Incidental durotomy in lumbar spine surgery - incidence, risk factors and management

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Abstract: Incidental durotomy is a common complication of lumbar spine operations for degenerative disorders. Its incidence varies depending on several risk factors and regarding the intra and postoperative management, there is no consensus. Our objective was to report our experience with incidental durotomy in patients who were operated on for lumbar disc herniation, lumbar spinal stenosis and revision surgeries. Between 2009 and 2012, 1259 patients were operated on for degenerative lumbar disorders. For primary operations, the surgical approach was mino-open, interlamar, uni- or bilateral, as for recurrences, the removal of the compressive element was intended: the epidural scar and the disc fragment. 863 patients (67,7%) were operated on for lumbar disc herniation, 344 patients (27,3%) were operated on for lumbar spinal stenosis and 52 patients (5%) were operated for recurrences. The operations were performed by neurosurgeons with the same professional degree but with different operative volume. Unintentional durotomy occurred in 20 (2,3%) of the patients with herniated disc, in 14 (4,07%) of the patients with lumbar spinal stenosis and in 12 (23%) of the patients who were operated on for recurrences. The most frequent risk factors were: obesity, revised surgery and the physician's low operative volume. Intraoperative dural fissures were repaired through suture (8 cases), by applying muscle, fat graft or by applying curaspon, tachosil. There existed 4 CSF fistulas which were repaired at reoperation. Incidental dural fissures during operations for degenerative lumbar disorders must be recognized and immediately repaired to prevent complications such as CSF fistula, osteodiscitis and increased medical costs. Preventing, identifying and treating unintentional durotomies can be best achieved by respecting a neat surgical technique and a standardized treatment protocol.
Key words: durotomy, dural tear, CSF fistula;

Introduction

Incidental injury of lumbar dura during surgery for lumbar herniated disc or lumbar spinal stenosis represents a serious problem which needs to be recognized and immediately repaired to prevent further complications, among which CSF fistula is the most common. The occurrence of CSF fistula increases the hospitalization period and also the costs of a new surgical intervention.

The incidence of unintentional durotomy during spinal operations was estimated in different series between 1,6% - 17,4%, depending on the complexity of the operation, the surgeon's experience, the type of operation – primary or reoperation, patient's age. (1,2,3,4,5).

The purpose of this study is to evaluate the incidence of unintentional durotomy during operations for degenerative lumbar spinal disorders and also the intraoperative and postoperative management of this complication.

Material and Method

Patient population

Medical records of 1259 patients who were operated during 2009-2012 in the Department of Neurosurgery by three senior neurosurgeons with a different surgical volume were retrospectively reviewed.

Every patient with lumbar disc herniation presented with radicular leg pain, paresthesia and the following neurological signs: straight leg raising pain under 45°, external or internal popliteal sciatic nerve paresis, depressed/ asymmetric reflexes. The lumbar disc herniations were visualized on MRI imaging. In all cases the symptoms persisted for more than 6 weeks and did not respond to conservative therapy.

Patients with lumbar spinal stenosis presented with neurogenic claudication.

Some patients were operated on before in other institutions during the period in which the operation was performed by laminectomy. They were admitted for reoperation for they were diagnosed with lumbar disc herniaton or lumbar spinal stenosis at 2 or 3 levels.

The operation

Primary surgery for lumbar disc herniation consisted of interlamar approach at the herniation site, followed by discectomy.

For spinal stenosis we performed bilateral interlamar approach in case of foraminal stenosis and laminectomy in case of central spinal stenosis.

There were cases with previous lumbar herniation operated by laminectomy, readmitted with recurrence of herniation associated with spinal stenosis. In these cases we tried to identify normal dura mater at the extremities of the laminectomy, in order to resect as much as possible from the fibrous scar and to remove the herniated disc.

When incidental durotomy occurred, we tried to close the dural breach by primary suture if possible with 4-0 silk. The suture was covered with gel foam, fat graft, muscle graft or tachosil. In another cases the dural breach was small that the suture was unnecessary or impossible. In these cases we applied tachosil, tissucol or, in absence of these prefered materials, we applied muscle graft, fat graft, gel foam.

Subfascial drains were used according to the surgeon's preference.

In the past year, we used Vancomycine which was placed in the epidural space at the end of the operation.

Postoperative management

Patients received antibiotics (cephazolyne) for three days. They remained at bed rest in prone position for 2 a 3 days, depending on the length of the durotomy and the quality of dural repair.

Results

During the study period there were 1259 patients operated for lumbar degenerative diseases. Incidental durotomy occurred in 46 cases, with an overall incidence of 3,6%.

Patients' characteristics are presented in tabel I.

