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Safe Discharge of Patients From an Ambulatory Care Center After Incidental Durotomy During Minimally Invasive Spine Surgery

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ABSTRACT

Background: Incidental durotomy is a well-known complication of spinal surgery that may occur occasionally. Increasingly, minimally invasive techniques are being used for spinal decompressions in an ambulatory surgical center (ASC) setting. The management of this complication in an ASC setting has not been reported.

Methods: A total of 832 consecutive minimally invasive decompressive spinal surgeries were performed by a single surgeon in an ASC during the course of 1 year. Incidental durotomies with cerebrospinal fluid leakage were repaired and patients were discharged to home. Patients with a watertight suture dural repair did not receive any modifications to the usual discharge activities allowed. All other patients were treated with bed rest overnight and head of bed restrictions. A protocol for close patient follow-up after discharge was followed. The complications were collected prospectively and analyzed retrospectively.

Results: There were 30 incidental durotomies (3.6%), with all occurring in the lumbar spine. Suture repair was accomplished in 28 patients (93%). Patch repair was performed in 2 patients (7%). All patients were discharged to home from the ASC. There were 2 short-term complications noted after discharge. The patient safety protocols in place identified the complications and allowed timely interventions.

Conclusions: Incidental durotomy occurring during minimally invasive spinal decompressive surgery is an occasional event. Suture repair of the laceration is feasible in most instances. Lumbar spine patients may be safely discharged to home from the ASC. Patients can be stratified into those with, or without, a watertight suture dural closure. Those with such a closure, who are without symptoms of intracranial hypotension, do not require modification of their activities. A short period of bedrest with head of bed modification successfully treated the remainder. Hospitalization or routine prolonged bed rest is not necessary. Protocols must be put in place to identify and timely manage potentially serious sequelae.

Minimally Invasive Surgery

Keywords: incidental durotomy, CSF leakage, minimally invasive spine surgery, ambulatory surgery, complications, dural repair, safety protocol, surgical technique, patient safety

INTRODUCTION

The costs associated with the health care of an aging population are of a major concern to our economic stability. Surgery performed in ambulatory surgical centers (ASCs) is associated with reduced costs compared with inpatient surgery. The rate of spine surgery being performed in an ASC has increased significantly in the last 2 decades.[1] However, the cost savings associated with the shift of patients from an inpatient setting to an ambulatory setting can only be justified if patient safety is not compromised. When intraoperative complications arise, management and outcomes of the incidents should be comparable to those occurring within a hospital setting.

Incidental durotomy is a well-recognized complication of spinal surgery, with the incidence of the event generally ranging from 1% to 17%.[2–7] The intraoperative management of an incidental durotomy, with leakage of cerebrospinal fluid (CSF), involves sealing the egress of fluid from the intradural space.[8–12] This can often be accomplished by direct suture of the dural opening, placing a patch, applying a sealant, or a combination of these modalities. Diversion of CSF flow from the durotomy by the placement of a lumbar drain is sometimes performed. Some surgeons also routinely place a subcutaneous drain.[10] Postoperative man-

agement generally involves a period of bed rest. This can lead to an extended hospital stay with increased resource use and costs.[13–15] Here, we report the incidence, management strategy, and short-term outcomes for patients who have experienced an incidental durotomy during decompressive spinal surgery occurring within the setting of an ASC. To our knowledge, the detailed management of incidental durotomy occurring during outpatient surgery has not been previously described.

MATERIALS AND METHODS

This is a consecutive series of patients operated on by a single surgeon (T.L.F.) during the 12 months of 2016. The patients were referred to a large multispecialty group private practice, with multiple surgical facilities, specializing exclusively in minimally invasive spine surgery. The surgeries took place in multiple ASCs, each without 23-hour monitoring capabilities. All patients operated on in the ASC were required to stay within 15 miles of the facility until they are routinely evaluated in our clinic the morning after surgery. Only procedures involving a posterior decompression of the neural elements are included in this study. If a patient was thought to require spinal stabilization in addition to the decompression, a transforaminal lumbar interbody fusion with bilateral pedicle screw fixation was performed at the same time. Procedures with anterior and lateral approaches are not included because the incidence of incidental durotomy is quite small and suture repair is usually not performed.[10,16] Patients were operated on in the prone position under general anesthetic. A minimally invasive approach to the spinal column was used and is described elsewhere.[17] Tubular retractors and an operating microscope were used in all cases.

