

# Intermittent Cerebrospinal Leak After Inadvertent Dural Puncture During Epidural Catheter Placement for Postoperative Analgesia

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## Abstract

Regional anesthesia is being used more frequently in pediatric anesthesia practice, including the perioperative care of neonates and infants. Adverse effects may be encountered during epidural needle placement, with catheter advancement, or subsequently during infusion of local anesthetic agents. We present the rare occurrence of a persistent cerebrospinal fluid (CSF) leak following inadvertent dural puncture (wet tap) during attempted placement of an epidural catheter in a 6-year-old child. Potential adverse effects of epidural anesthesia in children are discussed, and options for treatment of a persistent CSF leak after inadvertent dural puncture are reviewed.

**Keywords:** Epidural anesthesia; Dural puncture; Cerebrospinal fluid leak; Fistula

## Introduction

Epidural analgesia is an essential component of a multimodal approach to perioperative pain management in children [1]. Although opioids are commonly administered to prevent or treat severe postoperative pain, their use may be associated with adverse effects including respiratory depression and delayed gastrointestinal motility [2, 3]. Epidural anesthesia has shown to be a safe and effective alternative for the prevention of postoperative pain [4]. Despite its promising efficacy in controlling postoperative pain, adverse effects may still occur related to catheter placement or its subsequent use [5]. These may include failure to correctly identify the epidural space,

inadvertent dural puncture, epidural hematoma, neurological injuries, medication errors, catheter malfunction, catheter migration, infection, or local anesthetic toxicity [6-8]. We present a 6-year-old child with Hirschsprung's disease who was scheduled for anesthetic care during planned laparotomy and transanal pull-through procedures. A persistent cerebrospinal fluid (CSF) leak developed following inadvertent dural puncture during placement of an epidural catheter. Potential adverse effects of epidural anesthesia in children are discussed. Previous reports of persistent CSF leak are reviewed, and options for treating a persistent CSF leak are presented.

## Case Report

### Investigations

The patient was a 6-year-old, 20.8 kg boy with a past history of Hirschsprung's disease functionally treated with previous Duhamel pull-through surgery. He was scheduled for revision of the transanal pull-through and creation of loop ileostomy. Parental consent was obtained for general anesthesia and placement of an epidural catheter for postoperative pain control. Following the induction of anesthesia and endotracheal intubation, the patient was placed in the lateral decubitus position. Given the proposed surgical procedure, mid-thoracic placement of the epidural catheter was planned. Following sterile preparation, an initial attempt was made with a 2 in, 18-gauge Tuohy needle at the T8-9 interspace (identified by surface landmarks) which resulted in an inadvertent dural puncture and the return of CSF. The needle was promptly removed, and the procedure was repeated successfully placing a new Tuohy needle (2 in, 18 gauge) at the T9-10 interspace followed by a 20-gauge catheter on a single attempt. Loss of resistance was noted at 2 cm and the catheter was secured at 6 cm at the skin. A test dose of 2 mL of 1.5% lidocaine with epinephrine 1:200,000 was administered after negative aspiration for blood and CSF. General anesthesia was supplemented by intermittent dosing of the catheter with 2 mL of 0.2% ropivacaine every 30 min. The surgical procedure lasted approximately 8 h. The patient's trachea was extubated. After an uneventful recovery in the post-anesthesia care unit, he was admitted to the inpatient ward. Adequate postoperative analgesia was provided by an epidural infusion of 0.2% ropivacaine with clonidine at 4 mL/h.

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## Diagnosis

On the fifth postoperative day, the epidural was removed. Shortly after that, CSF was noted to be leaking from the epidural catheter insertion site (lower puncture site). This fluid leak persisted despite placement of a pressure dressing. The patient complained of mild back pain, but no headache or fever were observed.

## Treatment

Neurosurgery was consulted, and a suture was placed bridging together subcutaneous tissue and skin at the site of the observed CSF leak. The procedure was performed at the bedside following cutaneous infiltration of local anesthetic. The CSF leak resolved, and the patient was further monitored. There were no signs or symptoms consistent with meningitis.

## Follow-up and outcomes

The patient's postoperative course was complicated by prolonged ileus, multiple abdominal fluid collections requiring ultrasound-guided aspiration under general anesthesia, and the need for total parenteral nutrition. He was eventually discharged on postoperative day 15. Per recommendations of the neurosurgical team, the suture was removed 2 weeks from original placement.