TABLE I

Patients' characteristics

Characteristics	Number	Percentage
Age - range	35-81	
Sex:		
• female;	25	54,3%
• male;	21	46,7%
Comorbidities:		
• Hypertension;	17	36,9%
• Obesity;	12	26,08%
• Chronic obstructive pulmonary disease (COPD);	13	28,26%
Disease:		
• Lumbar disc herniation;	863	67,7%
• Spinal stenosis;	344	27,3%
• Reoperation for reccurence;	52	5%
Level:		
• L3-L4;	3	6,52%
• L4-L5;	25	54,34%
• L5-S1;	14	30,43%
• 2 levels;	3	6,52%
• 3 levels;	1	2,17%
Type of operation:		
• Unilateral interlamar;	30	65,21%
• Bilateral interlamar;	6	13,04%
• Hemilaminectomy;	4	8,63%
• Laminectomy;	6	13,04%
Durotomy:		
• Disc herniation;	20	2,3%
• Spinal stenosis;	14	4,07%

• Reoperation;	12	23%
Site of dural lesion:		
• Lateral;	39	84,78%
• Anterior;	1	2,17%
• Root sheath;	3	6,52%
• Root axilla;	3	6,52%
Epidural drain:		
• With drain;	12	26,08%
• Without drain;	34	73,31%
Complications:		
• CSF fistula;	4	8,69%
• Osteodiscitis;	2	4,34%
• Headache;	3	6,52%
• Wound dehiscency;	1	2,17%

Dural leak occurred in patients aged between 31 and 85 years, with a peak in the sixth decade. This peak corresponds to the decade of appearance and operation on patients with herniated disc, representing 67,7% of all cases.

Between the comorbidities, only obesity can be a risk factor because, regarding a "mini-open" approach like the interlamar approach, the depth of the lesion can create the condition of an unintentional dural rupture.

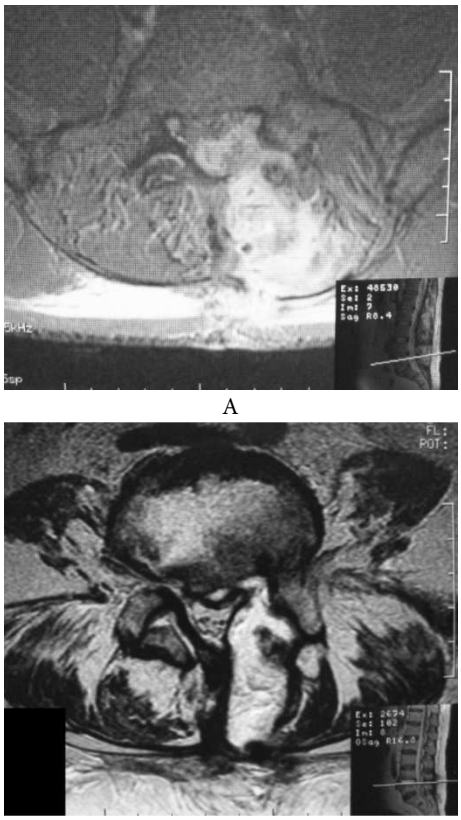
All patients were operated under general anesthesia. When operations were occasionally performed under spinal anesthesia, we found that when the patient coughs during the operation there occurs a displacement and swelling of the dura due to increased intracanial pressure, which is why we are not partisans of spinal anesthesia because, during discectomy, sudden mobility may favor dural breaking.

Dural leak occurred more frequently during reinterventions (23%), compared with the primary approaches for herniated disc (2,3%) or spinal stenosis (4,07%). The extremely large number of dural leaks in cases of reinterventions is due to the fact that many of these patients were operated for herniated disc many years back through laminectomy performed at 1 or 2 levels. The postoperative scar was extensive and adherent. Reintervention was performed for recurred hernia at the same level or adjacent levels, aiming to remove the fragment of the herniated disc and also the epidural scar. While studying the operation protocols, we observed that the dura mater was described as thin, translucent, even in cases without dural rupture. In such cases, if an adjustment of the superior articular facet after removing its internal third is not performed, puncture dural fissures may occur after closing the operative wound due to dural friction on the bone's irregularities.

The surgeon's experience seems to influence the rate of unintended durotomies. We found that, although the surgeons have the same level of training, the operative volume is

different and thus the frequency of dural rupture. The frequency has fluctuated between 2,8 and 8,1%, being higher in surgeons with a lower operative volume (5/61 cases) than those with a higher operative volume (20/738 cases).

The most common locations of the dural injury were the lateral lesions (84,7%), followed by injuries of the root sheath and root axilla.



A

B

Postoperative MRI, axial section demonstrates a CSF fistula and site of dural tear: lateral (A) and anterior (B)

In one case where the intervertebral disc was completely expelled into the spinal canal having 3,7 cm in cranio-caudal length, there occurred an anterior dural leak, unrecognized intraoperatively. After the appearance of CSF fistula, MRI showed the CSF spill site in the tecal sack.

Primary dural repair was made by suturing the dura in 8 cases, supplemented by applying curaspon, fat, muscle or tachosil. In other cases (n=38, 82,6%), curaspon or autologous fat or muscle were used to cover the dural defect. A good sealant agent was tachosil. In these cases, the suture of the dura was not necessary because the breach was punctate.

The epidural drain was used in 12 cases. In other cases it was considered that epidural bleeding promotes breach closure, but of course blood can also be a good medium culture and can lead to secondary infection.

