

Original Research Article

Incidence and management of incidental durotomy during thoracic and lumbar spine surgeries: a retrospective review in a tertiary care centre

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ABSTRACT

Background: Incidental durotomy is among the most common complications of spine surgery with reported incidence ranging from 1.7% to 16%. Various management options including primary repair, fascial or fat graft, epidural blood patch, fibrin glue sealant, etc., have been proposed. The purpose of this study is to evaluate the incidence of incidental durotomy and the efficacy of different management options during a five year period at a tertiary care center.

Methods: All patients who underwent various surgical procedures in thoracic and lumbar spine from January 2006 - December 2010 in our centre were retrospectively reviewed. Data on demographics, primary diagnosis, associated co morbidities, details of surgical procedure, training level of the operating surgeon, details of the incidental durotomy, the treatment, complications and the postoperative stay were recorded.

Results: Of 2270 patients, 1401 patients were included in the study. The incidence of incidental durotomy was 3.49% (49 patients). We found a very high incidence of 33.33% incidental durotomies among patients who underwent revision procedures as compared to 3.23% for patients who underwent primary surgeries. 5.10% of incidental durotomies were caused by fellows under training, 4.27% by junior consultants and 2.92% by senior consultants. Of 49 durotomies, complications were 5 cases of intracranial hypotension, 5 postoperative neurological deficits, 2 deep wound infection, 2 pseudomeningocele and 1 meningitis.

Conclusions: The risk of incidental durotomy in thoracolumbar surgeries is high in revision surgeries and when performed by fellows in training. Intraoperative identification and primary repair with suturing or sealant reduces postoperative complications.

Keywords: Incidental durotomy, Incidence, Management, Complications, Pseudomeningocele

INTRODUCTION

Incidental durotomy is defined as an unintended dural laceration or tear.¹ Incidental dural tears are among the most commonly seen complications in spine surgery.^{2,3} The incidence reported in the literature ranges from 1.7% to 16%.⁴⁻⁹ Most of the dural tears occur during the

decompression procedure and the primary tool involved is the Kerrison's rongeur.⁵ The dura can be injured by a pedicle probe or a pedicle screw if it breaches the medial wall of the pedicle. Incidental durotomy is also frequently encountered during the exposure in post laminectomy patients (revision surgeries) due to loss of anatomic landmarks and tissue adhesions.

Several consequences of inadequately treated dural tears have been reported. If the dural tear is not properly closed or unrecognized, patients can present with postural headaches, vertigo, posterior neck pain, nausea, photophobia, tinnitus and blurred vision.²⁻¹⁰ These symptoms are due to intracranial hypotension caused by a persistent CSF leak from the subarachnoid space.

The purpose of the current study is to know the incidence and efficacy of the different management options of incidental durotomy during a five year period at a tertiary care centre.

METHODS

All patients who underwent various surgical procedures in thoracic and lumbar spine from January 2006 - December 2010 at Christian Medical College, Vellore were retrospectively reviewed. We collected data on demographics, primary diagnosis, associated comorbidities, surgical procedures, operating surgeon, incidental durotomy, treatment, complications and postoperative stay.

Inclusion criteria

All patients who had complete data and those who had either intra operative dural tear or post operative CSF leak were included in our study.

Exclusion criteria

All patients who had incomplete data and those who did not have the complication of a dural tear or CSF leak were excluded from the study.

The overall incidence of dural tears was calculated. We then grouped the patients according to the primary diagnosis and the procedure done to identify the variation in incidence of dural tears according to the complexity of the procedure (Table 1).

We further classified the patients into two major groups on the basis of whether the dural tear was identified intra operatively or post operatively (Table 2). We tabulated the complications in each of the two groups to find out the incidence and severity of the complications and also the need for further surgical procedures in each group. We also studied the follow up records of the patients who had complications to look for any long term sequelae following dural tears.

Since our study was descriptive in nature, no statistical test was performed.

