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Review

Incidental durotomy during spine surgery: Incidence, management and complications. A retrospective review

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ABSTRACT

Study design: Retrospective review of a series of patients who underwent spinal surgery at a single spine unit during a 1 year period.
Objectives: To assess the incidence, treatment, clinical consequence, complications of incidental durotomy during spine surgery and results of 37 months clinical follow-up.
Summary of background data: Incidental durotomy is an underestimated and relatively adverse event during spinal surgery. Several consequences of inadequately treated dural tears have been reported.
Methods: A retrospective review was conducted on 1326 consecutive patients who underwent spinal surgery performed in one French spine unit from January 2005 to December 2005. We excluded from this study patients treated for emergency spine cases.
Results: Fifty-one dural tears were identified (3.84%). Incidental durotomies were associated with anterior cervical approach in 1 case, with posterior cervical approach in 1 case, with anterior retroperitoneal approach in 1 case and with posterior thoracolumbar approach in 48 cases. In addition, any clinically significant durotomy unrecognised during surgical procedure were included. Thirteen patients presented postoperative complications including 7 cerebrospinal fluid leaks, 2 wound infections, 2 postoperative haematomas, and 2 pseudomeningoceles. Nine of these 13 patients required a revision procedure. A mean follow-up of 37 months showed good long-term clinical results.
Conclusions: Incidental durotomy is a common complication of spine surgery. All incidental durotomies must be repaired primarily. Dural tears that were immediately recognised and treated accordingly did not lead to any significant sequelae at a mean follow-up of 37 months. However, long-term follow-up studies will be needed to confirm this finding. The risks associated with dural tears and cerebrospinal fluid leaks are serious and should be discussed with any patients undergoing spine surgery.

Contents

Introduction

An incidental dural tear is a frequent intraoperative complication of spine surgery[3,37] epidural injections and myelography.[5]

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Various studies have reported incidences ranging from 1% to 17%.[5,21,31,32,36,39] Spine surgeons tend to underestimate the frequency of incidental durotomy.[37] Several consequences of inadequately treated dural tears have been reported.[2,3,20,38] If the dural tear is not properly closed or unrecognised patients can present with postural headaches, vertigo, posterior neck pain, neck and/or stiffness, nausea, diplopia, photophobia, tinnitus, and blurred vision.[3,24,28] These symptoms are caused by a persistent cerebrospinal fluid leak from the subarachnoid space. The decrease in cerebrospinal fluid pressure leads to a loss of buoyancy and caudal displacement of the intracranial content.[38] Cain et al.[4] have studied the biology of dural tear repair in a canine model. They found that fibroblastic bridging of the dural defect starts on the 6th day and by the 10th day the defect is healed.

The purpose of the current study is to evaluate incidental durotomies during one year in our practice. We want to clarify associated surgical procedures, treatments, postoperative clinical outcomes, complications and revision procedures.

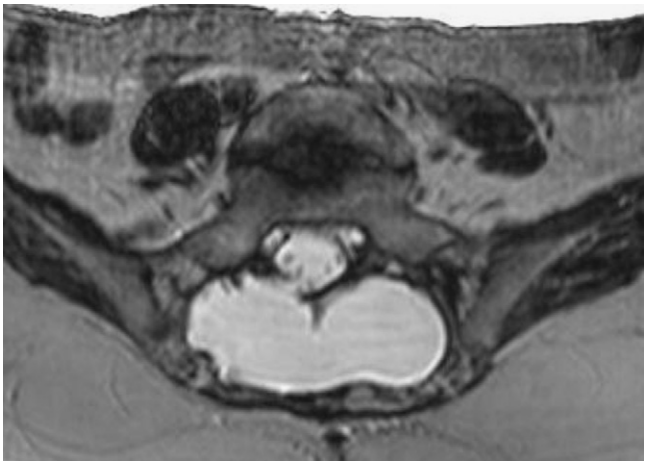

Fig. 2. T2 axial magnetic resonance image. Pseudomeningocele.

Materials and methods

All patients who underwent degenerative spine and spinal tumour surgeries performed between January 2005 and December 2005 in our spine unit were retrospectively reviewed. We excluded from this study patients treated for emergency spine cases. We collected information on demographics, diagnoses, prior spine surgeries, details of the surgical procedure, details of the incidental durotomy, treatment, postoperative evaluation at a minimum 36 months follow-up.

