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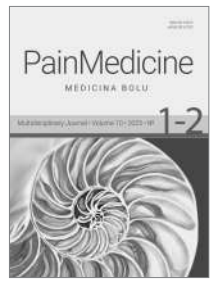

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Efficacy of CT Guided Epidural Blood Patch for Spontaneous Intracranial Hypotension: a Case Series

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Abstract

Incidence of Supine intracranial hypotension(SIH) is 5/100000 in a year and is more common in females. It presents with postural headache secondary to structural dural weakness resulting in atraumatic cerebrospinal fluid leak. Variable treatment modalities exist however, targeted image guided autologous Epidural blood patch(EBP) has proven to be more effective in relieving the symptoms. Six patients diagnosed with SIH presented to us with failure of conservative management and were successfully treated with CT guided targeted EBP with immediate resolution of their symptoms. Targeted image guided epidural blood patch seems to be a promising treatment modality in patients with SIH after failure of conservative strategies.

Keywords: *spontaneous intracranial hypotension (SIH), cerebrospinal fluid (CSF) leak, orthostatic headache, CT myelography, epidural blood patch, targeted epidural blood patch*

Introduction

Spontaneous intracranial hypotension (SIH) is a condition with postural headache secondary to structural dural weakness resulting in atraumatic cerebrospinal fluid (CSF) leak (1). Incidence of SIH is ~5/100,000/ year with female preponderance (2,3,4). The structural dural weakness at the level of the spine results in loss of CSF volume that bathes the brain and spinal cord. This results in decreased intracranial pressure causing postural headache, nausea, vomiting, giddiness, tinnitus and cranial nerve palsy. Leak of CSF into epidural space results in low CSF volume which is responsible for loss of buoyancy and downward displacement of brain structures causing traction to the cranial nerves. The cranial nerves commonly involved are oculomotor and abducent nerve. Patients present with ophthalmoplegia or diplopia. (5) As the presentation is non-specific there is often delay in diagnosis and treatment of the patient.

Various treatment modalities of SIH exist which include bed rest, adequate hydration, abdominal binders, oral or intravenous caffeine and also invasive options like epidural injections of saline, dextran or fibrin glue. However, an autologous epidural blood patch (EBP) has proven to be more effective in relieving the symptoms of SIH. EBP can be performed based on anatomical land-

marks or with imaging guidance(6). With radiographic imaging guidance, treatment can be better targeted with a precise sealant effect using a lower volume. EBP works via two separate mechanisms:

1. The volume of blood that is injected into the epidural space causes compression of the dural sac which provides immediate relief of symptoms.

2. The fibrin clot seals the dural defect which prevents CSF leak into epidural space thereby providing a definitive management (6).

After obtaining ethical clearance, we are presenting a case series of sixSIH patients with failed conservative management who underwent CT-guided EBP with resolution of clinical symptoms.

Methodology

All patients were assessed on admission and blood cultures were sent. Once culture report was negative, written informed consent was taken from the patient and shifted to CT room. CT whole spine was done after which the arterial line was secured under aseptic precautions. CT Myelography was performed with patient in prone position (with a pillow under the abdomen) and CSF leak site was identified. Patient was positioned for epidural: Lateral decubitus/prone. Epidural needle (18 G Tuohy's needle) was inserted into the epidural space using a standard sterile technique and confirmation of space with CT done. Fresh autologous arterial blood was collected under aseptic precautions and immediately injected into the epidural space through the epidural needle until the patient reported fullness or discomfort in the back, buttocks, or neck, whichever comes first.

Patient was kept in a recumbent position for 1–2 hours after the procedure. An IV infusion of 1 L crystalloid was administered to alleviate the headache until the effect of EBP started. Arterial line was removed after the procedure and tight dressing applied. Patient was monitored for 24 hours after the procedure in ward and 6 months later a follow up was planned.

