



### Case Series

## Epidural Blood Patch under Local Anaesthesia for Spontaneous Intracranial Hypotension: A Single Institute Experience

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### Abstract

*Spontaneous Intracranial hypotension is an uncommon benign condition that occurs due to cerebrospinal fluid leakage leading to low CSF pressures. Orthostatic headache is the most common distressing symptom. The aim of treating spontaneous intracranial hypotension (SIH) is to stop the CSF leak. SIH needs to be addressed in a timely manner, as the symptoms are disturbing, and also because the most common complication is subdural hematoma which could be potentially life threatening.*

**Materials and Method:** *We reviewed 12 cases from August 2015 to August 2021 of SIH in our institute. All cases were conducted by lumbar interlaminar approach, under fluoroscopic guidance. Results were shown as numbers (n) and percentage (%).*

*Epidural space was detected with loss of resistance technique in lateral position in L3-L4 space with a 16 gauge Tuohy needle, and a catheter introduced cranially as high as possible, but not necessarily at the leak site. 2cc Iohexol dye with 5 cc saline was then injected and epidural placement of catheter and spread of dye was confirmed. Thereafter, 15 cc of venous blood was withdrawn and injected immediately under fluoroscopic guidance. Catheter was then withdrawn and the head-low position given for at least thirty minutes. The patient was then shifted to the ward with instructions for strict bed rest for 24 hours.*

**Observation:** *All cases had a single successful epidural puncture attempt. No adverse hemodynamic events occurred. No Motor block of lower limbs or worsening of headache occurred.*

**Results:** *83.33% had satisfactory relief of headache. 8.33% required surgery for repair of leak, this was observed in the post lumbar laminectomy patient, while 8.33% required repeat of epidural blood 3 times within a span of 3 months due to no significant relief of headache.*

**Conclusion:** *The interlaminar approach under local anesthesia for EBP is an easy and effective treatment modality for SIH for relief of pain.*

*The epidural blood patch seals the CSF leak, thereby improving the pressure and causing relief of symptoms. An epidural blood patch can be repeated if symptoms are not relieved as the complication rate is very low.*

**Keywords:** *epidural blood patch, spontaneous intracranial hypotension.*

## Background

Spontaneous intracranial hypotension (SIH) is an uncommon, benign and commonly self-limiting condition, with an incidence of 5:100000, affecting middle aged adults with a female to male ratio of 2:1.<sup>1</sup>

Spontaneous intracranial hypotension occurs due to cerebrospinal fluid leak leading to low CSF pressure.<sup>2</sup>

Orthostatic headache is the most common symptom, amongst other symptoms.

The aim of treating spontaneous intracranial hypotension by the epidural blood patch is to stop the CSF leak by increasing CSF volume and thereby increasing the CSF pressure, irrespective of the site for CSF leak. Relief of symptoms occurs in 90% patients after an epidural blood patch.<sup>3</sup>

The interlaminar approach at the lumbar region for insertion of a catheter and injection of blood is safe, easy, and acceptable, with a low risk of recurrence.<sup>4</sup>

Spontaneous intracranial hypotension needs to be addressed in a timely manner, not only because the symptoms are distressing, but also because the most common complication, the subdural haematoma (SDH), can be potentially life-threatening.<sup>5,6</sup>

## Case Series

### Materials and Methods

We reviewed 12 cases of spontaneous intracranial hypotension, from August 2015 to August 2021. A valid written informed consent was obtained for the procedure from all the patients, with witnesses.

All the cases were performed under fluoroscopic guidance, using the interlaminar approach.

The results were shown as numbers (n) and percentage (%).

Total cases of spontaneous intracranial hypotension n=12 (100%), which included:

- Spontaneous intracranial hypotension without history of trauma or surgery n=10 (83.33%)

- Presenting with subdural haematoma n=1 (8.33%)
- Underwent lumbar laminectomy surgery n=1 (8.33%)

Presenting Features were as follows:

- Orthostatic headache n=12 (100%)
- Nausea and vomiting n=7 (58.3%)
- Neck pain and stiffness n=3 (25%)