Results

1326 patients underwent degenerative spine surgery in one year. Of these, 240 underwent anterior cervical surgery, 14 underwent posterior cervical surgery, 24 underwent anterior thoracic surgery, 32 anterior lumbar surgery and 1048 underwent posterior thoracolumbar and/or lumbo-sacral surgery. We identified 51 dural tears (3.84%) in the population. Incidental durotomies were associated with anterior cervical approach in 1 case, with posterior cervical approach in 1 case, with anterior retroperitoneal approach in 1 case and with posterior thoracolumbar approach in 48 cases. The mean age of patients with incidental durotomies was 59.6 years (range 28–84). There were 32 men and 19 women (sex ratio). Thirteen patients (25.5%) had previous spine surgery. None of them had previously documented dural tears. All incidental durotomies were diagnosed in the perioperative period. The incidence of durotomies according to the specific procedure performed is shown in Table 1. The most common cause of dural tears was decompression procedures for lumbar stenosis.

Diagnosis. All incidental durotomies were recognised during the perioperative period.

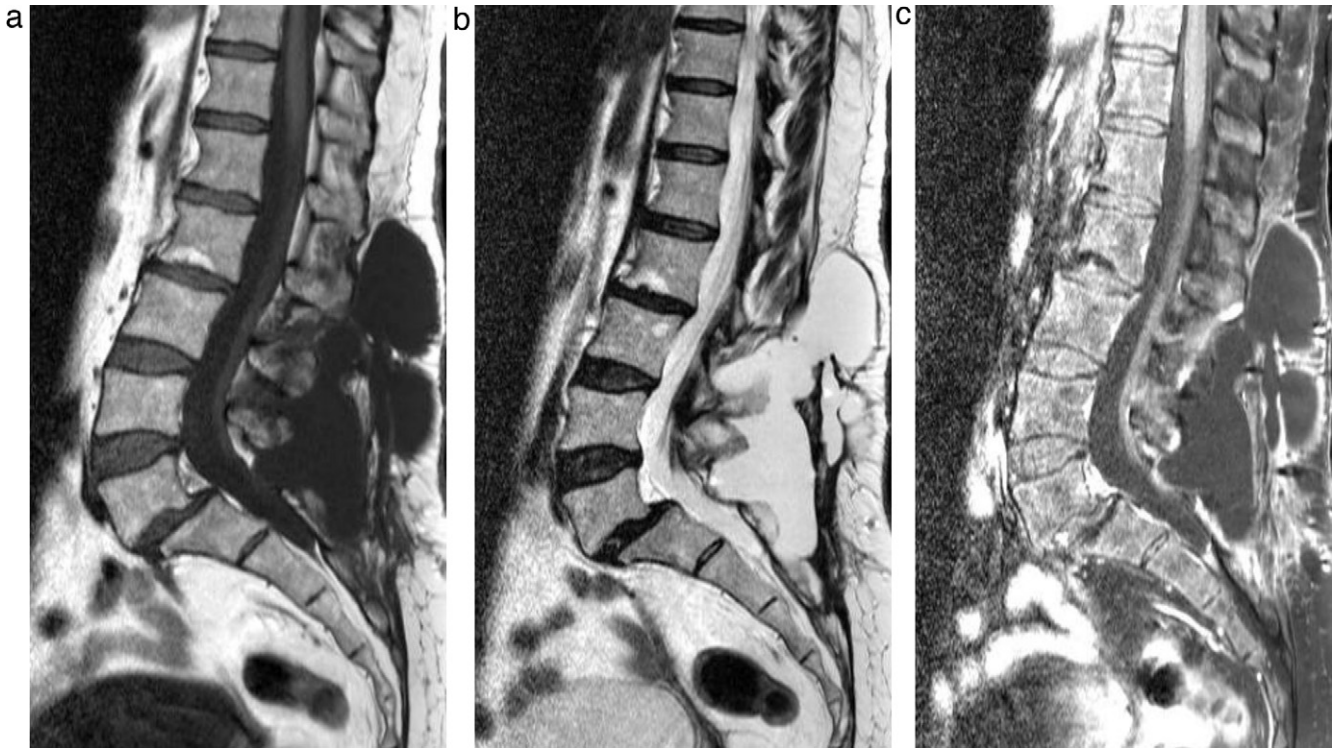

Fig. 1. Sagittal magnetic resonance images. Sequence T1 (A), T2 (B), Spir with gadolinium enhancement (C). The cerebrospinal fluid leak of this pseudomeningocele was completely contained. There was no leakage from the incision site.