## Discussion

Regional anesthetic techniques such as epidural analgesia have been shown to be a safe and effective option for intraoperative and postoperative analgesia in infants and children, with potential benefits over intravenous opioids including earlier tracheal extubation, improved blunting of the hormonal-metabolic stress response, earlier return of bowel function, decreased respiratory complications, and shorter hospital stays [1, 4]. Despite these benefits, adverse effects may occur related to initial needle or catheter placement or the subsequent epidural administration of medications. Adverse effects related to placement, including bleeding or direct neurologic damage, are rare. In a 2018 comprehensive review of neuraxial anesthesia practice by the Pediatric Regional Anesthesia Network (PRAN), there were no reports of hematoma formation or permanent neurologic injuries related to needle placement [7]. Among 30,000 epidural catheters placed, there were no reports of persistent CSF leak or cutaneous fistula. Although the observation and diagnosis of a persistent CSF-cutaneous fistula is a rare event, anecdotal reports in both adult and children have demonstrated its occurrence following spinal surgery, placement of intrathecal catheters, combined spinal-epidural anesthesia, diagnostic or therapeutic lumbar puncture, and epidural anesthesia [9-24]. A summary of the reports from pediatric-aged patients is outlined in Table 1. Our review identified six reports including a total of seven patients (Ta-

ble 1). Persistent CSF-cutaneous fistula in children has been identified with the prolonged postoperative use of indwelling intrathecal catheters for CSF drainage following craniofacial or neurosurgical procedures, in the setting of multiple lumbar punctures, following multiple attempts at epidural catheter placement, and following apparently uncomplicated epidural catheter placement. Potential identified risk factors from these anecdotal cases reports included the extended use of an intrathecal catheter (3 and 9 days), repeated penetration of the dura with multiple lumbar punctures, and use of larger bore needles or catheters. However, the development of a CSF-cutaneous fistula remains a rare complication in children as demonstrated by the lack of reports found in comprehensive reports from the PRAN database [5-7].

The initial indication of the problem in our patient was the identification of clear fluid (CSF) draining from the insertion site following removal of the epidural catheter in absence of other significant clinical signs and symptoms. Additional clinical signs and symptoms reported in the literature have generally been non-specific including irritability, headache, vomiting, back pain, or listlessness. In our patient, the CSF-cutaneous tract was likely formed during the inadvertent dural puncture at the T8-9 interspace during the first attempt at epidural catheter placement. We would postulate that CSF drainage from the fistula was tamponaded by the presence of the catheter passing from the interspace below through the tract into the epidural space thereby blocking the leak of CSF. Additionally, this CSF leak may have been prevented by expansion of the epidural space following administration of the local anesthetic agent and pressure on the fistula tract. The leak was only manifested after removal of the epidural catheter. A similar chain of events was reported by Hosu et al with placement of an epidural catheter at an interspace below an area of inadvertent dural puncture and subsequent persistent CSF leakage after catheter removal [21].

Although there is limited evidence-based medicine on which to develop a treatment algorithm, due to the theoretical risk of infection with a persistent leak, the observation time for spontaneous resolution should be limited. Furthermore, there is no evidence to suggest that treatment strategies should differ between pediatric and adult patients. While spontaneous resolution of a CSF-cutaneous fistula may occur, treatment may be necessary given the concerns regarding the potential for retrograde infection of CSF, and the development of meningitis in the presence of a persistent leak. Invasive treatment with surgical exploration is unlikely to be required except with CSF leaks following surgical procedures or traumatic injuries. Conservative treatment with bedrest in the horizontal position has been shown effective in hastening resolution of a dural tear after lumbar decompressive surgery with a mean duration of bed rest of 2.6 days (range 2 - 4 days) [25]. Other potential approaches suggested by Fang et al to treat CSF leak after spinal surgery have included suture placement, or augmented closure with dural substitute material, slowing CSF leakage by reducing the subarachnoid fluid pressure, or increasing the epidural space pressure using a tight fascial closure or an epidural blood patch [26]. The latter approach has been reported anecdotally to be successful by several authors following the occurrence of a CSF leak after

