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ORIGINAL RESEARCH REGIONAL ANESTHESIA

Clinical effect of cervical vs. targeted epidural blood patch in spontaneous intracranial hypotension with unclear leakage sites

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ABSTRACT

Background and Aims: Epidural blood patch (EBP) is the most commonly used treatment for spontaneous intracranial hypotension (SIH). EBP is generally targeted at the cerebrospinal fluid (CSF) leakage site; in unclear leakage sites, it is performed blindly in the lumbar region. Therefore, to investigate effectiveness of cervical EBP in SIH patients having unclear CSF leakage sites, we conducted a retrospective case control study to compare the effectiveness of cervical EBP for unclear leakage site and targeted EBP at leakage sites.

Methodology: We reviewed the records of SIH patients who had undergone EBP at a single hospital. Patients were divided into Group CE (cervical EBP for unclear leakage site) and Group TE (targeted EBP at leakage site). the demographics, clinical characteristics, leakage site, EBP injection level, injected volume, and change in pain score (numeric rating scale [NRS]) were analysed for both groups.

Results: We analysed 54 patients, with 13 and 41 patients in the CE and TE groups, respectively. EBP regions in the TE group included the cervical, thoracic, and lumbar regions. There were no significant differences in demographic data between the groups. The baseline NRS scores for headache were 7.8 ± 0.9 and 7.7 ± 0.8 (P = 0.771); scores after EBP were 2.9 ± 1.7 and 2.2 ± 1.1 (P = 0.195) in groups CE and TE, respectively. NRS changes of 4.9 ± 2.0 and 5.6 ± 1.5 (P = 0.348) occurred in groups CE and TE, respectively. The mean blood volume in the CE group was 10.4 ml. Clinical effectiveness did not differ significantly between the groups.

Conclusion: Cervical EBP is as effective as targeted EBP when the CSF leakage site is unclear. Therefore, cervical EBP is appropriate for SIH in patients with unclear CSF leakage.

Abbreviations: CSF - Cerebrospinal Fluid; EPB - Epidural Blood Patch; NRS - Numeric Rating Scale; SIH - Spontaneous Intracranial Hypotension

Key words: Epidural Blood Patch; Spontaneous Intracranial Hypotension; Headache

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1. INTRODUCTION

Spontaneous intracranial hypotension (SIH) is characterized by low cerebrospinal fluid (CSF) volume and orthostatic headache; accompanying symptoms include neck pain, tinnitus, photophobia, and nausea.[1] Epidural blood patch (EBP) has both immediate (volume replacement) and delayed (sealing the dural tear and constriction of epidural vessels) effects on SIH.[2] EBP is usually targeted at the leakage site; when the site is unclear or the procedure to identify leaks is harmful, non-targeted EBP is performed. Although EBP is an

effective treatment for SIH, its response rates vary from 30% to 90% depending on the method used and blood volume.[3] It is important to perform EBP near the CSF leakage site;[4] however, locating these sites in SIH patients may prove challenging and inconsistent.[5] Therefore, non-targeted EBP at the lumbar level has been recommended as an effective SIH treatment. Non-targeted blood patches cannot seal the CSF leak site.[6] We hypothesized that the effectiveness of cervical EBP at unclear ESF leakage sites would be equal to that of targeted EBP at known leakage sites.[7] We reviewed SIH patients who had undergone either procedure, and compared their effectiveness by measuring the NRS scores for headache. Moreover, we compared the proportions of patients requiring a second EBP in both groups.