Surgical complications were recorded prospectively as part of the ASC quality program. All of the incidental durotomies were of the full-thickness type with an egress of CSF visible. Durotomies in which the arachnoid remained intact and there was no CSF leak are not included in this series. Repair of the durotomy was accomplished by either suturing or the onlay of a dural patch using resorbable collagen matrix (Durepair Dura Substitute, Medtronic Neurosurgery, Goleta, CA). The onlay patch was not sutured. Sealant (DuraSeal, Integra, Plainsboro, NJ) was used as an adjunct to the dural patch, or when the surgeon felt the suture closure was potentially tenuous.

The technique for suture repair of the defect was similar in all instances. The operating table was adjusted for the patient's head to be in a dependent position in an effort to reduce the gravitational force on egress of CSF from the thecal sac. Any nerve rootlets protruding through the defect were replaced within the thecal sac using microsurgical technique. The dural edges were opposed using 6-0 Prolene suture with a bayonetted Castroveijo type needle holder, suitable for working within the tubular retractor. The instrument's curved jaw is essential for visualizing the tip of the needle. Following closure of the durotomy the patient was placed in a reverse Trendelenburg position to increase the pressure of CSF on the suture line. Valsalva maneuvers were then instituted to help identify any continued leakage of CSF. If a nonwatertight closure was evident, or if the closure seemed tenuous, then further sutures, a patch, or sealant was placed. Wound closure consisted of reapproximating the lumbar fascia and subcutaneous layers with an absorbable suture. Reapproximating the skin edges was performed with a topical skin adhesive, except in fusion procedures where Steri-strips were applied.

The patient was taken to the postanesthesia care unit (PACU) on a stretcher with the head of bed (HOB) at zero, unless there was an overriding ventilatory concern. Once the patient was alert, those patients thought to have a sutured watertight seal of the dura gradually had their head elevated. If the patient then had no symptoms of intracranial hypotension, no HOB restrictions were given, and activity was as tolerated with no lifting. If there were symptoms of decreased intracranial pressure (ICP), the patient was instructed to keep his or her HOB at zero until the next morning. They were allowed to sit up in bed while taking nourishment, and to ambulate for bathroom usage. In patients with low CSF pressure symptoms, there was not a reevaluation for potential liberalization of activities prior to ASC dismissal. Patients kept at bed rest were given a battery-operated sequential compression device for deep venous thrombosis prevention. Patients without a watertight seal of their dura were given the same instructions as those with symptoms of low ICP. Patients were evaluated by their surgeon prior to discharge, where symptoms were recorded. All patients were discharged to home on the day of

Table 1. Summary of operative locations and durotomies.

Location	No.
Total decompressive operations	832
Cervical	126
Thoracic	19
Lumbar	687
Total durotomies (incidence, %)	30 (3.6)
Cervical	0
Thoracic	0
Lumbar	30

Table 2. Summary of method of durotomy repair and sequelae.

Item	No.
Total durotomies/repaired, No./total (%)	30/30 (100)
Suture repair, No. (%)	28 (93)
Patch repair, No. (%)	2 (7)
Average operative blood loss, cc (range)	31 (5–100)
Average length of stay prior to discharge, min (range)	178 (85–343)
Sequelae, No. (%)	2 (7)
Headache (resolved), No. (%)	1 (3)
Urinary dysfunction (resolved), No. (%)	1 (3)

surgery. A dedicated "Spine Line" telephone number was given to the patient, where questions or concerns could be addressed. The patients were contacted by a nurse via telephone on the day of discharge in order to further address any questions or problems.

All patients in this series were assessed in our clinic the day after surgery, where symptoms of decreased ICP would be noted on the patients' charts. The surgeon telephoned each patient on postoperative day 2 and charted any symptoms. Approximately 2 weeks after surgery, all patients were contacted by a nurse via telephone call, and all symptoms were recorded. These data were collected in a prospective manner and then retrospectively analyzed.