Patients with intraoperative CSF leak remained at bed rest in prone position for 3 days. During this period they received antibiotics to prevent infection.

Of the 4 CSF fistulas, in 3 cases the dural leak was not recognized intraoperatively during the primary surgery. Their repair was performed during reintervention by dural suture in 2 cases and by applying tachosil and tissucol in other 2 cases. Another postoperative complication, osteodiscitis, occured in 2 patients with dural leak who had no epidural drainage after surgery.

In the case of one patient who was operated on but had no fistula and no infection, a wound dehiscency appeared when the stitches have been removed.

Discussions

Incidental durotomy was reported in several series of patients operated for degenerative spinal injuries and it is a common complication of spinal surgery, even among surgeons with high professional

qualification.

The current literature reports a wide incidence variation in rates of dural leaks in spine surgery. The reported incidence varies between 1,6% and 17,4%.

Our study reported an incidence of 3,6% which is located towards the lower limit of the incidence reported by current literature.

Dural leaks are more common in obese patients and among surgeons with lower operative volume.

Irregular bone surfaces in interlamar approach could explain the occurrence of CSF fistula in cases when intraoperative there was not notified any dural break and the dura was thin, translucent.

Durotomies occurred more frequently within patients in the sixth decade of life, double the adjacent decades. Unlike Williams et. al, we cannot support an increased incidence in relation to age (1). The sixth decade of life is the period with the most frequently occurring herniated disc.

We confirm that regarding operations for recurrent disc herniations there is a significantly higher incidence of unintetional durotomy, which has been reported previously (4, 5, 6, 7). In our series, the high incidence in revision operations can be explained through the fact that, in the past, the approach used for disc herniations was laminectomy, which left behind an extensive epidural scar at the level of the dura and the nerve roots. We aimed to remove the entire epidural scar and the disc herniation. If the dissection in the epidural space is lateral, at the level of the herniated disc, leaving scar on the posterior dural sac, the incidence rate of unintentinal durotomy decreases.

In our series, durotomy did not associate with damage to the spinal nerves and has not created new neurological deficits postoperatively.

Wang et. al, Jones et. al, Cammisa et. al reached similar conclusions: dural tears do not have deleterious effects in outcomes, do not increase the risk of other perioperative morbidities or later outcome (4,5,7).

Saxler et. al had different results: in his group of 41 lumbar discectomy patients with intraoperative durotomies, they presented a poorer outcome after surgery (8).

Dural tear is detected intraoperative by the presence of CSF in the epidural space. In punctiform dural tear, CSF is in small quantity, mixed with blood, and dural fissure can remain unrecognised. Anterior, small dural sac rupture is difficult to observe. In this case a postoperative MRI can demonstrate the site of dural lesion. Even after dural suture CSF can be observed leaking in the epidural space through the repaired defect if Valsalva maneuver is made.

To decrease intradural pressure of CSF when the dura mater is very thin or during the dural suture, we used the Trendelenburg position and/or have blocked the CSF circulation with a cotonoid placed at the superior pole of the interlamar approach.

Primary repair of durotomies, once recognised, should always be done to prevent the complications. In small punctiform durotomies, fat graft, muscle graft, tachocomb can be effective. Larger durotomies have to be sutured. In all cases fibrin glue is recommended.

To drain or not to drain?

The use of drains is controversial. We used it in 26% of cases. Wang et al placed a drain in all cases (5). Eismont et al do not recommend subfascial drain because it could favor the

formation of CSF fistula (9). Cammisa et al used a drain in case of adequate repair of the tear (4).

A good repair of dural tear can be accompanied by postoperative bed rest. Patients from our group remained in bed rest for 3 days, in prone position.

In other series postoperative bed rest was used for a similar period of time but in supine position (4,5). Hodges et al reported that 75% of the patients who had dural tears which were repaired during surgery did not need bed rest (10).

In case of dural tear and intraoperative dural repair, postoperative bed rest and prolonged postoperative antibiotherapy were recommended to prevent complications.

The rate of discitis in the present study was 0,65% (2 cases) and 1 case with dehiscent wound. Weinstein et al reported an overall infection rate of 2,1% and 8,1% deep normal infection rate in durotomy cases (11).

The presence of dural tears necessitates a prolonged hospital stay. The development of CSF fistula or deep wound infection are serious dreaded complications of dural tear in lumbar surgery, which increase much more the period of hospitalization and medical costs.

Conclusions

Dural tear in lumbar surgery is not a benign event. In order to prevent or to minimize the incidental dural tear, spinal surgeries performed by experienced spine surgeons are advised. When is considered that a durotomy is possible to appear, a change in Trendelenburg position of the patient is recommended.

Dural fissures have to be repaired intraoperatively to prevent complications. There is not a consensus regarding the protocol to follow.

Suture is the best way to treat dural tears. If this is not possible, there are various sealants to be used. Tachosil and fibrin glue are the best.

A non-aspirating drainage is proposed when dural tear is adequately repaired. To reduce the hidrostatic pressure of the CSF, bed rest is recommended.

Antibiotic therapy with Cefazoline or Vancomycin for 72 hours is advised.

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