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Epidural Blood Patches Performed with Miethke Sensor Reservoir for Continuous Intracranial Pressure Monitoring

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Abstract

An epidural blood patch (EBP) is a procedure performed by injecting autologous blood into a patient's epidural space, usually at the site of a suspected CSF leak. It is typically performed in patients with characteristic postural headaches due to low intracranial pressure. We report a case of a young female with an implanted Miethke Sensor Reservoir, which was used for continuous intracranial pressure (ICP) monitoring during a two-level epidural blood patch. ICP increased only with thoracic injection, suggesting thoracic EBP may have greater efficacy than lumbar EBP in treating SIH and PDPH when the site of CSF leak is unknown.

Keywords

Epidural Blood Patch, Intracranial Pressure Monitoring, Spontaneous Intracranial Hypotension, Post Dural Puncture Headache, Pain Management

1. Background

An epidural blood patch (EBP) is a procedure performed by the injection of autologous blood into a patient's epidural space. Typically, this is performed at or around the level of a known or suspected CSF leak. It can also be performed in patients with symptoms consistent with intracranial hypotension, but with unknown site of leak as a test and therapeutic procedure. Characteristic symptoms of intracranial hypotension, also known as post-dural puncture headache (PDPH), include headaches, neck stiffness, vision/hearing changes, nausea/vomiting, and altered mentation worsened when standing, and improved when supine [1]. PDPH occurs when dura has been violated, typically following a subarachnoid injection, such as a spinal anesthetic or a lumbar puncture, or

following unintentional puncture of dura when performing an epidural injection or placement of an epidural catheter [2].

EBP is indicated for treatment of PDPH in patients who do not respond to conservative treatment, such as rest, intravenous hydration, non-steroidal anti-inflammatory drugs, and caffeine. It improves symptoms by patching up the site of dural puncture to prevent further CSF leak, and by increasing intracranial pressure by volume effect.

EBP is a highly effective treatment for PDPH with an 85% first procedure success rate [3]. In rare, refractory cases, surgical exploration and placement of fat grafts may be considered. The role of EBPs in cases of spontaneous or unknown CSF leak leading to intracranial hypotension is, however, less clear [4]. Although initial results of EBPs performed in the setting of spontaneous intracranial hypotension (SIH) have been promising, rarely has the procedure been paired with continuous intracranial pressure monitoring.

The following case details the complex clinical course of a patient with intracranial hypotension, who underwent a two-level EBP with continuous intracranial pressure monitoring with an implanted Miethke Sensor Reservoir device.

2. Case Presentation

The patient is a young female with a complex past medical history of Ehlers-Danlos Syndrome, C1 fracture status post anterior cervical discectomy and fusion with multiple revisions, and thoracic outlet syndrome complicated by intracranial hypertension for which a ventriculoperitoneal (VP) shunt was placed. Later, however, it was found that she developed intracranial hypotension with characteristic symptoms of PDPH that were refractory to multiple adjustments of her VP shunt setting. She subsequently had the Miethke Sensor Reservoir implanted for continuous ICP monitoring as part of her care in Berlin, Germany.

She presented to our institution for a repeat epidural blood patch. She had two prior epidural blood patches performed in Europe and New York, which gave her relief for several hours. Patient consented to the use of her wireless ICP monitor during the procedure and was awake for its entirety. Thoracic and lumbar epidural blood patches were performed during which intracranial pressures were monitored during injection. A 20-gauge Tuohy needle was inserted in the T11-12 epidural space, identified by loss of resistance and fluoroscopic guidance. Continuous ICP monitoring was performed using her implanted sensor and wireless receiver device. Baseline pressure was 8 cm H_2O while supine. Pressures increased to ~14 cm H_2O with 5 cc blood and gradually increased to 18 cm H_2O with 10 cc blood injected. At this point, the procedure was paused, and pressure decreased back to single digits after a few minutes rest. A total of 15 cc blood was injected into the thoracic level at which point, the patient complained of lower back discomfort. ICP reading was 17 cm H_2O at this point.