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Table 1
Incidence of dural tears according to surgical procedure.

	Patients	Total	Incidence (%)
Cervical anterior decompression	1	240	0.42
Cervical posterior decompression	1	14	7.1
Thoracic anterior decompression	2	24	8.3
Lumbar discectomy	8	312	2.6
Lumbar decompression (±) fusion without instrumentation	25	143	17
Thoracolumbar/lumbosacral decompression + fusion with poster lateral graft + instrumentation	11	529	2.1
Lumbar decompression + circumferential arthrodesis + instrumentation	2	32	6.3
Lumbar anterior procedure	1	32	3.1
Total	51	1326	

Table 3
Incidence of dural tears in different studies behind procedure.

Microscopic lumbar discectomy	4% Kotilainen et al.[21]
Lumbar Post discetomy dural tears	1%: Wang et al.[39], 7.1%: Stolke et al.[36], 3.2% Saxler et al.[32], 3.5% Tafazal and Sell[37]
Decompression for stenosis	3.1%: Cammisa et al.[5], 13%: Wang et al.[39], 8.5% Tafazal[37]
Decompression and fusion without instrumentation	1.0% Cammisa et al.[5]
Decompression and fusion with instrumentation	2.0% Cammisa et al.[5]
Revision spine surgery	8.1%: Cammisa et al.[5], 17.4%: Stolke et al.[36], 15.9% Khan et al.[18]
Revision discetomy	13.2% Tafazal and Sell[37]

Operative management. All incidental durotomies were treated primarily (Table 2). Seventeen cases were not sewn. Of these 11 patients were treated with fibrin glue only. The remaining 6 were treated with Surgicel® (Ethicon, Inc., Somerville, NJ) and fibrin glue. In the remainder (33 patients), the repair consisted of suturing the defect with a running locked technique. Fibrin glue was used in 29 of these patients and fibrin glue and Surgicel® (Ethicon, Inc., Somerville, NJ) in 1 patient. We do not use muscle graft, fat graft or fibrin patches for the primary repair of durotomies. The Tredelenburg position (for thoracolumbar repair) or reverse Tredelenburg position (for cervical repair) was used in the all cases. Upon completion of the repair we proceeded to perform the Valsalva manoeuvre. Muscular fascial closure was achieved with Vicryl® sutures (Ethicon, Inc., Johnson & Johnson, Skillman, NJ) and skin closure was achieved with either staples, running suture, or interrupted sutures. Subfascial drains were used for 45 patients (88.2%) and were kept in place for 2 days in all patients. For these patients, we did not use wound drains.

Postoperative bed rest. The average postoperative bed rest was 2.68 days (range 0–10 days). The length of bed rest required was determined by the surgical procedure, the size of durotomy, the quality of primary repair and postoperative symptoms.

Antibiotic prophylaxis. If the dural tear is recognised and treated, broad spectrum antibiotic prophylaxis (cefuroxime) is initiated before surgery during 24 h. This protocol is used routinely in our Spine Unit.

Complications. Thirteen patients (25.5%) presented with a postoperative complication (Table 2). These resulted in 9 revision procedures. Two patients presented with a deep wound infection. They underwent surgical debridement (10 and 14 days after primary surgery) and antibiotic therapy. Two patients presented with postoperative epidural haematoma and required surgical evacuation. Seven patients presented with a persistent cerebrospinal fluid leak. Four of these cases were treated conservatively with bed rest. The remaining three patients required a revision procedure. One patient was treated with primary closure via suture, the other with a muscular graft and fibrin glue, and the last with suture and a lumbar subarachnoid drain. Two patients developed a pseudomeningocele (Figs. 1 and 2) (Fig 1a/b/c and Fig 2). They also underwent a revision procedure. Both of them were repaired with suture and Surgicel® (Ethicon, Inc., Somerville, NJ). Fibrin glue was used additionally in one of these patients. All 13 patients with complications achieved satisfactory outcomes. There were no long-term sequelea at an average of 37 months follow-up (range 36–48).