RESULTS

2,270 patients underwent various surgical procedures in thoracic and lumbar spine during the five year period (January 2006- December 2010). Of these 2,270 patients

1,401 (61.71%) patients who had complete data were included in our study. On analyzing these 1,401 patient's records we found that they underwent various surgical procedures for different spinal pathologies. It included 763 disc herniations, 276 spondylolisthesis, 130 infective spondylodiscitis, 98 degenerative canal stenosis, 81 traumatic fractures and dislocations, 23 tumors, 18 deformities and 12 failed back surgeries. We identified 49 dural tears (3.49%) in this population. The mean age of the patients with incidental durotomy was 39.18 years (range 14-70 years). There were 29 men and 20 women (sex ratio).

Table 1: Incidence of dural tears according to primary diagnosis and specific procedure.

Diagnosis/surgical procedure	No. of cases	No. of cases with dural tears	Incidence (%)
Disc herniation			
Discectomy	763	23	3.01
Spondylolisthesis			
PLIF	276	9	3.26
Infection			
Decompression	18	1	5.55
PLIF	59	4	6.77
EPCD	48	0	0
Front and back	5	0	0
Deg.canal stenosis			
Decompression	98	2	2.04
Trauma			
Post fusion	37	0	0
PLIF	12	0	0
EPCD	11	1	9.09
Front and back	21	0	0
Tumor			
Decompression	6	1	16.66
EPCD	14	1	7.14
Front and back	3	0	0
Deformity			
Post.fusion	10	1	10
PSO	6	2	33.33
Front and back	2	0	0
Revision surgeries			
Decompression	4	0	0
PLIF	7	3	42.85
PSO	1	1	100
Total	1401	49	3.49

Incidental durotomies were associated with discectomy in 23 cases (23 primary disc herniations), with decompression in 4 cases (2 degenerative canal stenosis/ 1 infective spondylodiscitis/1 tumor), with posterior fusion in 1 case (1 deformity), with posterior lumbar inter body fusion (PLIF) in 16 cases (9 spondylolisthesis /4 infective spondylodiscitis/3 failed back surgeries), with extended posterior circumferential decompression (EPCD) and fusion in 2 cases (1 infective

spondylolisthesis/1 traumatic fracture) and with pedicle subtraction osteotomy (PSO) in 3 cases (2 deformity/1 failed back surgery). The incidence of durotomies according to the primary diagnosis and specific procedure performed is shown in Table 1.

We found a very high incidence of 33.33% incidental durotomies among patients who underwent revision procedures as compared to 3.23% for patients who underwent primary surgeries in thoracic and lumbar spine. We also found that, 5.10% of incidental durotomies were caused by fellows under training, 4.27% by junior consultants and 2.92% by senior consultants, proving a positive correlation between the level of surgical training and the incidence of dural tears.

Diagnosis

Of these 49 patients, the dural tear was identified intra operatively in 31 patients (63.26%) and post operatively in 18 patients (36.73%) (Table 1).

Management

Of the 31 patients in whom the dural tear was identified intra operatively, 14 patients underwent primary repair of the dura by direct end to end suturing with 6-0 prolene (Ethicon) under magnifying loops. And in the remaining 17 patient’s surgicel (Ethicon) and gelfoam (Johnson and Johnson)/fat graft was used to seal the CSF leak. We did not use fibrin glue or other adjuvants in any of our repairs. Upon completion of the repair, we performed a Valsalva maneuver on all patients. We used lumbar subarachnoid drain (LSAD) in 3 patients in whom the repair was inadequate. LSAD was inserted by the anesthesiologist under strict aseptic precautions after the surgical procedure was completed. None of these 31 patients had persistent CSF leak during the postoperative period and the surgical wound healed without complications.

Of the 18 patients in whom the dural tear was identified post operatively, 16 presented with CSF leak in the

immediate postoperative period (range 2-12 days) and the remaining 2 patients presented with pseudomeningocele later during the follow up. Of these 16 patients, 11 were treated with LSAD and 5 were treated with bed rest alone.

