

Management of Persistent Cerebrospinal Fluid Leakage Following Thoraco-lumbar Surgery

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Study Design: This was a retrospective study of patients who had developed a dural tear after thoracic and lumbar spine surgery that was not recognized during the surgery, and was treated either by lumbar drainage or over-sewing of the wounds.

Purpose: To revisit the treatment strategies in postoperative dural leaks and present our experience with over-sewing of the wound and lumbar drainage.

Overview of Literature: Unintended durotomy is a frequent complication of spinal surgery. Management of subsequent cerebrospinal fluid leakage remains controversial. There is no distinct treatment guideline according to the etiology in the current literature.

Methods: The records of 368 consecutive patients who underwent thoracic and/or lumbar spine surgery from 2006 through 2010 were retrospectively reviewed. Seven cerebrospinal fluid fistulas and five pseudomeningoceles were noted in 12 (3.2%) procedures. Cerebrospinal fluid diversion by lumbar drainage in five pseudomeningoceles and over-sewing of wounds in seven cerebrospinal fluid fistulas employed in 12 patients. Clinical grading was evaluated by Wang.

Results: Of the 12 patients who had a dural tear, 5 were managed successfully with lumbar drainage, and 7 with over-sewing of the wound. The clinical outcomes were excellent in 9 patients, good in 2, and poor in 1. Complications such as neurological deficits, or superficial or deep wound infections did not develop. A recurrence of the fistula or pseudomeningocele after the treatment was not seen in any of our patients.

Conclusions: Pseudomeningoceles respond well to lumbar drainage, whereas over-sewing of the wound is an alternative treatment option in cerebrospinal fluid fistulas without neurological compromise.

Key Words: Cerebrospinal, Drainage, Spinal, Primary repair, Wound Healing

Introduction

Unintended durotomy is a frequent complication of spinal surgery with a reported incidence ranging from 1% to 17%. It varies according to the studies reviewed as well as the type of surgical procedure performed [1-9].

Possible sequelae of unintended durotomy include the formation of a pseudomeningocele, a cerebrospinal fluid

cutaneous fistula, arachnoiditis, meningitis, epidural abscess and deterioration in neurological status [10,11].

A cerebrospinal fluid leak also predisposes the patient to poor wound healing and possible wound dehiscence.

Dural tears seen intra-operatively are repaired by primary closure if the tear is simple and easy to repair, or repaired using a patch of deep fascia if the tear is very large or located laterally [12]. Management of subsequent cerebro-

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spinal fluid leakage remains controversial. Many surgeons advocate primary repair, while others recommend a trial of cerebrospinal fluid diversion for postoperative cerebrospinal fluid fistula [13]. Direct dural closure is both invasive and technically difficult due to the scar tissue that complicates the procedure.

The purpose of this article is to present our experience with postoperative dural leaks in 12 patients that were not recognized intraoperatively.

Materials and Methods

The records of 368 consecutive patients who underwent thoracic and/or lumbar spine surgery from 2006 through 2010 were retrospectively reviewed. Guidelines for inclusion in the study included those patients who had developed a dural tear that was not recognized during the surgery. All surgical notes, clinical notes, inpatient records, and imaging studies were analyzed for a possible persistent cerebrospinal fluid leak.

Detailed reviews of charts for all of the patients were conducted to determine the method of treatment, whether there had been a persistent leak of spinal fluid, and whether an intervention had been necessary.

Palpable accumulation of cerebrospinal fluid, after suture removal, in the subcutaneous area in the back was defined as a pseudomeningocele, whereas leakage that occurred at the suture line postoperatively was defined as a cerebrospinal fluid fistula.

Seven cerebrospinal fluid fistulas (Fig. 1) and five pseudomeningoceles occurred in the 12 procedures (Table 1). As the dural tears were recognized postoperatively, we are unable to describe intraoperative findings for details such as size and location of the durotomy.