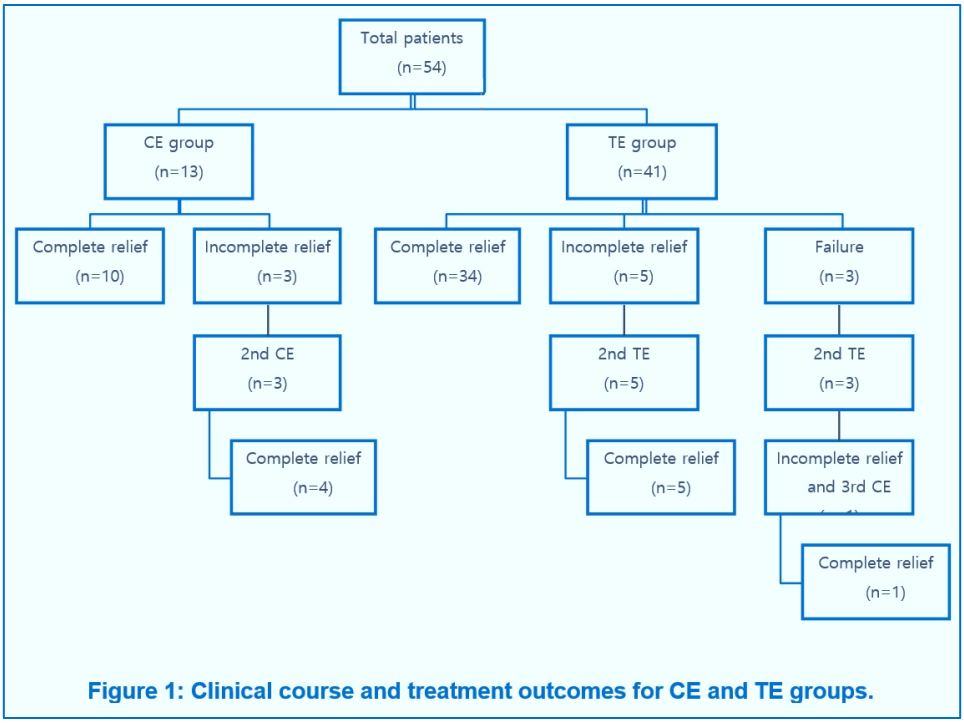

Figure 1: Clinical course and treatment outcomes for CE and TE groups.

2. METHODOLOGY

This study was approved by the Ethics Committee on May 30 2019 (YUMC 2019-05-020) and registered with the Clinical Research Information Service of South Korea (registration number: KCT 0008061). STROBE (Strengthening the Reporting of Observational studies in Epidemiology) guidelines were followed. We retrospectively evaluated electronic medical records of 54 patients who had undergone EBPs for SIH in a single hospital from 2010 to 2019. Diagnosis was based on symptoms and neuroimaging findings, including brain and spinal magnetic resonance imaging (MRI) or computed tomography (CT) myelography. The patients were divided into two groups: those with unclear leakage sites who underwent cervical EBP, the CE group; and those with known leakage sites, who underwent targeted EBP, the TE group.

EBP was performed on all patients, using anatomical landmarks in the cervical, thoracic, and lumbar regions. Patients were placed in a sitting position for cervical EBP or in a lateral decubitus position for thoracolumbar EBP. Loss-of-resistance and hanging drop techniques were used to confirm epidural space using an 18-gauge Tuohy needle. For EBP, 10 ml of autologous blood was injected at the cervicothoracic junction or 20 ml of blood at the thoracolumbar level. All procedures were performed by an experienced physician. After EBP, the patient remained supine with continuous conservative treatment including bed rest, hydration, and analgesics. Neurologists evaluated recovery status for all patients by assessing pain relief from orthostatic headaches within 24 h; using a numeric rating scale (NRS) and improvement in headache. Failure was defined as no improvement in symptoms or need for additional EBP.

We analysed demographics, clinical characteristics, leakage site, EBP injection level, injected EBP volume, and changes in pain score. The initial recovery status, including changes in NRS and need for additional EBP, was compared between the CE and TF groups, and the significance of intergroup differences was evaluated using chi-squared tests. Data were expressed as means ± standard deviations. Statistical analyses were conducted using SPSS Statistics 23 software. In addition, adverse effects of EBP, such as axial pain, radicular irritation caused by blood by-products, and pyretic response, were evaluated.

3. RESULTS

This analysis included 54 patients, with 13 and 41 patients in the CE and TE groups, respectively. Several EBP regions were part of the TE group, including cervical, thoracic, and lumbar regions, whose target EBP administration sites were numbered 13, 25 and 3 respectively. No significant intergroup differences were observed in demographic characteristics (Table 1).

Table 1: Demographic characteristic of patients with SIH who received non-targeted cervical epidural blood patch and targeted epidural blood patch.

Parameter	Group CE (n = 13)	Group TE (n = 41)	P value
Mean age	39.3 ± 11.19	38.4 ± 9.19	0.763
Gender (M/F)	2/11	13/28	
BMI (kg/m^2)	22.7 ± 3.17	23.1 ± 2.35	0.651
Initial NRS	7.85 ± 0.9	7.75 ± 0.86	0.771

Group CE: Cervical EBP for unclear leakage site, Group TE: Targeted EBP at leakage site, BMI: Body Mass Index, NRS: Numeric rating scale

Table 2: Clinical data of patients

Variable	Group CE (n = 13)	Group TE (n = 41)	P-value
Initial NRS	7.85 ± 0.9	7.75 ± 0.86	0.771
NRS after EBP	2.92 ± 1.71	2.19 ± 1.11	0.195
Difference of NRS	4.92 ± 2.06	5.56 ± 1.55	0.348
More than 2 times of EBP	3	8	

Group CE: Cervical EBP for unclear leakage site, Group TE: Targeted EBP at leakage site, NRS: Numeric rating scale

Clinical course and treatment outcomes of all patients are shown in Figure 1.

Outcomes of the first EBP were compared between the two groups; the changes in NRS scores were 4.9 ± 2.0 and 5.6 ± 1.5 respectively in the CE and TE groups *(*P = 0.348*)*. No significant inter-group differences in initial EBP outcomes were found (Table 2).

