Unintended Dural Tear during Lumbar Spine Surgery

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ABSTRACT

Objectives: *This study aimed to determine the frequency of unintended dural tear (DT) during lumber spinal surgery and to evaluate the efficacy of a proposed DT management protocol.* ***Patients & Methods:*** *Among 2016 cases of lumbar spine surgery, 183 cases of unintended DT were reported with a frequency of 9.08%; 19 cases among 76 cases had revision spinal surgery (25%) and 164 cases had primary spinal surgery (8.45%). Management protocol insisted on preventive measures and urgent treatment once CSF is noticed by primary closure of DT using 4-0 vicryl. Anterior side DT was accessed through a posterior durotomy that was subsequently closed by 4-0 vicryl and a small muscle patch over it. If primary repair was impossible, alternatives included placement of muscle graft over the suspected leak site or the use of gelfoam. Non-suction wound drainage was used in few cases if there is some bleeding. Early mobilization 1-day after repair was practiced and carbonic anhydrase inhibitor in divided doses between 250-1000 mg –day and diuretics like frusimide 40 mg -day were used immediate postoperatively for 3 weeks.* ***Results:*** *Dural thinning in cases of longstanding stenosis, adhesion of the dura to removed bone and dural retraction were the commonly encountered causes (23.5%, 22.4% and 17.5%) followed by perforation of the dura when it expands onto a surgically created spicule of bone or due to an obscured fold of dura caught in a rongeur or curette or slippage of an instrument (10.4%, 8.2% and 6.5%, respectively). DT due to adhesion to scar tissue was reported in 10.4% of cases had DT. All DT were repaired with a 4-0 vicryl suture; after this repair, a Valsalva maneuver showed that there was no CSF leakage from the repair site. Failure of primary closure was reported in 4 patients (2.18%) presented as persistent headache and clear fluid drainage from the drain after the procedure. However, conservative measures failed and these 4 patients underwent a second repair of the dural defect 4-weeks later.* ***Conclusion:*** *DT was reported in 9.08% of cases had lumber spine surgery and was more frequent after revision surgeries. The applied policy of prompt identification and careful water-tight closure of the dural defect with early mobilization and administration of carbonic anhydrase inhibitor and diuretics provided successful outcome in 98.2% of cases with DT.*

Key word: *lumbar surgery, dural tear, CSF leak*

INTRODUCTION

Dural tear is one of the distressing sequale of spinal surgery forming multi-armed dilemma because of its undefined frequency, varied etiologies, and its relation to type of surgical procedure undertaken and strategies for treatment and its inherent complications. Although dural tears are a known potential intraoperative complication of spine surgery, there is a relative lack of information about the true incidence of this common occurrence. Unrecognized dural tear is the summit of the problem for its subsequent complication as unrecognized cerebrospinal fluid (CSF) leakage can lead to the formation of a fistula or pseudomeningocele[(1)]. Spinal pseudomeningoceles and CSF fistulas may occur due to an incidental durotomy, during intradural surgery, or from trauma or congenital abnormality[(2)]. Although they are often asymptomatic, they may cause low-back pain, headaches, and even nerve root entrapment. Leakage of CSF from the wound may cause a fistulous tract, which is a conduit for infection and should be repaired immediately[(3)] or

chronic CSF leakage leads to spontaneous intracranial hypotension syndrome[4].

Incidental dural tear is a frequent complication of lumbar spinal surgery and due to increasing number and complexity of spinal procedures, a greater prevalence of dural tears was reported[5]. However, the most important determinant factor is the type of surgery; whether primary or revision spinal surgery, several studies have shown that the incidence of durotomy in revision spinal surgery is higher than in primary surgery; ***Cammisa, et al.***[6]**,** reported an overall 3.1% incidence of durotomy in 2144 spinal procedures; however, its incidence in primary surgeries was 1 to 3.1%, whereas the incidence in revision surgery was 8.1%.