Patientdemography

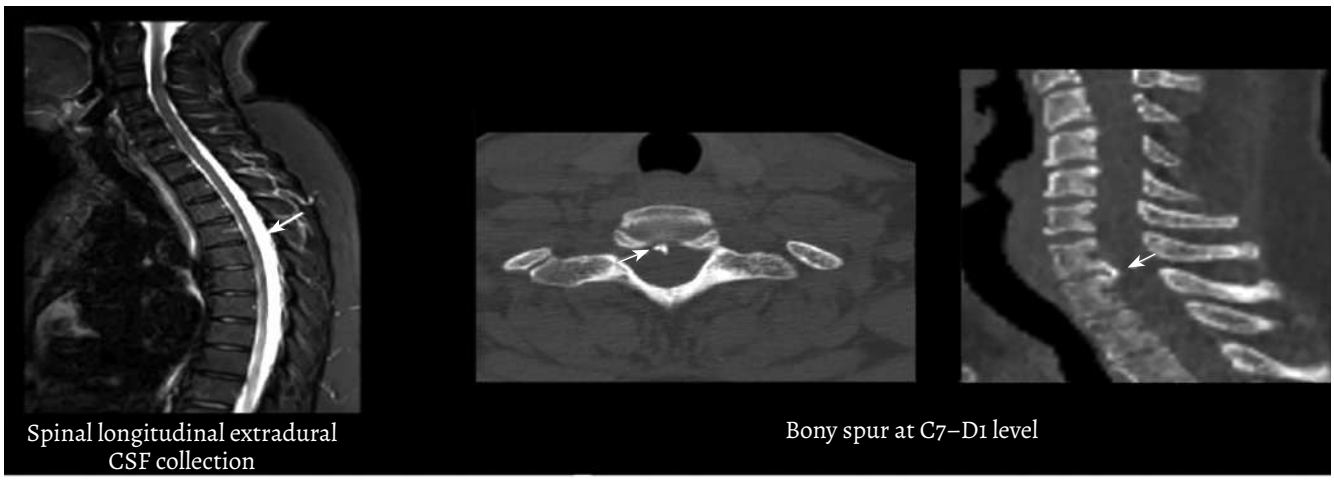
GENDER	
MALE	2
FEMALE	4
AGE(YEARS)	
< 25	1
25–34	1
35–44	2
45–54	1
> 55	1
SMOKING STATUS	
Smoker	0
Ex-smoker	0
Non-smoker	6
ALCOHOLINTAKE	
YES	0
NO	6
COMORBIDITIES	
DIABETES MELLITIS	1
HYPERTENSION	1
HYPOTHYROID	1
ASTHMA/COPD	1
NO COMORBIDITY	2
RADIOLOGICFINDINGS-CSFLEAK SITE	
CERVICAL	1
THORACIC	4
LUMBAR	1

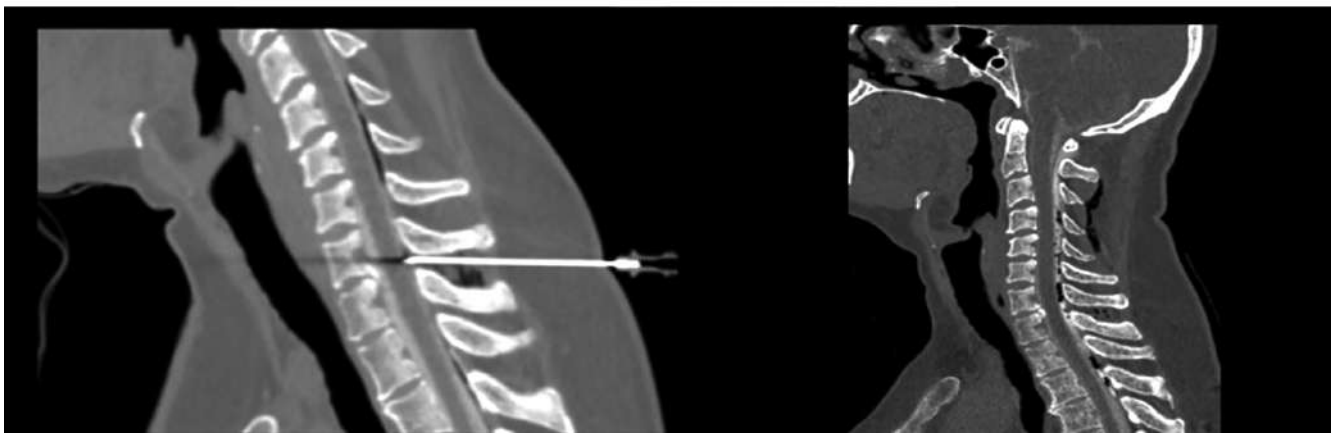
Casereport

Patient 1

40-Year-old female, ASA PS 1 who had underwent 2 LSCS presented with complaints of — frontal headache which was relieved in supine position associated with nausea for 3 weeks.

Physical examination was unremarkable. She was diagnosed with SIH and treated conservatively with intravenous fluids and caffeine. The patient's headache did not improve and an epidural blood patch was planned. MRI brain revealed normal findings. CT Myelogram showed a CSF leak between D3–D4. A single epidur-





al blood patch was performed with 13 ml of autologous blood which resulted in resolution of symptoms.

Patient 2

57 year old female, ASA PS 2 with hypertension and bronchial asthma underwent hysterectomy 5 years back. She presented with complaints of postural headache, since 8 months, aggrevated on sitting, standing and straining and relieved on lying supine. She had undergone 2 sessions of EBP (July and October 2022) which failed to resolve her symptoms.MRI brain showed age related changes. CT myelogram revealed a leak site at T12-L1. EBP was performed with 15mlof autologous blood.