## Method

Epidural space was detected with loss-of-resistance technique in lateral position, in L3-L4 space, with a 16 gauge Tuohy needle Figure 01. The catheter was introduced cranially as high as possible, but not necessarily at the leak site. 2cc Iohexol dye with 5 cc saline was then injected and epidural placement of catheter and spread of dye was confirmed. 15 cc of venous blood was withdrawn and injected immediately under fluoroscopic guidance. Catheter was then withdrawn and the head-low position given for at least thirty minutes. Monitoring of blood pressure and pulse was continued. After confirming stable vitals and motor movements of lower limbs, patients were then shifted to the ward with instructions for strict bed rest for 24 hours

## Observations

- All cases had a single attempt, successful epidural puncture, with no accidental intrathecal punctures
- Opening CSF pressures were low in all cases
- No adverse hemodynamic events occurred
- No motor block of lower limbs
- No worsening of headache
- No neurological deficits
- None had retention of urine

## Results

All the patients were followed up regularly.

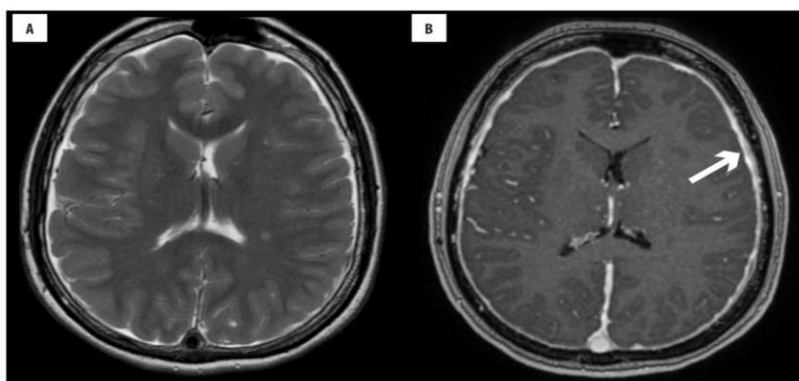
- n=10 (83.33%) had satisfactory relief of headache

- n=1 (8.33%) required surgery for repair of leak, this was observed in the post lumbar laminectomy patient.
- n=1 (8.33%) epidural blood patch had to be repeated 3 times within a span of 3 months due to no significant relief of headache.

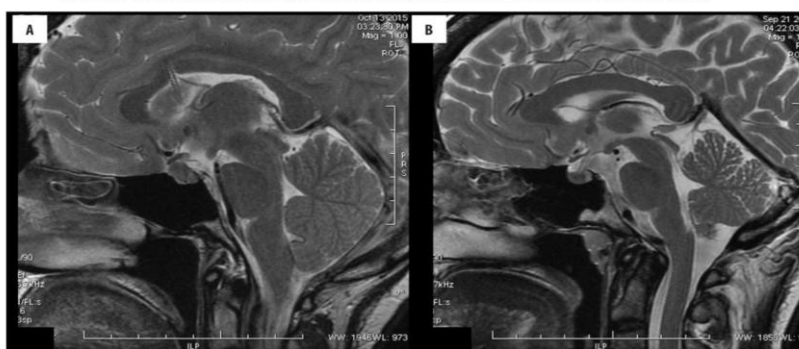


**Figure 01:** Epidural catheter set with Tuohy needle

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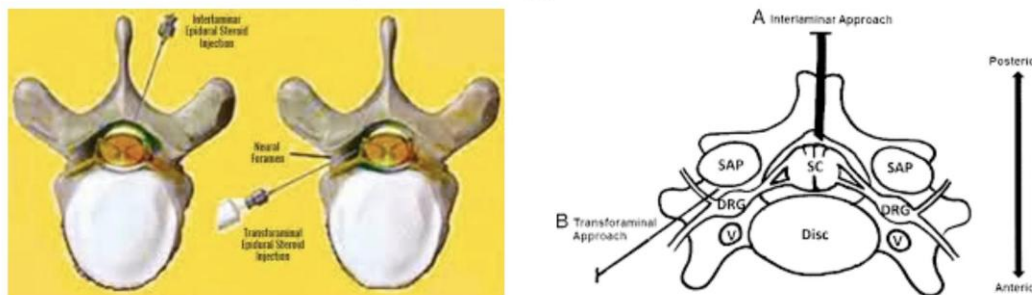
**Figure 1.** MRI in patients with IH. Axial T2-weighted (A) and axial enhanced T1-weighted image (B). There is bilateral, hyperintense, subtle widening of subdural spaces (A) with a significant pachymeningeal enhancement after contrast administration (arrow).