Subsequently, we compared the proportions of patients requiring a second EBP in both groups. In general, patients required a second EBP procedure if pain relief was incomplete or there was no effect; failure rates of the first EBP were 23% and 19%, respectively. The proportion of patients who underwent a second EBP, as well as that of clinical effects of the second EBP, did not differ significantly between the groups. All patients in both groups were eventually relieved. No adverse effects or complications due to the procedure were observed.

4. DISCUSSION

SIH resolves with therapy consisting of bed rest, hydration, and analgesia; a conservative approach to treatment is employed due to its benign clinical course. If patients still exhibit symptoms, autologous EBP is performed to restore CSF pressure through volume replacement and seal the dural tear.[2] However, there is insufficient evidence to address the clinical therapeutic outcomes. Although EBP is an effective treatment for SIH, response rates vary from 30% to 90% depending on the methods and the blood volume used. [3]

Ideally, EBP should be performed near the CSF leakage site;[4] recent studies have shown that targeted EBP is more effective than non-targeted EBP.[8] An investigation of 25 patients revealed that those who underwent targeted EBP showed greater headache improvement.[9] In another study of 56 patients, those treated with targeted EBP showed significantly higher improvement rates.[10] Cho et al. suggested that targeted EBP may be more effective than non-targeted EBP for SIH.[10] However, identifying the linkage of CSF leakage with SIH can be challenging and inconsistent.[5] Since most of the leaks cannot be localized based on MRI and myelography studies. Moreover, performing iatrogenic epidural puncture for myelography to identify CSF leakage may worsen SIH.[11]

In cases where the CSF leak cannot be localized or epidural puncture may worsen SIH, non-targeted patches are required.[12] Several studies have investigated the effectiveness of non-targeted EBP in treating SIH; it has been recommended as a lumbar-level treatment, regardless of the actual leakage site. This is because the space between the yellow ligament and the dura mater is relatively wide in the lumbar region, making non-targeted EBP safer than cervical or thoracic targeted EBP.

Although increased pressure around the thecal sac relieves headaches immediately after performing EBP at the lumbar level, failure to seal the CSF leak may cause intracranial hypotension. The non-targeted blood patch could not seal the CSF leak site, because the clot appeared to be concentrated in the area around the blood injection site.[6]

Spontaneous CSF leaks occur via three mechanisms: ventral dural tears, meningeal diverticula, or CSF venous fistulas (CVFs).[13] Ventral dural tears are found in approximately one-third of SIH cases, and are the most common in the thoracic or lower cervical spine. Meningeal diverticula are most frequently found either in the thoracic region along the spinal nerve root sleeve, or at the nerve root axilla. Meanwhile, the most common location for CVFs is the lower cervical and thoracic spine. In conclusion, the majority of CSF leaks occur in

the thoracic or lower cervical spine; hence, non-targeted EBP performed in this region is considered effective.

In our investigation, cervical EBP was performed when the leak site could not be located. Cervical EBP was preferred, since many cases of SIH leakage occur at the cervical level. We reviewed SIH patients with unclear CSF leakage sites who had undergone cervical EBP, as well as those who underwent targeted EBP at known leakage sites. When the CSF leakage site is unclear, cervical EBP is considered as effective against SIH as targeted EBP. We have, therefore, confirmed its effectiveness as an initial treatment for SIH; and as a result, non-targeted cervical EBP achieved a similar treatment effect to targeted EBP.

Although cervical EBP was performed to treat SIH, cervical epidural procedures may pose a higher risk of complications than that associated with lumbar epidural procedures. These include vascular injury by needle, dural or subdural puncture, pneumocephalus, spinal nerve damage, and spinal cord trauma. Fluoroscopy or ultrasound guidance was used to ensure accuracy and safety of the procedure.[14] In addition, the optimal cervical EBP volume has not yet been established. The narrow diameter of the cervical epidural space, combined with the large EBP volume, leads to a high risk of direct cord compression. In a previous review article, 15 mL of blood was injected at the cervical level without serious adverse events.[15] Another study reported injection of up to 20 mL of blood without serious adverse events at the cervicothoracic junction.[16] In our case, 10 ml of blood was injected for cervical EBP, and no serious adverse events were observed.

5. LIMITATIONS

Our investigation had some limitations, namely its retrospective design and lack of group randomization. In addition, there was an imbalance in the study population; the CE group was only approximately one-third of the size of the targeted epidural group.

6. CONCLUSION

In conclusion, no significant difference in effectiveness was found between the cervical epidural and targeted epidural groups. We recommend a cervical epidural blood patch with 10 mL of autologous blood as an effective and safe treatment method in spontaneous intracranial hypotension patients with unclear CSF leakage sites.

7. Data availability

The numerical data generated during this research is available with the authors on a reasonable request.

8. Acknowledgement

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9. Conflict of interest

The study utilized the hospital resources only, and no external or industry funding was involved.

10. Authors' contribution

HR: Conduction of the study, Manuscript Writing

HSL: Conduction of the study, Manuscript editing, Final approval of the manuscript

HK: Concept, Conduction of the study, Manuscript wring and editing

All authors have read the manuscript and approved for publication.

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