RESULTS

There were 832 consecutive decompression procedures performed (Table 1). The number of cervical, thoracic, and lumbar cases was 126, 19, and 687, respectively. Incidental durotomies occurred in 30 patients, for an incidence of 3.6%. There were no instances of cervical or thoracic durotomies, with all of the durotomies occurring in the lumbar region. The management of the durotomy was suture repair in 28 cases (93%; Table 2). Despite various laceration lengths and configurations, no durotomy was considered irreparable by suture if the dural margins could be visualized. The 2 cases (7%) where suture repair was not performed involved durotomies on the ventral aspect of the thecal sac, occurring during revision disk removal. In both patients, despite "rolling" the lateral dura dorsal-medial, the durotomy could not be visualized, and a patch was placed under the dura, covering the presumed durotomy site. The average blood loss from the surgery was 31 mL (range, 5–100 mL), and the average postoperative stay until discharge from the ASC was 178 minutes (range, 85–343 minutes).

Two patients with incidental durotomies experienced associated short-term sequelae (7%). The first patient had a revision L3 to L4 decompression with a nonwatertight suture closure of the durotomy, which was augmented with sealant. He had persistent postoperative positional headache and was treated with relative bed rest at home for 48 hours, followed by activity as tolerated. At follow-up 10 days after the surgery he was completely free of headaches. The other patient had an L5 to S1 decompressive laminectomy with a watertight suture closure of her durotomy, which was further augmented with sealant. After meeting discharge criteria, which includes pain control, ability to void and ambulate, with no new neurologic deficit, she was discharged from the ASC. She later spoke with her surgeon by telephone expressing concerns of intermittently "wetting" herself. She could feel the urge to void and was able to void, with no loss of body sensation or weakness. She underwent imaging followed by exploration of her wound at the ASC within 24 hours. Her urinary dysfunction and severe back pain persisted, leading to open exploration of her wound as a hospital inpatient. At the time of hospital discharge her urinary symptoms had resolved, and her back pain had improved.

DISCUSSION

Previous reports of the incidence of unintended durotomy generally range from 1% to 17%. In this report of a consecutive series of 832 posterior decompressive procedures, the 3.6% incidence falls within this range. It should be noted that all the incidental durotomies were of the full-thickness variety, with egress of CSF from the dural sac. The perioperative management of this clinical situation is the focus of this manuscript. Partial-thickness durotomies, where the clinical importance is not well defined, are not included in this series. There were no incidental durotomies in either the cervical or thoracic areas in this series. This is in keeping

with other authors who report a lower incidence in the cervical and thoracic area, compared with the lumbar area.[6,18,19] The lower incidence in these areas may be due to fewer revision operations, which is a known risk factor for incidental durotomy.[3,7,12,18] Also, given the sensitivity of the spinal cord to being manipulated in the cervical and thoracic areas, which is not present in the lumbar area, there is decreased retraction and manipulation of the dura in these decompressions, possibly decreasing the probability a laceration. Because there were no cervical or thoracic durotomies in this series, conclusions regarding management of an incidental durotomy in these areas cannot be made with these data.

The goal of intraoperative management of durotomy is to lessen the probability of complications, such as pseudomeningocele, CSF leakage through the skin, neurologic impairment, arachnoiditis, infection, and symptoms of low ICP. Intraoperative techniques to address these potential complications can include sealing the durotomy with suture closure, patching, sealant, or a combination of these modalities. In this series, suture closure was performed in all patients where the dural defect could be visualized (93%). In the 2 patients (7%) where the dural edges could not be visualized, a patch was placed anterior to the dura, in the area thought to be the origin of the CSF leak. An advantage of suture repair is containment of nerve rootlets within the thecal sac, and the possible reduction of subsequent neurologic injury from the herniated rootlets. Incarceration of a nerve rootlet through a durotomy as a cause of pain has been reported.[20] With revision surgery as an outcome measure, Kamenova et al.[21] reported no difference in patients who had their incidental durotomy treated with suture, a patch, or a combination of both. In that series, patients were treated in a hospital setting with a length of stay generally being longer than a week. With suture repair, the ingress of blood and other materials into the CSF is reduced, potentially lessening the possibility of arachnoiditis and meningeal irritation. Finally, a theoretically reduced risk of symptomatic intracranial hypotension, pseudomeningocele, and transcutaneous CSF leakage is possible with a watertight dural closure. It has been suggested previously that the minimally invasive approach, whereby the retractor is inserted through the dorsal spinal musculature, may be a protector of CSF leakage through the skin.[22] Following removal of the retractor the muscles can be seen to re-oppose, thus potentially acting as a barrier to communication between the dura and the skin. Tan and colleagues[23] reported postoperative magnetic resonance imaging findings 1 to 3 months after intended durotomy was performed during minimally invasive spine surgery. All 23 patients had sutured closure of the dura augmented with fibrin sealant, and were treated with bed rest for less than 24 hours. The authors state that in each case, a miniscule fluid collection of variable size was noted immediately at the laminectomy site. None of these collections, however, extended into the dorsal paraspinal musculature, consistent with the occlusion of dead space from muscle reapposition unique to the MIS approach.