Patient 3

47-year-old male patient with new onset diabetes presented with complaints of bilateral frontoparietal postural headache which was insidious in onset and continuous. MRI brain revealed bilateral subdural collections overlaying both hemispheres, rounding of superior sagittal sinus with possibility of intracranial hypotension. CT myelogram revealed leak site at D3-D4. EBP was performed with 14mlof autologous blood.

Patient 4

23-year-old male patient with alleged history of RTA with TBI underwent left temporoparietal decompressive craniectomy 3 years ago and post operatively was on mechanical ventilation for 10 days in view of persistent seizure and discharged later. He came with history of postural headache since 1 month which was insidious in onset and gradually progressive. Heachahe aggravated on sitting, standing, or bending down and was associated with history of projectile vomiting. CT BRAIN revealed Gliotic area seen involving left parietal lobe on left side. CT myelogram revealed leak site at D4-D5. EBP done with 15 ml of autologous blood.

Patient 5

32-year-old female patient with ASA PS 1 presented with history of frontal postural headache since 1 month which was insidious in onset and gradually progressive in nature. She had undergone Caesarian section under sub-arachnoid block in 2019.CTBRAIN revealed no significant abnormality. Ct myelogram revealed leak at C7-D1. EBP was performed at the same site with 12ml of autologous blood.

Patient 6

37 year old female patient with ASA 2 PS with history of rheumatoid arthiritis and hypothyroidism presented with history of holocranial postural headache since 25 days, throbbing in nature relieved on lying down. On evaluation MRI brain revealed bony spur at D3–4 and D8–9 with vertical linear degenerative signal noted from C7 to D5 in epidural space of spinal cord. EBP targeted at D7–8 with 15 ml of autologous blood.

Discussion

Intracranial hypotension also known as craniospinal hypotension is classified into:

- primary — spontaneous intracranial hypotension;
- secondary — iatrogenic due to lumbar puncture, surgical or traumatic.

Spontaneous intracranial hypotension is typically encountered in middle age (30–50 years of age) and has a predilection for women (F:M = 2:1). Patients clinically presents with orthostatic headache relieved by lying in a recumbent position within 15–30 minutes (1).Few patients have atypical presentation with headaches that are not relieved by lying down, and in few others the headache develops slowly during the course of the day (7). Associated symptoms include nausea, vomiting, neck pain, visual and hearing disturbances including tinnitus, and vertigo (7, 8).

Occasionally, patients present with frontotemporal brain sagging syndrome in which there is a progressive cognitive impairment, altered level of consciousness, coma, and parkinsonism (9). Two percent of the patients develop cerebral venous thrombosis masking the underlying presence of intracranial hypotension (10). CSF leak results in CSF hypovolemia which can lead to other severe complications like subdural hematomas (11).

Clinical features which help to diagnose SIH include any postural headache with evidence of low CSF pressure (< 6 cm H_2O) or evidence of CSF leakage or both. In a study done by Kranz P et al (12), only 34 % patients had evidence of low CSF pressures < 6 cm H_2O, measurement of CSF opening pressure with lumbar puncture as a diagnostic tool is not recommended.

Spontaneous CSF leaks are classified into the following (13,14):

1. **Type 1:** dural tear.
2. **Type 2:** ruptured meningeal diverticulum along the proximal nerve root.
3. **Type 3:** CSF-venous fistula.
4. **Type 4:** distal nerve root sleeve leaks.
5. Imaging strategy should consist of (15):
   - confirming the presence of intracranial hypotension;
   - confirming the presence of CSF leak;
   - identifying the specific location and cause of CSF leak.

Imaging modalities include CT, MRI and Myelography. Features of intracranial hypotension on CT imaging include (13):

- subdural collection;
- acquired tonsillar ectopia;
- Dural venous sinus distention;
- layer cake skull: diffuse layered calvarial hyperostosis seen in 14–32 % of patients.

Features in MRI include: (13)

6. Qualitative signs:
   - pachymeningeal enhancement (most common finding;
   - increased venous blood volume;
   - enlargement of the pituitary gland;
   - subdural effusions and eventual subdural haematomas;
   - diffuse cerebral oedema;
   - reduced CSF volume.
7. Quantitative signs:
   - mamillo pontine distance <6.5 mm (15);
   - ponto mesencephalic angle <50 °;
   - interpeduncular angle <40.5 ° measured in the axial plane at or immediately below the level of the mammillary bodies (16).

Hereditary connective tissue disorders, calcified spinal discs or bone spurs which may tear the dura result in spontaneous intracranial hypotension (6). Patients in whom initial conservative management have failed to resolve their symptoms, an autologous epidural blood patch remains the treatment of choice. Prompt detection of SIH and early treatment of CSF leak can avoid complications from occurring including SDH (11).