Persistent symptoms lasting more than 72 hours after the initial surgery were seen in all 12 patients in our study. Indications for the intervention were clear wound drainage or positional headaches, photophobia, and nausea and vomiting associated with clinical evidence of a bulging mass with



Fig. 1. Postoperative clear wound drainage.

a ballotable collection of fluid.

Cerebrospinal fluid diversion by lumbar drainage in five patients and over-sewing of the wounds in seven patients were used as a revision procedure, and patients were instructed to remain flat in bed for 48 to 96 hours after surgery. Lumbar drainage was performed particularly for the treatment of pseudomeningoceles to avoid development of a fistula after a surgical incision, whereas a cerebrospinal fistula was managed with over-sewing of the wound.

In the over-sewing procedure, the wound edges were tightly re-approximated after the excision of the fistula. Subcutis tissue was sutured with No.1 prolene sutures at a distance of 6 to 8 cm from the wound. The stitches were inserted parallel to the wound so that two stitches, one on either side of the wound, formed a pair. A rolled gauze pad was placed over the wound. The long ends of the sutures were then tied over the gauze pad (Fig. 2). This acted as a pressure dressing and helped to decrease the dead space underneath the wound. After 5 days, the gauze pad was removed by cutting the tied-over knots.

After identification of the proper level by palpation of the fluid collection, a 18- to 20- gauge epidural needle was advanced through the spinal canal in a 10- to 30- degree cephalad direction. After collection of cerebrospinal fluid, a thin plastic catheter was placed through the needle into the subarachnoid space. The needle was then removed, leaving the catheter in place, which was then connected to appropriate drainage and monitoring devices. The drain was typically removed after several days.

The patients were asked about headache, low back pain and leg pain. A rating of excellent indicated complete resolution of the preoperative symptoms with no back pain; a rating of good indicated nearly complete resolution of the preoperative symptoms with minor back pain; and a rating of poor indicated symptoms that were worse than they had been preoperatively as described by Wang [5].

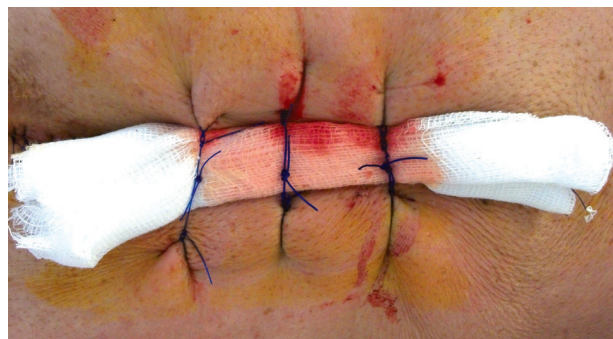


Fig. 2. Technique of wound over-sewing.

Table 1. Demographic data of the patients and type of intervention according to the clinical manifestation

Patient No.	Age/sex	Indication of initial operation	Level of lesion	Initial operation	Clinical manifestation	Type of intervention
1	61/M	Metastatic Tumor	T5	Resection/posterior instrumentation	Cerebrospinal fluid fistula	Over-sewing
2	40/F	Herniated intervertebral disc	L5-S1	Microdiscectomy	Pseudo meningocele	Lumbar drainage
3	46/F	Spondylolisthesis	L5-S1	Laminectomy/posterior instrumentation/ reduction/anterior fusion	Cerebrospinal fluid fistula	Over-sewing
4	19/F	Traumatic compression fracture	L1	Laminectomy/posterior instrumentation	Pseudo meningocele	Lumbar drainage
5	40/F	Herniated intervertebral disc	L4-L5	Microdiscectomy	Cerebrospinal fluid fistula	Over-sewing
6	67/M	Recurrent herniated intervertebral disc	L4-L5	Microdiscectomy	Pseudo meningocele	Lumbar drainage
7	57/M	Recurrent herniated intervertebral disc	L4-L5	Microdiscectomy	Pseudo meningocele	Lumbar drainage
8	64/M	Herniated intervertebral disc	T10-T11	Costotransversectomy/discectomy	Cerebrospinal fluid fistula	Over-sewing
9	28/M	Herniated intervertebral disc	L4-L5	Microdiscectomy	Pseudomeningocele	Lumbar drainage
10	21/M	Thoracolumbar kyphosis	T10-L4	L1 pedicle subtraction osteotomy/posterior instrumentation/fusion	Cerebrospinal fluid fistula	Over-sewing
11	69/F	Spinal stenosis after spondylolisthesis surgery	L5-S1	Laminectomy	Cerebrospinal fluid fistula	Over-sewing
12	45/M	Herniated intervertebral disc	L5-S1	Microdiscectomy	Cerebrospinal fluid fistula	Over-sewing

