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Case Report

Minimally invasive repair of a pseudomeningocele caused by a sheared intrathecal catheter following implantation of a drug delivery system

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Abstract

Background: Shearing of an intrathecal catheter during implantation of a drug delivery system is an underreported complication that can be challenging to manage.

Case Description: A 53-year-old man with refractory cancer pain had an intrathecal pump system implanted. The procedure was complicated with catheter shear and retention in the intrathecal space. A second catheter was successfully placed but formation of a painful pseudomeningocele and ineffective pain relief complicated the outcome. A minimally invasive approach through a tubular retractor was employed to access the spinal canal via a laminotomy, the sheared catheter was removed and the dural defect repaired. Complete resolution of the pseudomeningocele and efficient pain control were observed at follow-up.

Conclusion: Minimally invasive approach to the spine is demonstrated as a safe and effective alternative in this case of retained catheter induced cerebrospinal fluid (CSF) leak.

Key Words: Cerebrospinal fluid leak, minimally invasive surgery, pseudomeningocele, retained intrathecal catheter

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INTRODUCTION

Percutaneous placement of an intrathecal catheter is commonly performed for drug delivery or cerebrospinal fluid (CSF) diversion. Catheter breakage is an underreported complication that can occur during or after the procedure and may result in CSF leak, pseudomeningocele and failure or drug delivery to the intrathecal space.[1,8,30] Optimal management of a retained intrathecal catheter needs to be individualized to the patient's presentation, symptoms, and needs.[10] Avoiding significant surgical morbidity is desirable in this setting. A case is presented where a retained intrathecal catheter and its associated pseudomeningocele were successfully managed with a minimally invasive access to the spine

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through a tubular retractor. Management options and surgical indications for retained intrathecal catheters are discussed as well as the place of minimally invasive surgery (MIS) in this context.

CASE REPORT

Clinical presentation

A 53-year-old man was referred to the pain management clinic for a 7 months history of intractable thoracic back pain and abdominal pain following surgical resection of a duodenal adenocarcinoma (stage IV). His pain was refractory to all treatments previously tried, with a reported maximal pain intensity of 10/10. His pain did not respond to methadone, hydromorphone, cyclobenzaprine, gabapentin, pregabalin nor lidocaine patches. Previous interventional therapies provided only temporary, if any, relief. These included neurolysis of the celiac plexus, neurolysis of the superior epigastric nerve, 12th intercostal nerve, and paraspinal trigger point injections. Given, his lack of response, the decision was made to move forward with a trial of intrathecal medication in preparation for a possible intrathecal drug delivery. At this time, he was receiving oral long acting morphine 100 mg three times daily, oral morphine 30 mg every 6 h as needed, tizanidine 4 mg three times daily as needed, and amitriptyline 25 mg every evening. The intrathecal drug trial was successful leading to the implantation of an intrathecal delivery system. During the implantation, the intrathecal catheter was successfully placed through a Tuohy needle at L3-4. In the course of the Tuohy removal, the epidural portion of the catheter was sheared. The fractured portion could not be removed. The decision was made to leave the sheared catheter in place. A second catheter was successfully placed at the same level and connected to the pump.

In the immediate postoperative period, the patient reported about 50% pain relief but 10 days after the procedure, he began to experience orthostatic headaches, nausea, vomiting, and the development of a painful lump in his right paraspinal lumbar area. The physical exam was unremarkable for any neurological deficits, but a tender mass was palpable in the left paraspinal area at L3-4. A pseudomeningocele in the subcutaneous lumbar tissue was demonstrated on computed tomographic (CT) imaging. Two intrathecal catheters were noted on CT imaging entering the spinal canal at the L3-4 level and a few millimeters of the proximal tip of the sheared catheter were visualized into the epidural space [Figure 1]. A CT with myelogram following injection of dye into the intrathecal pump showed CSF leakage and the pseudomeningocele at L3-4 [Figure 2].

The patient was initially treated conservatively with bed rest for 48 h, but his symptoms did not improve over time. In addition, to the symptomatic pseudomeningocele and intracranial hypotension, the patient presented significant anxiety due to his concerns about the retained drain fragment. Surgical resection of the retained catheter with CSF leak repair was then recommended.