Intentional durotomy may be a mandatory request, for disc herniations of the upper lumbar spine (L1-2 and L2-3), during posterior discectomy after laminectomy, significant manipulation of the exiting nerve root is unavoidable because of the narrow lamina and the difficulty in mobilizing the nerve root, a transdural approach was used and postoperative permanent CSF leakage and pseudomeningocele were not observed, and no patient had a progressive lumbar deformity at an average follow-up of 53 months[7].

Accidental dural tears could occur as posttraumatic complication or secondary to the applied spine devices for management of various spine diseases; ***Yokota et al.***[8] reported a 33-year-old man began to develop progressive Horner's syndrome 14 years after a brachial plexus avulsion injury, coronal magnetic resonance imaging scans clearly demonstrated herniation of the spinal cord into a large pseudomeningocele inside the C7-T1 intervertebral foramen and another pseudomeningocele inside the T1-T2 intervertebral foramen was also noted. ***Ono et al.***[9] reported 2 cases of dural damage from dislocation of the hydroxyapatite intraspinous spacer after laminoplasty MR imaging revealed the dislocation of the hydroxyapatite intraspinous spacer, the absorption of the tip of the spinous process, and dural sac compression due to the hydroxyapatite intraspinous spacer and liquorrhea around the hydroxyapatite intraspinous spacers.

The present study aimed to determine the frequency of unintended dural tear (DT) during lumber spinal surgery and to evaluate the efficacy of a proposed management protocol which relies on good closure and early postoperative mobilization if possible.

PATIENTS & METHODS

The current prospective study was conducted at Department of Neurosurgery, Cairo University since Jun 2003 till Sep 2006. The study included all patients assigned for lumber spine surgery, irrespective it is de novo or revision surgery throughout 3-year period.

Management protocol insisted on the preventive measures and the necessity of urgent treatment start once CSF is noticed; DT should be recognized at the time of surgery, primary closure of the tear using 4-0 vicryl so as to prevent pseudomeningocele and/or CSF fistula taking care to avoid incorporating a nerve root into the closure. Also, a cottonoid was placed over the opening to prevent aspiration of nerve roots during suction. When the opening is in the anterior side of the dura, intradural repair accessed through a posterior durotomy was conducted and the posterior durotomy was subsequently closed by 4-0 vicryl with a small muscle patch over it.

If primary repair was impossible, e.g. when the opening cannot be found

or accessed, if the opening occurred on the nerve root sleeve or in the axilla of the root; alternatives included either placement of muscle graft over the suspected leak site or the use of gelfoam; fibrin glue or dural patch graft were not applied.

Wound closure included widening of the skin opening till exposure of the edges of the fascia up and down then the muscle was closed in a few interrupted sutures and the fascia was closed in 3 layers, 2 continuous to and fro layers and one interrupted layer using vicryl 2, this was followed by closure of the subcutaneous layer by 2-0 vicryl. Skin was closed in 2 layers, one in subcutecular fashion and the other was interrupted layer. Wound drainage in a non-suction manner was used in few cases if there is some bleeding to be removed one day postoperatively. All patients were instructed to start mobilization 1-day after surgery. Carbonic anhydrase inhibitor in divided doses between 250-1000 mg –day and diuretics like frusimide 40 mg -day and diuretics were used immediate postoperatively for 3 weeks to decrease CSF formation and to help in its absorption.

RESULTS

Throughout the study period a total number of 183 case of unintended dural tear were reported among 2016 cases of lumbar spine surgery performed with a frequency of 9.08%. Nineteen cases of DT were reported among 76 cases had revision spinal surgery with a frequency of 25% among revision surgery cases, while the other 164 cases had primary spinal surgery with a frequency of 8.45% among primary spinal surgical cases, (Fig. 1). The higher number of DT was reported after laminectomy 2-4 levels for canal stenosis (2.84%), followed by laminectomy one level for lumber disc (1.99%), fixation for instability (1.73%), post-traumatic spine injury (0.94%) and the least frequency was during microdiscectomy (0.35%), (Table 1).