Thus, the success of outpatient durotomy repair in this series may be related to the minimally invasive muscle-splitting approach, and may not necessarily be applicable to patients undergoing open laminotomy. In the open procedure the muscle is initially detached from the spinous process and must be approximated with suture. The increased dead space created by retraction, along with possible fluid leakage through the suture line, may be a factor for potential symptomatic CSF leakage.

An advantage of suture repair during minimally invasive surgery, particularly when a watertight seal is accomplished, is the potential for early patient mobilization. Our protocol for postoperative management of patients with a durotomy includes assessment for positional headache and other symptoms of low ICP. If none are present, the patient's allowed activity is identical to that for those patients without an incidental durotomy. The patient is instructed to watch for a positional headache or other symptoms of decreased ICP, and if present to contact the facility and to keep their HOB at zero degrees overnight. Ambulating for bathroom privileges and sitting up to take nourishment are allowed. They are then assessed in our clinic the following day, and precautions are lifted if patients are without symptoms of low ICP. Discharge instructions in patients with a nonwatertight suture closure, those with patch repair of an anterior durotomy, or patients with symptoms of low ICP while observed in the PACU are the same as for a patient who notes symptoms after discharge (i.e., HOB restrictions and relative bed rest).

In all elective surgical procedures, patient safety is of paramount importance. In a hospital setting,

postoperative patient assessments can be performed on a direct observational basis. In this series of decompression surgeries performed in an ambulatory surgical setting, all patients who experienced an incidental durotomy were discharged the same day after meeting standard criteria. In lieu of being observed in a hospital, close patient contact is necessary after discharge. Our safety protocol includes patients being contacted by a nurse on the day of discharge. The patients are also given a telephone number to call with any questions or concerns, and they are evaluated in our clinic the day following surgery.

There were 2 sequelae to the incidental durotomies in this series which we do not believe were negatively impacted upon by having the patient being discharged from the ASC. The first was a low-pressure headache, the management of which was HOB restriction and relative bed rest. For this management protocol hospitalization is not necessary. The second complication occurred in a patient with postdischarge symptoms of urinary dysfunction. Prior to her discharge she was able to void and had no unusual complaints. When the patient later noted symptoms there was timely communication with the surgeon, and within 24 hours after surgery, imaging and surgical exploration had been completed. When continued complaints of back pain and urinary dysfunction were expressed by the patient in the PACU, she was admitted to a hospital and underwent open exploration of the surgical site. Thus, despite a significant complication manifesting itself following discharge from the ASC, there were processes in place for identification of the complication and communication with the staff and surgeon, thereby allowing for timely intervention.

CONCLUSIONS

This is the first report of the detailed management of patients with an incidental durotomy occurring in an ambulatory surgery setting. In this series, incidental durotomy occurring during minimally invasive spinal decompression was an occasional event (3.6%), with none of the occurrences involving the cervical or thoracic areas. Recommendations for management of incidental durotomies are made with regard to the lumbar area only. When CSF leakage is identified intraoperatively, suture closure is feasible in the vast majority of instances. If a watertight suture closure of the dura is accomplished, and the patient has no symptoms of decreased ICP in the PACU, the patient may be safely discharged from the ASC with no additional restrictions. Patients with a nonwatertight repair may be safely discharged to home with HOB restrictions and relative bedrest overnight. In-hospital management and prolonged bedrest are not necessary. If a patient experiences an incidental durotomy, minor sequelae are occasionally evident, whereas more serious complications can occur. Protocols for patient safety following discharge from the ASC must be in place, which allow for communication between the patient and staff, timely identification of problems, and interventions if necessary.

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