 ml because of epidural venous bleeding. These three cases occurred at the beginning of our experience of using thoracoscopy.

In seven cases (39%), a plane separating the herniated disc and the dura mater was found surgically; no dural tear occurred in these patients. In 11 patients no separating plane was found during surgery. Among

these 11 patients, three had lesions that were considered to be intradural by the surgeon and eight of the HTDH were adherent to the dura mater. In seven cases, a dural tear occurred during resection of the herniated disc. In four cases, dural tear was avoided by not removing the entire herniated disc, but by preserving a bony fragment of the interface of the herniated disc with the dura mater. In all cases, spinal-cord decompression was verified using postoperative CT. This refinement allowed us, in these four cases, to completely eliminate spinal-cord compression without violation of the dura (Fig. 2). Conversion to open surgery was performed three times, at the beginning of our experience, because of excessive epidural bleeding and/or dural tear.

Among postoperative complications, there were three temporary intercostal neuralgia, and one pleural suffusion requiring drainage. Despite the techniques of dural repair used (tissue glue, weak suction of the thoracic drain, lumbar shunt twice and a strict supine position in

Fig. 2 a–c Preoperative CT and MRI of a HTDH with dural adhesions. d, e Postoperative CT showing spinal-cord decompression and the bony chip left in place at the zone of adhesion

the postoperative period), four of the seven cases of dural tear required late surgical revision, because of a cerebrospinal fluid fistula. Revision of cerebrospinal fluid fistula was performed by open surgery. The dural tear was sutured using a patch of fascia.

Fifteen (83%) patients had neurological improvement (Table 1). Two patients had a neurological deficit that resolved in 3 months and one patient experienced persistent worsening, passing from Frankel stage B to A.

Discussion

Symptomatic HTHD is more frequent during the fourth and fifth decade of life [4, 6, 7, 14, 17, 22, 26, 30], in the framework of a spinal degenerative process. Distribution according to gender showed a marked female predominance in the present series consistent with the literature [4, 6, 7, 9, 14, 17, 19, 28, 30], perhaps due to changes in the hormonal status during menopause and its consequences on calcium–phosphorus metabolism. In the present series, all of the lesions were observed in the lower half of the thoracic spine with a peak of frequency between the eighth and twelfth thoracic vertebrae. According to published reports [2–4, 9, 19, 21, 22, 30], 75% of thoracic herniated discs are located below the eighth thoracic vertebra, probably because of the greater mobility of the thoracic spine at this level and an increase in the forces exerted on it there. The association of HTHD and Scheuermann's disease has been reported by several authors [8, 13, 14, 18, 33], but the connection between these two disorders is unclear. Since reports in the leading journals of the literature that the radiological signs are present in 18–40% of the population [8, 18], the diagnosis of Scheuermann's disease has become frequent. In the present series, 56% of the patients had Scheuermann's disease. Consequently, it appears that this association is not coincidental. Earlier age of onset for HTHD and more frequent location in the middle thoracic spine have been reported in patients who have Scheuermann's disease [8, 18, 33].

The presence of calcifications in the intervertebral disc is frequently found to be associated with hard herniated discs. This was observed in every case in the present series and on an average of 60% of cases in other series [11, 12, 32]. Awwad et al. described a “nuclear trail sign” on axial CT slices, a calcification that extends from the center of the disc to the calcified herniated disc [3]. This sign is present in 45% of HTHD according to those authors.

In two cases, we found enhancement of the interface between the herniated disc and the dura mater after injection of contrast medium. In these cases the PLL adhered to the thecal sac. Here, enhancement by the contrast medium might have reflected granulation tissue surrounding the hernia (explaining the existence of

adhesions), as suggested by Parizel et al. [23]. This enhancement did not correspond to opacification of the venous plexus as previously suggested in a report by Boukobza et al. [7].

In this series, the hard herniated discs occupied a substantial volume of the spinal canal. The average size of these lesions corresponded to 65% of the cross-sectional area of the vertebral canal. All the HTHD operated in this series were symptomatic. According to Awwad et al., there is a correlation between the size of the herniated disc and whether or not it is symptomatic [3]. Similarly, among 20 cases of operated symptomatic thoracic herniated discs, Delfini [15] noted 14 calcified lesions and, in eight cases, an occupation of more than 50% of the spinal canal. In contrast, regarding a series of 48 common asymptomatic herniated discs, Wood [35] reported a predominance of small (less than 10% of the canal cross-sectional area) and intermediate-sized forms (10–20% of the area). Nonetheless, the large volume of these lesions appears to be the rule in hard forms in the thoracic spine [3]. The predominant central location of HTHD in this series is consistent with literature findings [2, 3, 15, 16, 30]. For this reason, even posterior approaches enlarged with a costotransversectomy should be prohibited for this type of lesion [5, 16, 21, 22, 24, 26, 27]. Regarding a series of 15 surgical revisions after thoracic discectomy, Dickman et al. found 13 calcified central herniated discs and stressed the importance of the anterolateral approach to this type of lesion for a complete excision with less risk of neural injury [16]. Anterolateral exposure of these lesions is recommended and provides good exposure to remove this “rock” embedded in the anterior aspect of the spinal cord. Thoracoscopy is preferable to thoracotomy: endoscopy is less aggressive to the chest wall, limiting postoperative pain, and it better reveals the lesions by providing views from inside the thorax. The various aspects of the surgical technique have been well established [16, 24, 27].

Among the 18 operated patients, 39% had a dural tear during surgical resection of the HTHD, because of adhesion or intradural lesion. Four of these seven patients had previously been operated at the same level in an initial attempt to resect the disc herniation. As suturing the thecal sac is not feasible by endoscopy, various solutions have been proposed for dural repair, including use of biologic glue, interposition of fascia, application of siphoning through a thoracic drain, placement of a temporary lumbar shunt and maintenance of a strict supine position in the postoperative period [14, 25]. Nevertheless, dural tears lead to a high risk of cerebrospinal fluid fistula, because of the negative intrathoracic pressure with each inspiration.

In 57% of the present patients with dural tear, conversion to open surgery, surgical revision, or both were necessary. Some authors [14, 16, 22] recom-

mended managing these particular cases by thoracotomy for watertight suture of the dural sheath. We prefer to operate these lesions by adapting the thoracoscopic procedure to preserve all the demonstrated advantages of this endoscopic technique [24, 26, 27] compared to conventional surgery. We no longer remove lesions completely. Instead, we preserve a bony chip adhering to the anterior aspect of the dural sheath. Having adopted this technique, we observed no dural tears in the last four patients of this series with dural adhesion.

Conclusion

Hard thoracic herniated discs are generally voluminous, filling more than half of the spinal canal. They were either intradural or adherent to the dura in 61% of the patients in this series, making their resection difficult. To avoid dural tissue loss with an associated risk of post-operative CSF fistula in the thoracic cavity, we recommend that the entire HTHD not be removed. Instead, the surgeon should preserve a thin shell of the hard herniated disc that is in contact with the dura mater.

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