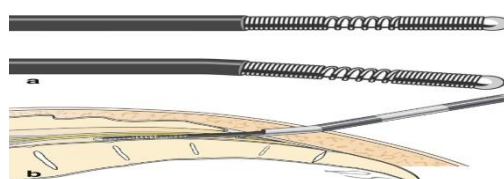
**Figure 2.** Sagittal T2-weighted MR images: (A) Patient with IH – evident sagging of the brain is observed, when compared to (B) a patient with normal brain.

**Figure 02:** MRI brain showing pachymeninges enhancement and brain sagging

### Interlaminar Vs. Transforaminal approach:



**Figure 03:** Interlaminar Vs. Transforaminal approach



**Figure 04:** RACZ catheter

### Discussion

Spontaneous CSF leak at any spinal level leads to spontaneous intracranial hypotension. A leak can occur due to dehiscence of the dural sac, either due to trauma, degenerative changes, heavy exercise or coughing aggressively, which triggers a tear in the weak areas around the nerve root sheath and dural sac causing CSF leak leading to low CSF pressure and thus, spontaneous intracranial hypotension.<sup>7</sup>

Secondary causes could be as follows:

- Following cranial or spinal surgery
- Following lumbar puncture
- Spinal anaesthesia
- Ventriculoperitoneal shunt placement
- Craniospinal trauma

### Typical diagnostic features of SIH are:<sup>8</sup>

- Orthostatic headache/postural headache (more on standing and relieved by lying), explained by International Headache Society as a headache that develops in the temporal region in relation to low CSF pressure or CSF leakage exact pathophysiology of which is not well explained.<sup>9</sup>

- MRI brain with contrast shows the following features: Figure 02

1. S Sagging of the brain
2. E Enhancement of the pachymeninges
3. E Engorged venous sinuses
4. P Pituitary hyperaemia
5. S Subdural collection

- Decreased CSF opening pressure  $\leq 60\text{mmH}_2\text{O}$

Other presenting symptoms could be signs of meningeal irritation, like nausea, neck pain or stiffness, dizziness, tinnitus, blurred vision or photophobia.

Thus, SIH headaches are to be diagnosed or specified when all of the following features are present.<sup>10</sup>

### Orthostatic headache

- Low opening CSF pressure on lumbar puncture
- Active CSF leak demonstrated /localized at any spinal level, by radionuclide cisternography, however exact site can be pinpointed only in about 50 % of patients.<sup>11</sup>
- MRI findings of brain sagging or pachymeningeal enhancement
- Improvement in headache after EBP

- No dural puncture for whatever reason.
- Other causes of headache are ruled out

### Pathophysiology

It remains unclear but there are certain theories regarding how it occurs:

- Monro-Kellie doctrine which states that the sum of volumes of venous blood, arterial blood, brain and CSF remain constant<sup>12</sup>
- Low CSF pressure, caused by dural tears, is compensated by an increase in the intracranial blood volume through enlargement of dural arteries or dilatation of cortical and medullary veins and dural venous sinuses that causes headache
- Increased venous blood volume presents as enhancement of pachymeninges on MRI
- CSF volume loss may cause a downward shift of the brain, which will tear the bridging veins causing them to rupture causing bleeding and a subdural haematoma, which can cause neurological deficits and may be potentially life threatening
- Epidural hypotension could be the main causative factor in SIH, as by increasing the pressure by EBP there is improvement rather than surgically sealing the CSF leak

### Treatment Modalities of SIH

The aim of treatment is to stop the CSF leak by increasing CSF volume<sup>2</sup>

- Conservative management
- Epidural blood patch
- Surgical closure of CSF leak: Less than 1% of patients with CSF leak will need surgical repair with fat pad placement or tensor fascia lata patch

### Conservative Treatment

- Bed rest: Supine posture reduces orthostatic headache and decreases

pressure at site of CSF leak, allowing closure of the site and resolution

- Increased fluid intake
- Caffeine or Theophylline: Adenosine receptor blockade caused by these drugs leads to arterial vasoconstriction and consequently decreased intracranial blood flow and decreased venous engorgement. Caffeine is more effective in PDPH than SIH
- Abdominal binders
- Vasodilator mixture therapy: 95% Oxygen + 5% Carbon dioxide; causes vasodilation, improvement of obstruction and increased CSF production, thus, improving CSF volume
- NSAIDs or non-NSAID analgesics
- Gabapentin: Acts on a subunit of calcium channels in the brain and spinal cord, affecting calcium currents and inhibiting the release of inflammatory neuropeptides, like Calcium G-related peptide (CGRP) and substance P
- Steroids: Regulating negative feedback of the nervous and immune systems
- Abdominal binders
- Vasodilator mixture therapy: 95% Oxygen + 5% Carbon dioxide; causes vasodilation, improvement of obstruction and increased CSF production, thus, improving CSF volume
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### Epidural blood patch:<sup>13</sup>