Table 2. Clinical outcomes according to the type of intervention

Patient No.	Preoperative symptoms	Type of intervention	Clinical outcome
1	Back pain, limb pain, headache, vomiting	Over-sewing	Poor
2	Headache	Lumbar drainage	Excellent
3	Headache, nausea	Over-sewing	Excellent
4	Back pain, headache	Lumbar drainage	Excellent
5	Symptom free	Over-sewing	Excellent
6	Symptom free	Lumbar drainage	Excellent
7	Headache	Lumbar drainage	Excellent
8	Back pain, limb pain, headache, nausea	Over-sewing	Good
9	Headache	Lumbar drainage	Excellent
10	Symptom free	Over-sewing	Excellent
11	Back pain, headache, vomiting	Over-sewing	Good
12	Headache	Over-sewing	Excellent

Results

Cerebrospinal fluid leakage was managed in all patients without surgical intervention. The type of initial surgery carried out for these patients was laminotomy, laminectomy, posterior instrumentation, anterior fusion and discectomy.

The overall rate of dural tears in thoracic and lumbar spine surgery was 3.2%, whereas the incidence rates of cerebrospinal fluid fistula and pseudomeningocele were 1.9% and 1.3%, respectively.

The commonest symptoms were back pain, headache, nausea and vomiting. Numbness in the legs or radiculopathy was not encountered. Complications such as neurological deficits or superficial or deep wound infections did not develop. Recurrences of fistula or pseudomeningocele after the treatment was not seen in any of our patients. Nine patients had an excellent outcome, 2 a good outcome and 1 a poor outcome (Table 2).

Discussion

A dural tear is one of the most common complications encountered in operations on the spine. Its incidence ranges from 1% to 17% [1-9]. A general belief is that spine surgeons tend to underestimate the frequency of this complication [14]. Reported risk factors for incurring a durotomy include older age, anatomic variations, revision surgery, thinning of the dura and inexperience of the surgeon [15-17].

Dural tears are more common in patients with a history of prior surgery with subsequent development of scar tis-

sue, altered anatomy, poor dissection plans and adherence of tissue to the dura [14-16]. The decreased dead space created by smaller incisions and a muscle-splitting approach that is used in minimally invasive spinal surgery may cause less potential for persistent leakage of cerebrospinal fluid in cases complicated by durotomy. There is a relative lack of information about the true incidence of dural tears with minimally invasive spinal surgery, and which of the dural tears mandate closure is not clarified yet.

Spinal instrumentation, especially the use of cross-links, may result in more dead space surrounding the dura and may prevent the paraspinal muscles from directly tamponading a dural tear [5].

The signs and symptoms of dural tears are caused by a persistent leak of cerebrospinal fluid from the subarachnoid space [16]. A persistent cerebrospinal fluid leak may result in a chronic pain disorder associated with cranial nerve palsies, radiculopathy and postural headaches [3,18].

Clinical manifestations of acquired dural tears may be classified as unintended durotomy during the surgery, pseudomeningoceles and cerebrospinal fluid fistula. Pseudomeningoceles and cerebrospinal fluid fistula are seen postoperatively, while unintended durotomy is seen intraoperatively. The main difference between these is the time of observation which guides the treatment strategy.

According to the literature, recommendations for the treatment of dural tears have included primary repair, closed subarachnoid drainage, grafts consisting of muscle, fat or fascia, blood patches, fibrin- adhesive or cyanoacrylate polymer sealant, application of Gelfoam to the tear and bed

rest [6-8,19-23]. However, there is no distinct treatment guideline according to the etiology in the current literature.