Postoperative bed rest

Of the 31 patients where the dural tear was identified intra operatively, except for 3 patients who had LSAD all others had bed rest for an average period of 3.34 days (range 2-7 days) during the postoperative period. Similarly of the 16 patients, where the CSF leak was identified post operatively had bed rest for an average period of 6.09 days (range 3-21 days) during the postoperative period.

Antibiotic prophylaxis

All patients undergoing elective spinal surgeries were given 1 dose of cefuroxime at the time of inducing anesthesia and 1 more dose 6 hours later post operatively. If a patient is identified to have a dural tear/CSF leak and requires LSAD then the same antibiotic is continued till the time of drain removal. This protocol is routinely followed in our spine unit.

Complications

Of all the 49 patients, 5 patients (10.20%) presented with clinical symptoms of intracranial hypotension like postural head ache, photophobia and nausea. And 10 patients (20.40%) presented with major complications (Table 2)– 5 with neurological deficit, 2 with surgical site deep wound infection, 2 with pseudomeningocele and 1 with meningitis (Table 2).

Of the 5 patients who had neurological complications, 3 had fresh neurological deficit and 2 others had neurological worsening of previous deficit. All 5 patients had root level deficits. It was severe (MRC grade 0-1) in 3 patients and moderate (MRC grade 2-3) in 2 patients.

Table 2: Complications of dural tears.

Identification of dural tear	Management	No of cases	Complications	Revision procedures
Intraoperative	Direct repair (sutures)	14	1 Neurodeficit	---
	Surgicel + Gelfoam/fat	17	---	---
Postoperative	LSAD	11	1 Wound infection	Debridement, washout and dural repair (sutures)
			3 Neurodeficit	---
			1 Meningitis	---
	Bed rest alone	5	1 Wound infection 1 Neurodeficit	Debridement and washout ---
Follow up	Nil (spontaneous resolution)	2	2 Pseudomeningocele	---

2 patients developed surgical site deep wound infection and both of them required debridement and washout of the wound. In 1 patient the tear was identified during the washout procedure and it was repaired with 6-0 prolene. The swabs sent for culture grew *S. aureus* and *E. coli* respectively and appropriate antibiotics were administered intravenously for a period of 6 weeks. Both the patients did not have persistent CSF leak and the wound healed well at the time of discharge from the hospital.

Table 3: Incidence of dural tears in various studies.

	Incidence (%)	Authors
Overall	1.7	Wolff et al ³²
	3.1	Camissa et al ⁶
	3.84	Guerin et al ⁵
	12.66	Kalevski et al ³³
	16	Sin et al ⁸
Primary discectomy	2.6	Guerin et al ⁵
	3.1	Desai et al ³⁰
	3.2	Saxler et al ⁷
	3.5	Tafazel & Snell ³
	7.1	Stolke et al ⁹
Decompression for stenosis	3.1	Camissa et al ⁶
	3.9	Thomsen et al ³⁴
	8.5	Tafazel & Snell ³
Decompression± Fusion	10.5	Desai et al ³⁰
	17	Guerin et al ⁵
Revision surgeries	8.1	Camissa et al ⁶
	13.2	Tafazel & Snell ³
	15.9	Khan et al ¹⁷
	17.4	Stolke et al ⁹

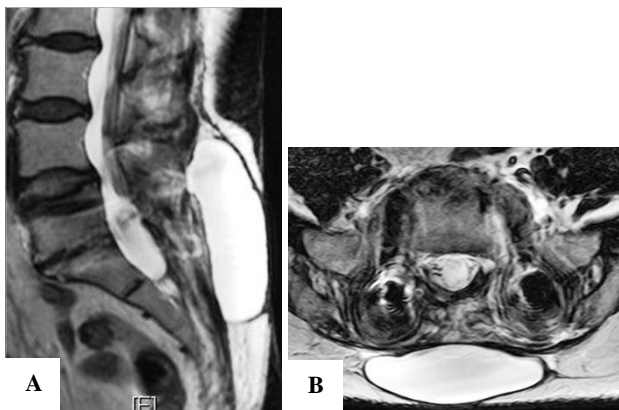


Figure 1: (A) Sagittal and (B) axial MRI sections demonstrating a well contained subcutaneous CSF collection at L5-S1 region – pseudomeningocele.