Epidural space is detected by the loss-of-resistance technique at any spinal level, not necessarily at the site of leak. The epidural

catheter is then directed as high as possible and blood is injected directly through the epidural needle. The epidural space is confirmed under fluoroscopy by injecting small volumes of iohexol dye.

15 to 20 cc of autologous blood is then injected in the epidural space to seal the CSF leak.<sup>14</sup>

### Mechanism of action of EBP

- Plug Effect: When the blood arrives in the area of the leak, the blood clots and closes the leak
- Mass Effect: The high volume of the blood in the epidural space causes a shrinkage in the Subdural space volume, which is interpreted by an increase in CSF pressure by the body

### Techniques for epidural blood patch

- Blind: Blood is injected into the lumbar epidural space, irrespective of the site of leak. It is easier to perform, requires less experience, and has fewer procedural complications, but is associated with higher failure rates, though it can be safely repeated.
- Targeted: It requires locating the site of CSF leak and injecting blood at that level. It is difficult to perform, requires imaging techniques that may not be accessible to all, requires more experience and has more procedural complications, although it has lower failure rates.

### Approaches to epidural blood patch: Figure 03

1: Interlaminar approach is the most commonly used method, it is easy and safe, performed under fluoroscopy, and a dye is used to confirm the epidural placement of catheter or the needle, before injecting the blood.

2: Transforaminal approach is a skilled procedure, longer learning curve, is indicated in the following

- Prior surgery at the puncture site. For example, laminectomy

- Epidural space fibrosis preventing proper catheter placement and spread of injected blood
- Dermal scarring/distortion

### Outcome of EBP:<sup>15</sup>

Depends on

- Volume of blood injected Most important determinant of success in EBP .In general, a volume of more than 20 cc was associated with higher success rates
- Targeted EBP is Superior than blind EBP
- Location of the leak: Anterior leak
- Extent of the leak: >8 spinal segments
- Diencephalic-pontine angle: <40 degrees

Precautions to be taken for approximately six weeks after ebp procedure:<sup>16</sup>

- Strict bed rest for 24 hours and get up only for toilet breaks.
- Avoid constipation which causes straining
- Avoid forward bending, stretches or twisting
- Avoid closing mouth or nose during coughing or sneezing
- Avoid lifting heavy weights
- Avoid self driving and also bumpy road travels.

### Complications of EBP

1.Failure of EBP: No resolution of symptoms after 24-48 hours. Factors for failure of EBP:

- Patient characteristics: Anxious patient
- Anterior dural tear
- Tear of more than 8 spinal segments
- Delay between dural puncture and EBP
- Volume of blood, if inadequate

2. Worsening of symptoms by creating inadvertent dural tear

3. Back pain: Self-limiting

4. Neck stiffness

5. Infection: Arachnoiditis, meningitis, local site infection

6. Intrathecal injection: Seizures, nerve root compression, spinal cord compression

**Recent Advances in EBP:**

- Targeted EBP: Higher success rates
- RACZ catheter is used If dural tear is located at previously operated site and has adhesions requiring steroid injections, and for transforaminal approach. Figure 04
- CT guided EBP
- USG guided EBP
- Transforaminal approach: For EBP at operated site

**Conclusion<sup>16</sup>**

In keeping with the Monro-Kellie doctrine, epidural blood patch causes a compensatory increase in CSF pressures, thereby causing a relief of the orthostatic headache and other symptoms. An epidural blood patch can be repeated if the symptoms persist as the rate of complications is low.

The interlaminar approach is the most commonly used, and it can be concluded that this approach under local anaesthesia for epidural blood patch administration is a safe and effective treatment modality for Spontaneous Intracranial Hypotension, and our case series have shown satisfactory relief from SIH symptoms after conventional Epidural Blood Patch procedure.

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