Review Articles
Cervical Epidural Blood Patch—A Literature Review

Shruti G. Kapoor, MD, MPH* and Shihab Ahmed, MBBS, MPH†
*Department of Anesthesiology, Stony Brook University, Stony Brook, New York, USA; †Department of anesthesiology, critical care and pain medicine, Harvard Medical School, Boston, Massachusetts, USA

Reprint requests to: Shruti G. Kapoor, MD, MPH, Department of Anesthesiology Stony Brook Medicine 101 Nicolls Road Stony Brook, NY 11794, USA. Tel: (631) 459-6429; Fax: 613-444-2907; Email: shruti.g.kapoor@gmail.com.

Conflict of interest: No conflict of interest.

Funding sources: None.

Abstract

Objective. Epidural blood patches (EBP) are rarely performed at the cervical levels, primarily due to fear of neurological complications such as spinal cord compression. We reviewed the literature to provide an evidence-based review of performance of cervical EBPs, with a specific focus on indication, technique, safety, and efficacy.

Design. A comprehensive electronic literature search was done to include studies that reported on performance of cervical EBPs in patients with CSF leak at the cervical level. Data regarding indication, level of CSF leak, level of cervical EBP, volume of blood used, efficacy, and complications were collected.

Results. A total of 15 studies, reporting on 19 patients were included. All patients presented with a headache that increased in the standing position, and improved in the supine position. All patients were identified to have a CSF leak at the cervical level. Eight patients first underwent a lumbar EBP, without complete, long-term relief. All these patients, along with 11 patients who did not undergo a lumbar EPB prior to cervical EBP, reported complete, long-term pain relief. EBPs were mostly done in the prone position, using imaging guidance. An average of 5–8 mL of autologous blood was injected in the epidural space. No major neurological complications were reported in any patient.

Conclusion. The review suggests that cervical EBP can be performed for cervical CSF leaks associated with positional headache without a significant risk of serious adverse events.

Classification of Evidence. Our review provides Class II level of evidence that cervical EBPs are safe and effective in relieving positional headache due to CSF leak.

Key Words. Cervical; Epidural Blood Patch; Headache

Introduction

Epidural blood patches (EBPs) are commonly done for headaches attributed to CSF leak. Their use in treating patients who present with headache after a known dural CSF leak has been reported as far back as 1955 [1]. The etiology of this leak is variable, with the most common reason being a lumbar puncture. In a recent Cochrane Review, EBP was found to be superior to conservative management for treatment of postdural puncture headache [2].

Most EBPs are, however, performed at the lumbar level. Cervical EBP are feared for numerous reasons. Commonly cited complications include cranial nerve palsy [3], changed mental status [4,5], subdural hematoma [6], seizures [7], and transient bradycardia [8]. Serious adverse events include compression of nerve roots [9], and chemical meningitis [10]. At the cervical level, then, spinal cord compression becomes the most feared complication. However, no systematic study has been done to elucidate the incidence of these complications.
Additionally, no prospective studies have evaluated indications for cervical EBP, the optimal cervical levels to access, the volume of blood to inject, or the efficacy of EBP at the cervical level.

We undertook a comprehensive literature review to evaluate studies demonstrating use of cervical epidural blood patch for cervical CSF leak. Our aim was to provide an evidence-based review of performance of cervical EBP, including epidemiology of patients for whom this procedure is used, the reason for performing the procedure, the levels of cervical spine most commonly accessed, amount of autologous blood injected, efficacy of the procedure, and most importantly, complications resulting from the procedure.

Methods

Literature Search

An electronic search was performed in PUBMED, EMBASE, and MEDLINE databases. The terms “epidural blood patch” were utilized to perform a broad search for all articles reporting on blood patches. To perform a very sensitive search, no filters including dates of publication, type of study, language, or species were utilized. No specific spinal levels were specified in the search criteria. The references of studies included in the review were also manually searched for additional articles.

Inclusion/Exclusion Criteria

Inclusion criteria, defined a priori, included study of EBP where CSF leak was identified to be at the cervical level. Additionally, EBP must have been performed at the cervical level. Studies were excluded if the site of CSF leak and/or EBP was not clear, if EBP was performed at noncervical level, or if EBP was performed at multiple levels including both cervical and noncervical levels simultaneously. References identified were retrieved and assessed by S.K. to check for inclusion criteria.