Discussion

There is wide variation in rates of incidental durotomy in the literature. The prevalence of incidental durotomy is 1–17.4%.[1,5,8,18,36,39] The incidence of dural tears is variable according to the indications, to the type of procedures and to the different studies. The incidence of incidental durotomies in different studies is shown in Table 3. Dural tears are commonly associated with complex spinal surgery[25,35] and revision procedures.[3,5,39] The morbidity is lower for younger patients and for surgeries of herniated discs. The rate was increased with age and with procedures for spinal stenosis.[5,7,8,16,36,39] The incidence increases with complexity of surgery.[5] Wang et al.[39] did not demonstrate deleterious effects from the use of spinal instrumentation.

Goodkin and Laska[12] reviewed 146 malpractice cases in a study looking into the medicolegal aspects of spine surgery. Incidental dural tears were the second most common complication in this study (16%). The authors suggest that an incidental durotomy

Table 2
Dural tears complications and postoperative management.

Primary repair	*N*	Complications	Revision procedure	Conservative treatment
Fibrin glue	11	1 Sepsis	Debridement	–
		1 Meningocele	Suture + Surgicel	–
		1 Persistent CSF leak	Muscular graft + fibrin glue	–
		1 CSF leak	–	1 Conservative treatment – stop CSF leak after 4 days
Fibrin glue + surgicel	6	1 Meningocele	Suture + fibrin glue + Surgicel	–
		1 Persistant CSF leak	Suture	–
Suture	4	1 Haematoma	Evacuation	–
Suture + fibrin glue	29	3 CSF leak	–	3 Conservative treatments
		1 Haematoma	Evacuation	–
		1 Sepsis	Debridement	–
		1 CSF leak	Subarachnoid drain + suture	–
Suture + surgicel + fibrin glue	1	–	–	
Total	51 Patients	13 Complications	9 Revision procedures	4 Conservative treatments

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should not be considered an entirely benign event since it has important legal ramifications.

Use of high speed drills, decompression for ossification of the posterior longitudinal ligament and spine surgery revision procedures are associated with an increase risk for incidental durotomies.[14,23,34] High speed drills and Kerrison ronguers must be used with caution. Spine surgeons must be careful during decompression procedures and must understand the insertion of the Ligamentum Flavum.[41]

Epstein[9] found 3 factors that contributed to dural tears: marked ossification of the yellow ligament, high frequency of synovial cysts, and prior surgery.

Prevention is the most effective way to minimise the prevalence of cerebrospinal fluid leak.[3] Preoperative planning and meticulous surgical technique are necessary to reduce the incidence of durotomies. Nonoperative treatment of durotomies is unsuccessful[8] and must be treated perioperatively.[3] Ideally primary repair of dural tears should be done and is successful in most cases.[3,16] Other studies have compared different treatment approaches to dural tears in prospective and randomised studies. In a European study (United Kingdom), Tafazal and Sell[37] reported that 58% of surgeons (24 surgeons) used Prolene® (Ethicon, Inc., Somerville, NJ), 30% used a different stitch, and 12% did not repair the dural tear. Careful and complete closure of durotomies recognised at the time of surgery was recommended for all cases.[8] It is possible to use muscles graft,[5,8,39] fat graft,[27] fibrin patch, fibrin glue,[17,33] blood-soaked Surgicel® (Ethicon, Inc., Somerville, NJ),[3] and gelatine matrix5,[32,39] if necessary. Eismont et al.[8] recommended fascial graft secured by interrupted sutures in the treatment of larger dural defects and suggested that small dural tears can be repaired with either running locked sutures or simple sutures using a fat graft. Wang et al.[39] used 4-0 or 5-0 silk interlocking suture, Gelfoam® (Johnson & Johnson, Gargrave, United Kingdom), subfascial drain, and a layered closure. Khan et al.[18] used 4-0 nylon. A tight fascial layer closure is necessary to provide an essential barrier to cerebrospinal fluid egress and infection. A Valsalva manoeuvre is recommended to check for the completeness of repair.[5,8,15,18] This manoeuvre increases the intrathecal pressure and will identify incompletely repaired dural tear as made evident by cerebrospinal fluid leaking through the repaired defect. The Tredelenburg position is used for lumbar repair and the reverse Tredelenburg for cervical repair.[5]

The use of drains is controversial. Eismont et al.[8] advised against placement of subfascial drains because it could precipitate the formation of a durocutaneous fistula. Cammisa et al.[5] reported their use of drain is dependent on the procedure, the size of the dural tear, the tissue quality and the quality of the repair. Wang et al.[39] placed a drain in all cases. They found that subfascial drains did not lead to the formation of durocutaneous fistulas in any patient. A subfascial drain can be used in the setting of durotomies, provided that adequate repair of the tear has been achieved and the tissue quality is satisfactory. Khan et al.[18] used subfascial drains in most cases. A subarachnoid drain can be an alternative for the treatment of postoperative cerebrospinal fluid leak[8,16,19] or chronic pseudomeningocele.[35]