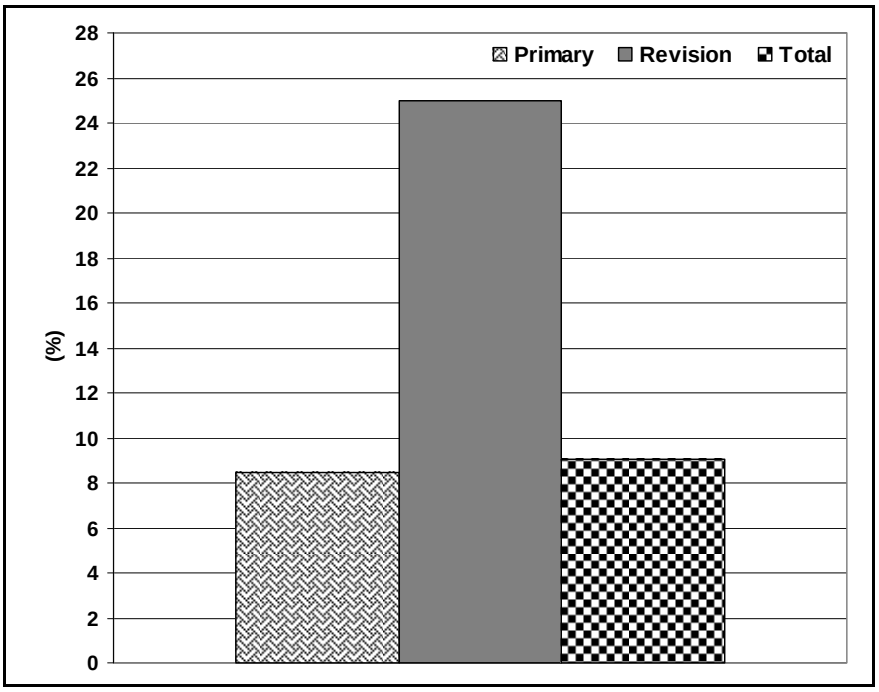

Fig. (1): Percentages of dural tear among studied cases

Table (1): Patients' distribution had DT categorized according to procedure undertaken

Type of spinal surgery		No DT	DT	Total
Primary	Microdiscectomy	388 (19.25%)	7 (0.35%)	395 (19.6%)
	Laminectomy one level for lumber disc	541 (26.78%)	39 (1.99%)	580 (28.77%)
	Laminectomy 2-4 levels for canal stenosis	560 (27.81%)	58 (2.84%)	618 (30.65%)
	Fixation for instability	250 (12.41%)	35 (1.73%)	285 (14.14%)
	Post-traumatic spine injury	37 (1.84%)	25 (1.24%)	62 (3.08%)
Revision surgery for disc or scar		57 (2.83%)	19 (0.94%)	76 (3.77%)
Total		1833 (90.92%)	183 (9.08%)	2016 (100%)

Data are presented as numbers, percentages are in parenthesis

The potential causes are variable with varied presentation; thinning of the dura in cases of longstanding stenosis, adhesion of the dura to removed bone and dural retraction were the commonly encountered causes and were reported in 23.5%, 22.4% and 17.5% of cases had DT. However, the possibility of a delayed CSF leak caused by perforation of the dura when it expands onto a surgically created spicule of bone or due to an obscured fold of dura caught in a rongeur or curette or slippage of an instrument showed a frequency of 10.4%, 8.2% and 6.5%, respectively. Unanticipated anatomic variations were met in 1.1% of cases. DT due to adhesion to scar tissue during revision surgery was reported in 10.4% of cases had DT, (Tabe2).