2 patients who presented with pseudomeningocele during the follow up (3 and 18 months post operatively) were advised surgical exploration and dural repair. One of them refused to undergo a revision surgery as she was mostly asymptomatic. And the other patient who obliged for surgery showed spontaneous regression of the

pseudomeningocele during the waiting period. Both these patients showed complete spontaneous resolution at subsequent follow up.

1 patient developed meningitis. He was identified to have a CSF leak through the postoperative wound and a LSAD was inserted on the 5th postoperative day. Since the LSAD did not drain properly he underwent repeated LSAD insertions on 4 different occasions and it was in place for a very long duration (total of 21 days). *Enterococcus* and *citrobacter* were grown on CSF culture. He was administered 5 different intravenous antibiotics for a total duration of 6 weeks. Eventually his symptom of meningitis subsided and was discharged after an inpatient stay of 60 days.

DISCUSSION

The overall incidence of incidental durotomy varies from 1.7% to 16% in the literature.^{4,9} The incidence is variable according to the indications and to the type of procedures. The incidence of incidental durotomies in different studies is shown in Table 3.

Dural tears are commonly associated with complex spinal surgeries and revision procedures.^{2,4,6,11,12} High speed drills and Kerrison’s Rongeur are the most common tools associated with incidental durotomies and it must be used with caution while decompression procedures.⁵

Epstein found three factors that contributed to dural tears: marked ossification of yellow ligament, high frequency of synovial cysts and prior surgery.¹³ Sin et al concluded that patients’ age and level of surgeons training were factors contributing to the incidence of dural tears.⁸

The most effective way to minimize the incidence of incidental durotomy is to prevent it. Pre-operative planning and meticulous surgical technique are necessary to reduce the incidence of durotomies. Non operative treatment of durotomies is unsuccessful and must be treated perioperatively.^{2,14} Ideally primary repair of dural tears should be done and is successful in most cases.² Different studies have compared different treatment approaches to dural tears. Tafazel & Snell in a study done in United Kingdom reported that 58% of surgeons used Prolene, 30% used a different suture material and 125 did not repair the dural tear.⁸ It is also possible to use muscle graft, fat graft, fibrin patch, fibrin glue and gelatin matrix if necessary.^{4,6,7,14-16}

Eismont et al recommended the use of fascial graft in the treatment of larger dural defects and suggested that small dural tears can be repaired with either running locked or simple sutures using a fat graft.¹⁴ Wang et al used 4-0 (or) 5-0 silk interlocking suture, gel foam, sub fascial drain and a layered closure.⁴ Khan et al used 4-0 nylon.¹⁷ A tight fascial layer closure is necessary to provide an essential barrier to CSF egress and infection. A Valsalva maneuver is recommended to check for the completeness

of repair.^{6,14,17} This maneuver increases the intrathecal pressure and will identify incompletely repaired dural tear as made evident by CSF leaking through the repaired defect. The Trendelenburg position is preferred for lumbar dural tear repairs.¹⁷

The use of drains is controversial. Eismont et al advised against placement of subfascial drains because it could precipitate the formation of a durocutaneous fistula.¹⁴ Camissa et al 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.¹¹ Wang et al placed a drain in all cases.⁴ They found that subfascial drains did not lead to the formation of durocutaneous fistulas in any patient. A subfascial drain can be used if adequate repair of the tear has been achieved.