Data Retrieval/Analysis

Data was independently extracted using a standardized form to assess all studies. Despite what was planned at
the design phase of our review, a quantitative synthesis of data was not possible due to study heterogeneity.

Results

The electronic search identified 883 references. 867 articles were excluded because either EBP was not performed, or the level of CSF leak was either unknown or at a noncervical level. Four studies were excluded because despite a known cervical dural CSF leak, EBP was performed at the lumbar level [11–14]. One study was excluded as EBPs were performed at multiple levels simultaneously, including noncervical levels [15]. The remaining eleven publications were identified as eligible, and included in this review [9,16–25]. An additional four studies were retrieved from hand search of references of included studies [26–29] (Figure 1).

The oldest included studies were published in 2002 [9,28,29] and the latest were published in 2011 [16,19]. All studies were case reports or case series. We were unable to identify any randomized, controlled trials to evaluate efficacy of cervical EBP. Most studies reported one case where cervical EBP was performed. Four studies, however, reported more than one case each of cervical EBP [16,20,22,27].

The demographic features of the studies are included in Table 1. About 42% of the cases reported were female (8/19). The average age of subjects was approximately 41 years (range 22–56 years). Patients presented with a variety of symptoms. All patients reported headache. This headache was positional - it worsened with upright posture, and improved with lying flat. Other common symptoms were nausea [16,21–24,27,29], neck pain or stiffness [9,18,21,24–28], tinnitus [19], dizziness [23], and photophobia [23,26]. The average duration of follow-up in the included studies was 9 months.

All case reports except one [26] included patients diagnosed with spontaneous intracranial hypotension (SIH). We did not find any studies (case-reports or otherwise) of cervical EBP performed for postdural puncture headaches. One study included patients with dural leak due to disc herniation [26]. The diagnosis of SIH was made using various imaging modalities, in addition to patient symptomatology. These ranged in invasiveness, from relatively noninvasive magnetic resonance imaging (MRI) to the quite invasive radionuclide cisternography. The most commonly employed imaging to diagnose SIH was myelography (44%). The choice of imaging modality did not appear to be related to date of publication of the case report. Cisternography, for instance, was reported used as early as 2002 [28,29], and as late at 2010 [24]. These imaging modalities were also used to identify the level of the CSF leak. The level of CSF dural leak was clearly listed for 13 patients. Leak was believed to be most commonly

<table>
<thead>
<tr>
<th>Study (Refs #)</th>
<th>Published</th>
<th>Type*</th>
<th>Age (yrs)</th>
<th>Gender†</th>
<th>Symptoms‡</th>
<th>Duration§ (wks)</th>
<th>Diagnosis¶</th>
</tr>
</thead>
<tbody>
<tr>
<td>[16] 2011</td>
<td>CS 27</td>
<td>F</td>
<td>HA, N, V</td>
<td>2</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[16] 2011</td>
<td>CS 22</td>
<td>F</td>
<td>HA</td>
<td>2</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[17] 2008</td>
<td>CR 39</td>
<td>M</td>
<td>HA</td>
<td>8</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[18] 2005</td>
<td>CR 37</td>
<td>M</td>
<td>HA, Neck Stiffness</td>
<td>4</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[19] 2011</td>
<td>CR 39</td>
<td>F</td>
<td>HA, Tinnitus</td>
<td>3</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[20] 2005</td>
<td>CS 50</td>
<td>F</td>
<td>HA</td>
<td>–</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[20] 2005</td>
<td>CS 25</td>
<td>M</td>
<td>HA</td>
<td>4</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[22] 2003</td>
<td>CS 28</td>
<td>M</td>
<td>HA, N</td>
<td>1</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[22] 2003</td>
<td>CS 41</td>
<td>M</td>
<td>HA, N</td>
<td>2</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[27] 2003</td>
<td>CS 55</td>
<td>F</td>
<td>HA</td>
<td>8</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[27] 2003</td>
<td>CS 51</td>
<td>F</td>
<td>HA, Neck pain</td>
<td>28</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[29] 2002</td>
<td>CR 54</td>
<td>M</td>
<td>HA, N</td>
<td>1</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[28] 2002</td>
<td>CR 44</td>
<td>M</td>
<td>HA, Neck Stiffness</td>
<td>2</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[23] 2010</td>
<td>CR 32</td>
<td>F</td>
<td>HA, N, Dizziness, PP</td>
<td>4</td>
<td>SiH</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* CS = case series (multiple patients); CR = case report (single patient).
† F = female; M = male.
‡ HA = Headache; N = nausea; V = vomiting; PP = Photophobia.
§ Duration refers to duration of symptoms prior to presentation to physician for cervical EBP.