Table (2): Patients' distribution had DT categorized according to procedure undertaken

Cause	Patients
Thinning of the dura in cases of longstanding stenosis	43 (23.5%)
Adhesion of the dura to removed bone	41 (22.4%)
Dural retraction	32 (17.5%)
Perforation of the dura when it expands on a surgically created spicule of bone	19 (10.4%)
An obscured fold of dura caught in a rongeur or curette	15 (8.2%)
Slippage of an instrument	12 (6.5%)
Unanticipated anatomic variations	2 (1.1%)
Adhesion to scar tissue	19 (10.4%)

Data are presented as numbers, percentages are in parenthesis

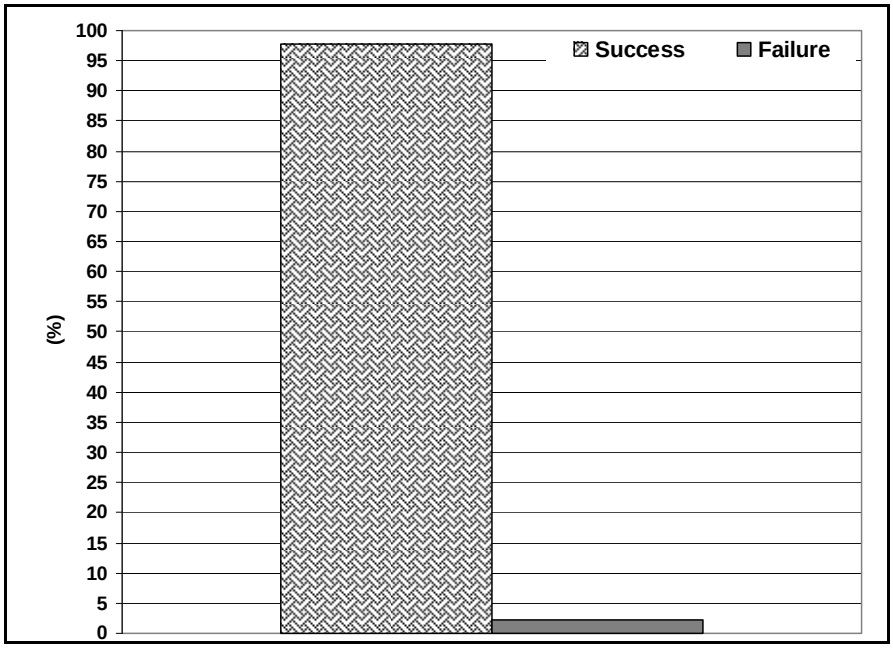

Fig. (2): Outcome of the applied technique for cases with dural tear

All patients had dural tears during the procedure were repaired with a 4-0 vicryl suture; after this repair, a Valsalva maneuver showed that there was no CSF leakage from the repair site. Failure of the primary closure technique was reported in only 4 patients (2.18%) presented as persistent headache and clear fluid drainage from the drain after the procedure. Patients were instructed to spend the first postoperative day in bed and then they mobilized immediate after that, if leak from the wound still present complete bed rest for 3-5 days in combination with antibiotic and dehydration measures were tried; however, conservative measures failed and these 4 patients underwent a second repair of the dural defect 4-weeks later. All other repairs were accomplished without complication or sequela to the patient with a success rate for the applied technique was 97.82%, (Fig. 2).

DISCUSSION

Incidental tear of the dural sac and subsequent cerebrospinal fluid leak is possibly the most frequent intraoperative complication of lumbar spine surgery. However, there is a wide variation in rates of dural tears in spine surgery[10]. Throughout the study period, a total number of 183 cases of unintended DT were reported among 2016 cases of lumbar spine surgery performed with a frequency of 9.08%. The frequency of DT among revision surgery was 25% and 8.45% among primary spinal surgical cases. These figures go in hand with that previously reported in literature; ***Wang et al***[11] reported that 14% (88 of 641) of patients undergoing degenerative lumbar spine surgery sustained dural tears. ***Cammisa et al.***[6] had an overall dural tears rate of 3.1% in their series of patients and a rate of 8.1% in revision cases. ***Khan et al.***[12] reported an incidence of DT during primary lumbar surgeries of 7.6% and an incidence of 15.9% for revision cases. ***Epstein***[10] reported that intraoperative DT occurred in 10 of 110 patients (9.1%).