Figure 1: Computed tomography imaging in axial sequence showing the severed catheter entering the intradural space

Operation

The patient underwent a minimally invasive repair of symptomatic CSF leak and removal of the sheared intrathecal catheter. Under general anesthesia with the patient prone on a Wilson frame, an 18 mm right-sided longitudinal incision 15 mm of the midline at L3-L4 was planned using fluoroscopy. Serial dilators were inserted and final 18 mm diameter retractor was docked at the junction of the inferior L3 lamina and facet complex.

A L3 laminotomy and medial facetectomy were performed and upon removal of the ligamentum flavum, CSF became visible in the surgical field. The functional intact catheter was visible at the midline in the epidural space and some CSF was leaking around its insertion site in the dura. The second sheared catheter was identified following completion of a L4 laminotomy and CSF was freely leaking from its open end [Figure 3a].

The non-functional catheter tip was removed with micro bayonet curved tip forceps [Figure 3b], and the resulting dural defect was sutured primarily with a 5-0 TF-4 silk suture (Ethicon, Somerville, NJ) [Figure 3c]. This particular suture is preferred by the senior author for dural closure through a tubular retractor because the needle has a semicircular shape which minimizes needle movements. A bayonet needle holder with a working distance of 6 cm is used to manipulate the needle and a knot pusher is employed to tie the knot. Additionally, a purse string suture was placed around the intact catheter to stop the CSF leak around it [Figure 3c and d]. A Valsalva maneuver was performed up to 40 mmHg and held

Figure 2: CT Myelography in sagittal plane showing leakage of CSF through the drain site

for 10 s to confirm the absence of residual CSF leak. A fine layer of absorbable polyethylene glycol hydrogel sealant (DuraSeal Spine Sealant System, Covidien, Waltham, MA) was applied over the sutures and hemostasis was achieved prior to closure.

Follow-up

Postoperatively, the patient complained of nausea and abdominal pain that improved in the weeks following procedure. He further reported complete resolution of his postural headaches and was able to tolerate continued use of his functioning morphine pump. Complete resolution of his presenting symptoms with no evidence of CSF leak was confirmed at 8 weeks postoperatively. The patient continued to benefit from palliative care until his death 5 months after the procedure.

DISCUSSION

Catheter-related complications

Intrathecal catheters are commonly used for CSF diversion or drug delivery. Complications involving the catheter itself such as leakage, fracture, dislodgement/migration, kink/occlusion, disconnection at the pump, granuloma formation, or infection may warrant catheter revision or explanation. Catheter-related complications can occur in 3% to 76% of patients implanted with an intradural drug delivery system (IDDS) with catheter breakage, migration, and obstruction being more frequently reported.[7-9,27,30] Different causes for postoperative IDDS catheter rupture or leakage has been reported: excessive mechanical stress at the connector, fibrous sheath at the spinal entry site, or iatrogenic puncture during pump refill.[1,8,30] Catheter shearing during the insertion, as with the presented case, has only been reported in series of subarachnoid lumbar drain placements.[21,26] Retraction of the catheter in the Tuohy needle, the use of a guidewire when confronted

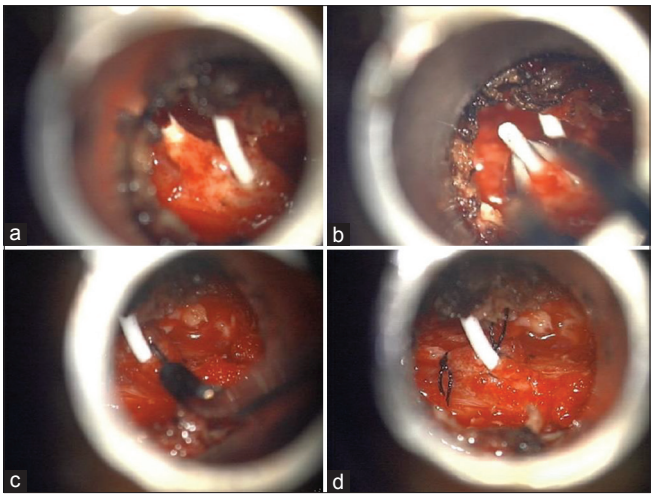

Figure 3: Intra-operative images showing (a) the functional catheter (right side) and the tip of the non-functional catheter (left side), (b) forceps being used to pull the severed catheter and (c) purse string suture being made around the remaining functional catheter to ensure a watertight closure and (d) before closure with a suture at the site of the sheared catheter and the purse string suture around the functional catheter

with a difficult placement and excessive traction during removal of the catheter has been proposed as risk factors for shearing during the implantation procedure.[10,15,21] The incidence of retained fragments has been reported in 1.8–3.3% of patients who underwent CSF diversion with lumbar drain.[4,21,26]