In such cases of large spinal wounds secondary to cerebrospinal fistula or exposed hardware, muscle coverage with paraspinous muscle flaps may become the only tool for providing effective, well-vascularized dural coverage for obliterating dead space [24].

A dural tear that is observed during the procedure should certainly be repaired primarily due to the well known risks of cerebrospinal fluid leakage. There is a general consensus that, if possible, the surgeon should perform a primary suture closure [25]. Adequate exposure of the tear is necessary for the proper repair of the dural tear.

Unrecognized or unrepaired dural tears may stay asymptomatic, but sometimes lead to a pseudomeningocele formation or result in cerebrospinal fluid leak during the postoperative period. The prevalence of these complications remains unknown [5].

A postoperative extradural accumulation of cerebrospinal fluid in the soft tissue of the back that extravasates through the dural tear and cerebrospinal fluid fistula can be managed either by direct repair or lumbar-subarachnoidal drainage. Over-sewing of the wounds was also described in the literature [15,25]; however there is far less data.

A precise evaluation of dermatomal sensation and muscle force of the lower extremities is mandatory. In the cases of existing neurological complications, pseudomeningoceles are surgically explored and nerve roots are gently dissected and then reduced into the thecal sac. The dural tear is then repaired by primary sutures [12]. Pseudomeningoceles and cerebrospinal fluid fistulas without neurological compromise may be managed traditionally by closed subarachnoidal or lumbar drainage.

In our study of 12 patients, which included 5 pseudomeningoceles and 7 cerebrospinal fluid fistulas, the pseudomeningoceles responded well to lumbar drainage, whereas cerebrospinal fluid fistulas were managed successfully by over-sewing the wound and bed rest for 2 to 4 days.

If the dural tear was detected intraoperatively by the presence of clear fluid emanating from the wound, patients were generally advised to remain flat for 4 to 7 days after surgical repair to reduce symptoms and facilitate healing. Bed rest is thought to reduce the hydrostatic pressure on the repaired dura [14]. Hodges et al. [26] showed that patients who had a repaired dural tear during the index procedure did well without bed rest. However there is an absence of data on the necessity of bed rest after dural tears that were treated non-

surgically.

Paraspinal muscles and fascia should always be reapproximated tightly. Otherwise extradural anatomic dead space that is created by surgical procedures leading to the leakage of cerebrospinal fluid may not be obliterated. The relatively significant subperiosteal dissection with resultant lateral muscle retraction can result in a larger dead space into which cerebrospinal fluid can leak after closure. With minimally invasive procedures, the resulting dead space is significantly small.

There are few reports of clinical outcomes after incidental durotomy in the literature. Sin et al. [16] reported that the overall outcome of the patients would not be affected adversely by the presence of a dural tear. On the contrary, Saxler et al. [1] reported poorer clinical outcome after surgery in patients with an incidental durotomy.

It is unclear whether the postoperative onset of pseudomeningocele and cerebrospinal fistula require different treatments. Due to the small numbers for this type of analysis, we cannot recommend a preferable method in the treatment of pseudomeningoceles and cerebrospinal fluid fistula.

It is our belief that dural tears were not recognized intraoperatively in our patients due to the small size of the durotomy. The small size of the dural defects might be the reason for our success without surgical intervention. Prompt identification and careful closure of the dural defect at the time of the index surgery should be the treatment of choice.

Conclusions

In the cases of cerebrospinal leakage following spinal surgery, nonsurgical treatment including lumbar drainage, over-sewing of the wound and bed rest was found to be very effective. It was possible to manage cerebrospinal fluid leakage in our patients even when the dura was not primarily sutured. Although primary repair of the leak should be undertaken whenever possible, which dural tears mandate primary closure is still under debate. The simplicity of this technique makes it a plausible alternative, particularly for minor dural tears, since the initial primary repair often proves to be the most successful.

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