Cervical Epidural Blood Patch

Table 1 Demographic features of included studies
<table>
<thead>
<tr>
<th>Study Refs #</th>
<th>Age (yrs)</th>
<th>Gender</th>
<th>Level Leak</th>
<th>Prior L EBP?*</th>
<th>Result of Prior LEBP</th>
<th>Level Effective EBP</th>
<th>Vol† (ml)</th>
<th>F/U ‡ (wks)</th>
<th>Efficacy of Cervical EBP in Relieving Headache</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>[16] 27 F</td>
<td>Cervical</td>
<td>Yes</td>
<td>Short term relief</td>
<td>C6-7</td>
<td>8</td>
<td>6</td>
<td>Immediate, long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[16] 22 F</td>
<td>Lower cervical</td>
<td>Yes</td>
<td>Short term relief</td>
<td>C6-7</td>
<td>8</td>
<td>3</td>
<td>Immediate, long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[17] 39 M</td>
<td>C1-2</td>
<td>Yes</td>
<td>No relief</td>
<td>C3-4</td>
<td>12</td>
<td>52</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[18] 37 M</td>
<td>C2</td>
<td>Yes</td>
<td>No relief</td>
<td>C2-3</td>
<td>8</td>
<td>24</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[19] 39 F</td>
<td>C7-T1</td>
<td>Yes</td>
<td>Partial relief</td>
<td>C7-T1</td>
<td>7</td>
<td>16</td>
<td>Long term pain relief</td>
<td>Arm and neck pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[20] 50 F</td>
<td>Cervical</td>
<td>Yes</td>
<td>Short term relief</td>
<td>C7-T1</td>
<td>-</td>
<td>52</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[21] 56 M</td>
<td>C1-2</td>
<td>Yes</td>
<td>Short term relief</td>
<td>C1-2</td>
<td>10</td>
<td>52</td>
<td>Partial pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[22] 28 M</td>
<td>C6-7</td>
<td>No</td>
<td>–</td>
<td>C6-7 &amp; 1 wk later L1-2</td>
<td>10 &amp; 30</td>
<td>–</td>
<td>Long term, partial pain relief with cervical EBP</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[22] 41 M</td>
<td>Upper cervical</td>
<td>No</td>
<td>–</td>
<td>C7-T1</td>
<td>10</td>
<td>–</td>
<td>Long term pain relief</td>
<td>Neck pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[26] 53 M</td>
<td>C6-7</td>
<td>No</td>
<td>–</td>
<td>C6-7</td>
<td>12</td>
<td>60</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[27] 55 F</td>
<td>C7-T1</td>
<td>No</td>
<td>–</td>
<td>C7-T1</td>
<td>20</td>
<td>–</td>
<td>Long term, complete pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[28] 44 M</td>
<td>C6-7</td>
<td>No</td>
<td>–</td>
<td>C6-7</td>
<td>5</td>
<td>16</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[29] 54 F</td>
<td>C6-T2</td>
<td>No</td>
<td>–</td>
<td>C7-T1</td>
<td>5</td>
<td>4</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[28] 44 M</td>
<td>C6-7</td>
<td>No</td>
<td>–</td>
<td>C6-7</td>
<td>5</td>
<td>16</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[9] 42 M</td>
<td>C5-6</td>
<td>No</td>
<td>–</td>
<td>C5-6</td>
<td>15</td>
<td>2</td>
<td>Long term pain relief</td>
<td>Back pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[23] 32 F</td>
<td>C1-2</td>
<td>No</td>
<td>–</td>
<td>C1-2</td>
<td>2.5</td>
<td>52</td>
<td>Long term pain relief</td>
<td>Neck pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[24] 55 M</td>
<td>Cervical</td>
<td>No</td>
<td>–</td>
<td>C4-5</td>
<td>6</td>
<td>12</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[25] 46 M</td>
<td>C1-2</td>
<td>No</td>
<td>–</td>
<td>C1-2</td>
<td>10</td>
<td>52</td>
<td>Long term pain relief</td>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* LEBP: Lumbar epidural blood patch.
† Vol: Volume (in ml) of autologous blood injected.
‡ F/U: Follow-up period (in weeks).
either at the C1-2 level (4 patients) or the C6-7 level (4 patients).