Indications for surgical extraction of a sheared intrathecal catheter

Management of a retained intrathecal catheter and surgical removal must be decided on an individual basis. Low surgical risk, progressive neurological symptoms, infectious risk, presence of pseudomeningocele, scheduled spine surgery at the same level, migrating catheter, and patient psychological distress are factors that can support surgical removal of a retained catheter fragment.[10] Some asymptomatic cases have been managed by observation only.[10,14,21,26] However, migration of the free intrathecal fragment can cause radiculopathy or subarachnoid hemorrhage.[12,13,18,21,22] Although rarely reported, retained subarachnoid or epidural catheters carry the risk of abscess formation and development of granuloma with neural compression.[3,16] In the presence of intracranial hypotension or symptomatic pseudomeningocele that are persistent despite conservative management, resection of the retained catheter with concomitant CSF leak repair is warranted.[31] Thin slice CT-scan of the spine allows localization of the retained fragment and helps to ascertain if there is an epidural component that can be retrieved. As in our case, the presence of pseudomeningocele can be determined by CT-scan and active CSF leakage or fistula can be visualized with CT myelogram.

The place of MIS for extraction of intradural foreign objects and repair of cerebrospinal fluid leak

MIS of the spine through tubular retractors has gained popularity due to its decreased surgical morbidity and the potential to achieve better postoperative clinical outcome.[23,24] Although it may require a longer learning curve,[2] MIS spine surgery is associated with less postoperative pain, shorter recovery time, faster mobilization, decreased opioid use,[17] and lower wound infections rate[20] which can be a significant advantage when treating chronic pain patients with mobility restrictions.

Intradural surgery can be safely performed through tubular retractors using MIS techniques.[6,11,19,29] Using the proper instruments, intradural tumors can be dissected and resected, and the dura can be closed in a watertight fashion.[28] Dural repair instruments has been developed for tubular MIS surgery and should include long shaft needle holder and a knot pusher (Scanlan International, St Paul, MN). Bayoneted instruments, such as microforceps or needle drivers, can also be used as long as the working length of the bayoneted instrument is longer than the length of the tubular retractor. This can be a limitation when treating obese patients. The width of the tubular retractors needs to be large enough in order to open, close, and manipulate the instrument freely. An 18 mm diameter retractor can be used when the tube length is 6 cm or 5 cm while a 22 mm diameter is preferable when the tube length is greater than 6 cm. When confronted with longer working distances, instead of using a bayoneted needle holders, which may be too short to reach the dura, a micro Decker pituitary forceps can be used to manipulate a semicircular needle on a 5-0 TF-4 silk suture (Ethicon, Somerville, NJ) to close the dura.[5] The durotomy can be closed primarily with a running suture and the suture line is covered with fine layer of absorbable polyethylene glycol hydrogel sealant (DuraSeal Spine Sealant System, Covidien, Waltham, MA). Alternatively, a small piece of dural substitute (Duragen, Integra, Plainsboro, NJ) can be placed intradurally over the nerve roots to protect them and the durotomy can be closed primarily with a suture or be covered with polyethylene glycol hydrogen or fibrin sealant. Incidental durotomy with MIS is as frequent as with open procedures, but delayed complications of CSF leakage are reduced by tubular retraction surgery as there is no wound cavity in which to accumulate a pseudomeningocele and no easy route of egress from the wound.[25] This aspect adds to the appeal of MIS for the repair of CSF leak.

We present the first case of successful removal of a retained intra/extradural catheter and treatment of resulting CSF leak through a minimally invasive approach. We present this approach as an optimal alternative for this population of terminally-ill patients in which more extensive procedures are preferably avoided.

CONCLUSION

MIS technique utilizing commonly available instruments can be successfully and safely used to remove retained sheared intrathecal catheters and to repair persistent spinal CSF leak after implantation of a IDDS. Although more technically demanding when compared to open approaches, MIS offers the advantage of minimizing the surgical morbidity, without creating a significant empty space in which CSF can accumulate, and thus can possibly decrease the incidence of postoperative pseudomeningocele.

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Conflicts of interest

There are no conflicts of interest.

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