The obtained results showed that higher number of DT was reported after laminectomy 2-4 levels for canal

stenosis (2.84%), followed by laminectomy one level for lumber sac (1.99%), fixation for instability (1.73%), post-traumatic spine injury (0.94%) and the least frequency was during microdiscectomy (0.35%). These findings are in line with ***Tafazal & Sell***[13] who in a European study of 93 patients with dural tears, the incidence was 3.5% for primary discectomy, 8.5% in patients who had surgery for spinal stenosis and 13.2% for revision discectomy.

All DT were repaired with a 4-0 vicryl suture and a Valsalva maneuver showed that there was no CSF leakage from the repair site. The study policy consisted of direct repair, a brief bed rest followed by early mobilization with administration of carbonic anhydrase inhibitor in divided doses between 250-1000 mg –day and diuretics like frusimide 40 mg -day were taken immediate postoperatively for 3 weeks to decrease CSF formation and to help in its absorption. No drainage technique was applied to safeguard against inherent problems of CSF leakage drainage; however, wound drainage in a non-suction manner was used in few cases if there is some bleeding to be removed one day postoperatively. The applied policy and the reported outcome go in line with ***Hughes et al.***[14] who suggested for postoperative lumbar CSF leak, primary closure of dural tear remains the standard of care, but in select cases, prolonged drainage in the setting of postoperative CSF leak may be a useful technique for the treatment of these leaks. ***Khan et al.***[12] found direct repair of DT and postoperative early mobilization protocol appears to be an effective and safe management strategy for treating this complication with a 98.2% success rate and very few patients (1.8%) needed a re-operation.

The applied treatment policy was found to be an effective strategy and was successful in treating 97.82% of cases and only 4 patients (2.18%) had postoperative persistent headache and clear fluid drainage. These results were superior to that reported by ***Hida et al.***[15] who tried to report the efficacy and safety of non-suture duroplasty using PGA mesh and fibrin glue (PGA-fibrin sheet) and reported a failure rate of 6.3% of studied patients; 10 patients experienced subcutaneous CSF leakage, of these, 6 required a second operation; in the other 4, the CSF collection diminished spontaneously. Also, the obtained results were superior to ***Timothy et al.***[16] who treated 58 patients with DT using non-penetrating clips and reported CSF leak in 8 patients (13.7%).

During the present study, if primary repair was impossible; alternatives included either placement of muscle graft over the suspected leak site or the use of gelfoam; fibrin glue or dural patch grafts were not applied. Such maneuver coincided with that reported by ***Shimada et al.***[17] who used suture and fibrin glue in a series of 20 consecutive cases and recorded CSF fistula in five patients (25%), while in a series of 10 patients, dural closure was performed by suture and fibrin glue with the use of absorbable PGA mesh and reported no CSF fistula.

As previously documented by ***Saxler et al.***[18] that patients with incidental durotomy had a poorer outcome after surgery, more frequently complained about headaches after surgery, showed worse outcome regarding complaints and daily activity and a tendency to more reoperations, a longer duration of inability to work, more back-pain, and functional limitations related to back-pain.

It could be concluded that it is better to avoid dural tear than to treat it. DT was reported in 9.08% of cases

had lumber spine surgery and was more frequent after revision surgeries. The applied policy of prompt identification and careful water-tight closure of the dural defect with early mobilization and administration of carbonic anhydrase inhibitor and diuretics immediately postoperative for 3 weeks provided successful outcome in 98.2% of cases with DT.

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