The summary of our findings is included in Table 2. Eight patients first underwent a lumbar EBP (LEB). On average, 1.5 LEBPs (12 procedures in eight patients) were performed prior to performing a cervical EBP. However, failure to relieve symptoms then led to subsequent cervical EBP. Eleven patients were, however, treated with a CEBP without a prior lumbar EBP.

The CEBPS were performed in a few different ways. The position of the patient was stated in only 7/15 reports. In all cases except one [25] in which the patient was in a lateral decubitus position, CEBP was performed with patient in the prone position. Use of imaging was discussed in 11 reports. The most commonly used modality was fluoroscopy (7/11 reports). Loss of resistance technique was used to find the epidural space, which was then confirmed using contrast spread under fluoroscopy. Four reports used CT guidance along with spread of contrast to confirm needle location in the epidural space (18, 23, 26, and 29). Only one report discussed using the “hanging drop” technique with the patient in the prone position to identify the epidural space [17]. They did not use any imaging guidance, in addition to the hanging drop technique, to confirm needle position.

Volume of blood used for cervical EBP varied between studies. The most commonly used volume was 5–8 mL (range 2.5 mL [23]–20 mL [27]). The amount of blood did not correlate with the level of the cervical EBP. Allegri [23] for instance reported using 2.5 mL of blood at C1-2 level, whereas Buvanendran [21] and Inamasu [25] used 10 mL of blood at the same level.

Of the eleven patients who underwent cervical EBP as the first EBP, five reported immediate relief of symptoms [9,22,24,27,28]. Of these, two patients reported only partial relief [22,27]. One of these patients then underwent a subsequent LEBP as an additional CSF leak was thought to be at the lumbar level due to a prior lumbar puncture. This led to complete relief [22]. The second patient underwent a subsequent repeat CEBP with complete relief of symptoms [27]. An additional three patients reported relief of symptoms that started 24 hours after the procedure [22,23,25]. This continued for the duration of follow-up. One additional patient reported onset of relief 3–5 weeks status post procedure, which too continued for the duration of the follow-up [27]. Cervical EBP needed to be repeated in three patients. Of these, two patients reported no relief of symptoms following a CEBP [26,29] and one reported partial relief [27]. All three patients reported complete, long-term relief of symptoms after the CEBP was repeated. Of the eight patients who first underwent thoracolumbar EBP, most reported immediate relief. However, this lasted for a short period of time (range 1–7 days). Cervical EBP in these patients then led to long-term relief.

The most common complication reported was neck pain/pressure. This was reported in three studies [19,22,23]. In one of these cases, the procedure was discontinued due to reported neck pressure. The patient then underwent a subsequent lumbar EBP with long-term relief of pain [22]. One study reported back pain after CEBP [9]. Additionally, Walega et al. also reported that the patient complained of arm pain [19]. No serious adverse events were reported in any of the studies. Specifically, there were no cases of neurological compromise or vascular complications/perforations. There were also no cases of cervical spinal cord trauma leading to quadriplegia or death.

Discussion

Our results suggest that CEBPs can be performed for positional headache due to cervical CSF leak without a significant risk of serious adverse events.

There are several hypotheses regarding mechanism of action of EBPs. These range from acute compression of the thecal sac due to increased hydrostatic pressure, to dural tamponade by blood clot that permanently seals the dural tear [30,31]. In fact, it has been suggested that while increased pressure around the thecal sac may help alleviate the headache immediately after the blood patch is performed, this relief would be short-lived if permanent sealing of the dural tear does not occur [32,33]. Our results further support this hypothesis—while lumbar EBP did often provide immediate relief, the effect was short-lived. CEBPs may have a higher likelihood of providing long-term relief by providing a direct sealing effect at the site of dural CSF leak, while lumbar EBPs presumably only increase pressure around the thecal sac, but do not provide a direct sealant effect.