The patients in the aforementioned situations received image-guided EBP close to the alleged leak source. Although other invasive treatment modalities like surgical ligation of leaking nerve root sleeves have been reported, it requires accurate preoperative localization of the leak site, and is not always effective in treating multiple potential leak sites. If the CSF leak cannot be identified

and confidently localized, surgical treatment options are limited. More intensive imaging investigation looking for the leak may be warranted in patients with significant disability who fail to improve after epidural patching to aggressively search for the leak site (17).

Suggested main mechanisms of EBP are, mass effect and epidural plug formation. Injection of blood into the epidural space increases pressure in the spinal compartment and causes cephalad displacement of CSF. This explains the rapid resolution of headache. Epidural plug is formed by the interaction of the injected blood with the procoagulants in the CSF. This plug seals the dural tear until the natural healing process is restored. Seven days after the administration of EBP, there is wide spread fibroblastic activity and collagen formation. This has been demonstrated in animal studies. EBP should be avoided if there is systemic infection. After the procedure patient is advised to lie down in supine position for 2 hours to promote clot formation at the site of dural tear. Patients should avoid vigorous exercise, valsalva maneuvers for 7 days post procedure to avoid dislodgement of the clot covering the dural tear (18).

We have to watch for complications following EBP which includes back ache, rebound intracranial hypertension. Rare adverse effects include chronic adhesive arachnoiditis, subdural or spine haematoma, seizures, cerebral venous sinus thrombosis, infection, incontinence, cauda equina syndrome, formation of calcified epidural mass. Other alternatives to EBP include injection of fibrin glue or EBP with allogenic blood. Surgical closure of the dural perforation should be considered if all the above mentioned measures fail. (18)

Non targeted EBP might relieve the symptoms immediately because of the pressure symptoms but there is a delayed recurrence as the dural tear is not plugged and CSF continues to leak through the perforation (19). Some studies have shown that targeted approach may be more successful than non-targeted blind technique. (20,21). However, one major drawback of targeted EBP is the procedure related risk when CSF leak is detected within the cervical and thoracic regions of the spine. The branching spinal nerve roots at these levels may lead to increased risk of injury to nearby structures during targeted EBP (22).

Feltracco et al conducted a retrospective study on 18 patients with SIH and a targeted thoracic epidural blood patch was performed on these patients. 15 patients out of 18 patients had complete relief of symptoms. Resolution of symptoms was noted in 3 patients. Two of them received a second thoracic epidural blood patch. 1 patient refused a second EBP. The conclusion was that long term success rate of 90 % was found in targeted EBP, both in terms of quality of headache and lower incidence of recurrence (23).

Leung et al performed LEBP in 14 patients and followed up for 2 months to 2 years. In terms of treatment response symptomatic improvement was achieved in 83 % of the patients 64 % of the patients had complete resolution of symptoms 21 % attaining moderate improvement 15 % complained worsening of symptoms. Patients who had symptomatic relief showed maximum relief during the first week (22). Resolution of radiological features was demonstrated during the follow up. The volume that was injected was 20–40 ml.

In our study, we had subset of different causes for SIH and all of them underwent both CT guided myelography and the leak space was located after which they were administered the autologous blood transfusion through Touhy's needle.All patients were followed up after 6 months and they had resolution of symptoms.

In conclusion, our case series proves the efficacy of CT guided epidural blood patch. Identification of the site of CSF leak and targeting EBP to the same site with the help of CT increases the success rate of epidural blood patch and hence is beneficial to patients.

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Ефективність КТ-керованої епідуральної аутогемопломби при спонтанній внутрішньочерепній гіпотензії: серія клінічних випадків

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Анотація

Поширеність спонтанної внутрішньочерепної гіпотензії (СВГ) становить 5 випадків на 100 000 населення на рік і частіше зустрічається у жінок. Вона проявляється ортостатичним головним болем, що виникає внаслідок структурної слабкості твердої мозкової оболонки, яка призводить до нетравматичного витоку спинномозкової рідини. Існують різні методи лікування, однак прицільна, візуалізована, аутологічна епідуральна кров'яна пломба (ЕКП) продемонструвала вищу ефективність у полегшенні симптомів. Шість пацієнтів із підтвердженим діагнозом СВГ звернулися до нас після відсутності ефекту від консервативної терапії та були успішно пролікувані за допомогою КТ-керованої прицільної ЕКП із негайним усуненням симптомів. Прицільна епідуральна кров'яна пломба під візуальним контролем видається перспективним методом лікування пацієнтів зі СВГ після неефективності консервативних підходів.

Ключові слова: *спонтанна внутрішньочерепна гіпотензія (СВЧГ), ліквoрний витік, ортостатичний головний біль, КТ-мієлографія, епідуральна кров'яна латка, прицільна епідуральна кров'яна латка*