The subsequent lumbar epidurogram was normal. A 20-gauge Tuohy needle was inserted into the L4-5 epidural space through loss of resistance technique

and fluoroscopic guidance. Baseline pressure was 16 cm H_2O. 14 cc of autologous blood was injected through the Tuohy needle. The injection was stopped at this point because the patient developed low back pain again. During this injection, there was no significant change in the pressure readings in the Miethke device. Pressure was 16 cm H_2O at the end of procedure. In total, 15 cc of autologous blood was injected at T11-12 and 14 cc at L4-5. Patient tolerated the procedure well. ICP did not exceed 18 cm H_2O per implanted device throughout this procedure. Results are seen in **Table 1** below. Following completion, ICP returned to 12 - 15 cm H_2O after several minutes. She was then placed in supine position and recovered without complication in the postoperative anesthesia care unit.

3. Discussion

Epidural blood patches involve the injection of autologous blood into a patient's epidural space to reduce CSF leak, which can occur when dura is violated leading to PDPH and SIH. Symptoms include abrupt onset of daily orthostatic bifrontal/occipital headaches improved in supine position. Associated symptoms include tinnitus, photophobia, nausea, vomiting and dizziness [5].

A literature review done at the Cleveland Clinic compared the results of four patients with SIH who received EBPs. All four patients were experiencing lowered intracranial pressures associated with headaches without clear evidence of etiology on spine MRIs and received nearly complete relief with EBP treatment. Of note, one participant initially received an EBP at L1-L2 with partial relief and subsequent return of pain in two days, then subsequently underwent an EBP at T4-T5 with complete long-term relief. Another case reported continued headache after lumbar EBP with complete long-term relief after a C5-C6 EBP. Two other individuals got total relief of headache after initial injections at T7-T8 and C7-T1 levels, respectfully [6]. These results may imply cephalad oriented injections, located in the cervical and thoracic spine, have greater efficacy in treating headache associated SIH compared to EBPs performed at the lumbar level, particularly when level of CSF leak is unknown.

The idea of thoracic EBP having greater efficacy than lumbar EBP was further supported by a retrospective case series in Italy, in which 18 patients underwent thoracic EBPs for intractable SIH. 15 patients had complete resolution of headache within 24 hours. 16 of the 18 had sustained pain relief 16 - 30 months follow-up. With a near 90% success rate, thoracic EBP proved to provide long lasting beneficial effects for severe SIH suggesting thoracic approach should be considered as the first approach when level of CSF is unknown [7].

Table 1. ICP changes with EBPs performed.

Level of EBP	Beginning ICP (cm H_2O)	Ending ICP (cm H_2O)
T11-12	8	17
L4-5	16	16

A case reported in Germany used continuous intracranial pressure monitoring during an EBP performed at a known CSF leak at the L2 level on a previously healthy middle-aged male presenting with bifrontal frontal/occipital headaches. During this procedure, ICP remained unchanged, before, during, and after the procedure. However, post-procedurally, the patient had increased GCS score from 12 to 15 and resolution of headache [8]. The findings of this study suggest that ICP monitoring may not correlate with successful treatment by EBP.

Our patient had a two-level EBP performed at T11-12 and L4-5 levels, respectfully, with thoracic injection corresponding to an increase in ICP, further suggesting cephalad injections at the cervical and thoracic level may have greater efficacy in treating headache when level of CSF leak is unknown. However, clinically, the patient reported only short-term resolution of her headaches for several hours after the procedure.

4. Conclusion

An epidural blood patch (EBP) is a commonly used procedure for the treatment of intracranial hypotension headaches. Here, we describe a unique case of an EBP performed with continuous ICP monitoring demonstrating that ICP increased only with thoracic injection, suggesting thoracic EBP may have greater efficacy than lumbar EBP in treating SIH and PDPH when CSF leak level is unknown.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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