One question that is often asked is whether CEBPs are necessary, or would lumbar EBPs suffice, even for dural leaks at the cervical levels. There are several reports indicating that lumbar EBP can permanently alleviate the headache regardless of whether or not the site of leakage is identified [14,34,35]. However, other reports demonstrate that lumbar EBP does not always result in permanent relief [36–38]. A study by Díaz suggests that the site of leakage should be identified by radioisotope cisternography and treated with EBP targeted to CSF leak site levels [39]. Cousins et al. suggested that placement of the EBP close to the site of CSF leakage is important [26]. Studies have shown that blood injected at the lumbar level does reach the cervical levels. Ferrante et al., for instance, performed epidural blood patch at L3-4 and placed in the patient in trendelenburg for 22 hours [14]. He was able to show presence of blood in the epidural space at the cervical levels on postprocedure MRIs. The mean spread of the blood patch in the epidural space has been found to be 4.6 ± 0.9 vertebral levels [32]. Most of the blood spread in the cephalad direction [32]. However, the amount of blood that reaches the higher cervical levels in
Kapoor and Ahmed

comparison to the amount of blood needed to form a stable clot is unclear. Despite spread of blood to cervical levels, Beards did note that after an epidural blood patch, the majority of the clot and mass effect appears to be concentrated in the area around the injection site [32].

No standard of care has been established regarding how the CEBPs are performed. In our review, most of the procedures were done with patient in the prone position. In most cases, loss of resistance technique was used to identify the epidural space, which was then confirmed using contrast spread under fluoroscopic guidance.

The exact amount of blood to be injected for cervical EBPs has also not been studied. Given the narrow diameter of the cervical epidural space, particularly above the C6 level, it is hypothesized that smaller volume of blood should be injected at the cervical levels (when compared to the lumbar levels) to avoid spinal cord compression. The greatest risk of injection of a large volume of blood is cervical spinal cord infarct due to direct pressure on the cord, or excess pressure blocking vascular flow. Our results show that up to 15 mL of blood have been injected at the cervical spinal levels without any serious adverse events [17]. At the C7-T1 level, up to 20 mL of blood has been injected without any serious adverse events [27].

There are, however, various complications possible after EBP, regardless of the level of injection. These include pain at site of injection, radicular pain, pneumocephalus, cranial nerve paralysis, seizures, and arachnoiditis [3,7,40]. Additional complications associated with the procedure performed at the cervical level include risk of direct spinal cord injury [41], and spinal cord compression and infarct [42], leading to possible paraplegia or death [43]. The complications found in our review include pain at site of injection, and radicular pain. Spinal cord injury or infarcts, though theoretically possible, were not reported in any of the studies.

All cases except one in our review were diagnosed with SIH. This group of patients often has MRI of the head and possibly cervical spine. It is conceivable that the physicians performing the CEBP had reviewed this imaging, and were able to assess the anatomy of the cervical epidural space prior to the procedure. This brings up an important question regarding whether physician should request an imaging study to evaluate the cervical epidural space prior to performing CEBP. We recommend that MRI of cervical spine be assessed prior to cervical EBP to evaluate the epidural space at the cervical level and allow for perhaps a safer procedure.

The greatest limitation of our review is that the literature regarding cervical EBP is sparse. Despite an exhaustive literature search, only 15 case reports (19 patients) were found. We suspect that the number of CEBPs performed is much higher than what is reported in the literature. This then raises concerns about under-reporting of complications as well. Additionally, all reports (except one) performed CEBP for patients with SIH. Applicability of this data to non-SIH patients may thus be limited.

In conclusion, the results of this review show that EBP may be safely performed at the cervical level. Though the number of studies reported in literature is limited, it is helpful to know that 2.5–15 mL of autologous blood has been injected at the cervical level into the epidural space without any serious complications.

Classification of Evidence

Our review provides Class II level of evidence that cervical EBPs are safe and effective in relieving positional headache due to CSF leak.

References
Cervical Epidural Blood Patch


24 Kim SY, Hong JH. Epidural blood patches in a patient with Multi-level cerebrospinal fluid leakage that was induced by spontaneous intracranial hypotension. Korean J Pain 2010;23:46–50.


31 Schievink WI. Spontaneous spinal cerebrospinal fluid leaks: A review. Neurosurg Focus 2000;9:e8