**Table 1.** Reports of CSF-Cutaneous Fistula in Children

References	Demographic data	Clinical course and outcome
Kumar et al, 1991 [10]	A 6-year-old boy with CSF rhinorrhea after an orbital fracture and a 6-year-old girl with an ethmoid tumor. Lumbar intrathecal catheter (14-gauge needle, 16-gauge catheter) was kept in place for 9 and 3 days respectively in both the cases.	In the first case, CSF leak persisted for 3 days after catheter removal. Epidural blood patch was used twice, 1 day apart and a figure of eight suture was placed. CSF leak stopped after the second epidural blood patch. In the second case, CSF leak continued after the catheter removal despite bed rest and epidural blood patch was placed on the fifth day along with a figure of eight suture around the fistula, which resulted in complete cessation of CSF leak.
Sanders et al, 2004 [11]	A 3-year-old child with B-cell lymphoma. Omayya reservoir placed for chemotherapy with an intrathecal catheter (12 - 14 gauge) to facilitate CSF access and allow continued intrathecal chemotherapy.	CSF leak began from the wound site on the day after the catheter and reservoir placement. CSF leak continued despite sutures, staples, and collodion glue. Four weeks later, the catheter and reservoir were removed, but the leak continued. CSF leak stopped after epidural blood patch on the fifth day of the catheter removal.
Kowbel et al, 1995 [15]	A 4-year-old child with acute lymphoblastic leukemia who had multiple lumbar punctures for chemotherapy.	Subarachnoid cutaneous fistula developed after multiple lumbar punctures. Epidural blood patch via the caudal approach 72 h after the leak was detected resulted in prompt cessation of CSF leakage.
Rusy et al, 2019 [17]	An 11-month-old infant for nephrectomy.	Epidural catheter was placed at L3 after three attempts. On day 3 following removal of the catheter, there was an asymptomatic CSF leak from the puncture site. Neurosurgeon placed a subcutaneous skin suture and the CSF leak ceased.
Franklin et al, 2013 [20]	A 25-month-old child following thoracotomy for division of a vascular ring.	Epidural catheter was placed at T6-T7. On POD 2, catheter was removed. Persistent leakage from the epidural insertion site was noted. Patient was fussy and periodically touched her head with her hand. On POD 4, an epidural blood patch was placed at T6-T7, and the CSF leak stopped immediately.
Hosu et al, 2008 [21]	A 5-year-old girl for ureteral reimplantation.	Epidural catheter was placed at L3-L4, after an unsuccessful attempt at L1-L2. The catheter was removed on POD 2. Persistent CSF leakage noted from the epidural site. She was sleepy, had occasional emesis, diaphoresis, and intermittent headache. On POD 5, an epidural blood patch was placed with prompt resolution of the CSF leak.

CSF: cerebrospinal fluid; POD: postoperative day.

repeated lumbar punctures or epidural catheter placement [10, 11, 15, 20, 24]. In our patient, as he was asymptomatic, a trial approach with placement of a sterile pressure dressing was attempted. When it failed, placement of a single subcutaneous suture was suggested by our neurosurgical consultants and proved to be effective. The role of prophylactic antibiotics for these patients is unclear, and its value in preventing infection remains unproven. As our patient was afebrile without signs of meningeal irritation, antibiotics were not deemed necessary. However, a low threshold to initiate antibiotic therapy is indicated should there be clinical concerns for local infection or meningitis.

### Learning points

Neuraxial anesthesia remains an important tool for providing postoperative analgesia with specific advantages over systemic opioids, and an excellent adverse effect profile even for the neonate and infant population. Although infrequent, complications related to placement or subsequent use of a catheter may arise. We present the rare occurrence of a persistent CSF leak following inadvertent dural puncture during attempted placement of an epidural catheter. Anecdotal reports in the literature suggest that the incidence of this complication may be increased by the use of an intrathecal catheter, repeated pen-

etration of the dura during multiple lumbar punctures, or with the use of larger bore needles or catheters. However, it can also occur following a single inadvertent dural puncture. Our experience suggests that the CSF leak was possibly facilitated by placement of an epidural catheter below the initial dural puncture, likely contributing to maintaining an open fistula tract. Consideration for placement of subsequent catheter placement at a level above the initial dural puncture is suggested to limit the occurrence of this complication. Treatment options include bed rest with the head of the bed flat to decrease CSF pressure, placement of a pressure dressing, attempts to seal or close the fistula tract with sutures, colloidal glue, staples, or epidural blood patch. More invasive interventions such as surgical exploration are rarely required. Anecdotal reports suggest that prompt resolution may occur even in difficult to treat cases with placement of an epidural blood patch.

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### Financial Disclosure

None to declare.

## Conflict of Interest

None to declare.

## Informed Consent

Informed consent was obtained from a parent for anesthetic care and use of patient data for publication purposes. The patient information was de-identified for publication.

## Author Contributions

BK performed the case review, literature review, initial manuscript preparation, and editing of subsequent revisions. DPM and RB provided clinical care and reviewed the manuscript. JT contributed to literature review, manuscript writing, and editing of the manuscript.

## Data Availability

The data supporting the findings of this case report are available from the authors.

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