Eismont et al.[8] et found that bed rest without surgical repair was an unsuccessful method of treatment for unrepaired dural tears. Hodges et al.[15] in a retrospective review of 20 patients, suggested that bed rest was not necessary for patients who had repair of an incidental durotomy during surgery with dural repair techniques. They reported that 75% of the patients did not need bedrest. However each of the incidental durotomies was between 1 and 3 mm in length. Wang et al.[39] systematically used bedrest for a short period (2.9 days). Cammisa et al.[5] used bed rest ranging from 3 to 5 days in all patients.

Khan et al.[18] used a special postoperative management protocol in 338 patients. In this study, the authors reported 98.2% success rate and 1.8% reoperation rate. They reported the largest series of patients with incidental durotomies in the literature.

Dural tears are detected by the presence of cerebrospinal fluid in most cases. Gerardi et al.[11] reported a 6.8% incidence of unrecognised dural tears. In their study, Cammisa et al.[5] reported the incidence of unrecognised durotomies during surgery with postop clinical significance at 0.28%. It is difficult to obtain the true incidence of unrecognised durotomies, because the majority of patients are asymptomatic.[25] Postoperative diagnosis of dural tear can be made by reagent urinary strips, immunofixation for Beta-2 transferrin, magnetic resonance imaging, or cisternography with computed tomography.[3]

Dural tears without primary repair can lead to a persistent cerebrospinal fluid leak, meningitis, arachnoiditis, pseudomeningocele, chronic pain and nerve root entrapment with resultant neurological damage.[5,8,12,19,27] There is no baseline data on the prevalence of complications due to dural tears.

Deyo et al.[7] evaluated postoperative complications in spinal procedures. The morbidity was lower for discetomy and younger patients. Other studies have shown similar results.[5,8,16,36,39] The development of pseudomeningocele is a rare complication of lumbar disc surgery.[24,35] Wang et al.[39] reported one case of arachnoiditis and suggested that the risk of meningitis appears to be very low. Karaeminogullari et al.[17] reported a case of cerebellar haemorrhage from a ruptured cerebellar arteriovenous malformation after excessive cerebrospinal fluid leakage. Cerebellar haemorrhage after spinal surgery is extremely rare.[6,10,26,29] An epidural blood patch[13,19,22] and percutaneous fibrin glue[30] can be used to close a dural defect. Stambough et al.[35] reported the case of a chronic pseudomeningocele which was successfully managed without surgical repair. They used a subarachnoid drain. Eismont et al.[8] suggested that dural repair or reconstruction is the standard treatment for pseudomeningocele. Weinstein et al.[40] reported an overall infection rate of 2.1% in a review of 1594 patients. A higher rate of deep wound infection was observed (8.1% of 74 patients) in durotomies. However they could not conclude that there was an increased risk of wound infection with incidental durotomies because the incidence of dural tears was highest in patients with complex revision surgery.

Dural tears are a frequent complication of spine surgical procedures but there is little data on long-term clinical outcome. The presence of a dural tear appears to portend a poorer prognosis.[1] Saxler et al.[32] compared a group of 41 patients with a similar control group at 10 years follow up. They found that patients with an incidental durotomy after lumbar disc surgery had poorer outcomes after surgery. There was a tendency for more reoperations, increased back pain, and functional impairment related to back pain leading to longer work disability. Some studies demonstrated no sequelae associated with durotomies when the patients were treated successfully.[5,8,16,39] However these studies have a shorter follow up period than that of Saxler et al.[32]

Limitations of the present study include the lack of a control group, the limited follow-up and the absence of clinical assessment with validated score. However this retrospective uncontrolled study reported a large series of patient with incidental durotomie.

Conclusion

Incidental durotomies are a common complication of spine surgery. All incidental durotomies must be repaired primarily. Dural tears that were recognised and treated did not lead to any sequelae at a mean follow-up of 37 months. Nevertheless long-term follow up is needed to assess the long-term outcome. Spine surgeons must be aware of the risks related to dural tears and cerebrospinal fluid leak. Patients must be informed of this

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complication before undergoing spine surgery, especially in lumbar decompression for stenosis.

Conflict of interest statement

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