Eismont et al found that bed rest without surgical repair was an unsuccessful method of treatment for unrepaired dural tears.¹⁴ Hodges et al in a retrospective review of 20 patients suggested that bed rest was not necessary for patients who had a satisfactory repair of an incidental durotomy.¹⁸ They reported that 75% of the patients did not need bed rest. Wang et al systematically used bed rest for a short period (2.9 days) and Camissa et al used bed rest ranging from 3-5 days in all patients.^{4,6}

Postoperative CSF leakage may occur along the suture line following inadvertent intraoperative durotomy.¹ It is difficult to obtain the true incidence of unrecognized durotomies because the majority of patients are asymptomatic.¹¹ Gerardi et al reported a 6.8% incidence of unrecognized dural tears. Postoperative diagnosis of dural tears can be made by simple clinical examination, immunofixation for β_2 transferrin, magnetic resonance immunofixation or cisternography with computed tomography.² A lumbar subarachnoid drain (LSAD) can be an alternate for treatment of postoperative CSF leaks or pseudomeningocele.^{11,14,20} Kitchel et al concluded that closed subarachnoid drainage when properly performed and monitored is a reasonably effective and safe method for treating CSF leak after spinal surgery.²⁰ Dural tears without primary repairs can lead to a persistent CSF leak, meningitis, arachnoiditis, pseudomeningocele and nerve root entrapment with resultant neurological damage.^{6,14,20}

McMahon et al found that 7.7% of patients went on to experience a neurological deficit with a dural tear as compared with 1.5% of those without a dural tear among 3000 electives spinal procedures.²¹ Weinstein et al 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.²²

Guerin et al had an incidence of 3.92% (2 out of 51 patients) for pseudomeningocele and both of them underwent re-exploration and repair.⁵ Elbiaadi et al reported successfully managed 2 cases of spinal pseudomeningocele by aspiration of CSF followed by epidural blood patch under CT guidance.²³ Jones et al and

Tosun et al reported the use of subarachnoid drain for treating pseudomeningocele.^{24,25} Weng et al treated 11 patients with giant pseudomeningocele successfully with extripation of pseudomeningocele, repair of the dural defect and placement of subarachnoid drain.²⁶

Wang et al reported 1 case of arachnoiditis and suggested the risk of meningitis appeared to be very low.⁴ Coplin et al in their study suggested that the incidence of meningitis in patients undergoing lumbar drain placement is around 4.2%.²⁷ Lanska et al also reported a case of meningitis following spinal puncture in a patient with CSF leak.²⁸ Although the incidence of meningitis is very low from our experience we found that the hospital stay, cost of treatment and morbidity of this complication is phenomenally high. Hence in order to prevent this complication high standard of care is essential at the time of insertion of the LSAD and during its management in the ward.

Kothe et al in a multi-center study involving 800 patients, reported a significant persistence of VAS score for low back pain in patients with incidental durotomy, which was noticeable at 12 month follow up.²⁹ They hypothesized that the additional exposure required for dural repair may lead to increased segmental instability and possibly poorer improvement in low back pain. In contrast, 409 patients in SPORT cohort with a mean follow up of 43.8 months did not have any difference in SF-36 or ODI scores between incidental durotomy and no durotomy groups.³⁰

A multi-center study of 4652 patients attempted to identify risk factors for incidental durotomy among adults undergoing posterior open surgery for degenerative diseases.³¹ Corrective vertebral osteotomy and revision surgery were identified as independent risk factors, while cervical surgery and discectomy were identified as factors that independently protected against incidental durotomy.

Limitations of the study

Lack of records- Out of the 2,270 patients operated from Jan 2006 to Dec 2010, we could not retrieve the records of 869 (38.29%) patients.

Since the number of dural tears was very low and we further categorized the cases into different primary diagnosis, the numbers were too low for a statistical analysis.

CONCLUSION

Incidental durotomy following thoracic and lumbar spinal surgeries is a common occurrence. The incidence increases significantly with revision surgeries and among surgeries performed by fellows in training. It is important to identify a dural tear intra-operatively and repair it primarily or seal it with surgicel and Gel foam or fat

graft, so that complications like wound infection, pseudomeningocele and meningitis can be minimized.

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Ethical approval: The study was approved by the institutional ethics committee

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