Effect of Intra-operative Saline Irrigation during Burr Hole Surgery on the Recurrence for Chronic Subdural Hematomas

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Objective: The aim of this study is to compare the postoperative recurrence rates and alteration in follow-up brain CT radiographic results between patients with chronic subdural hematoma (CSDH) treated by burr hole trephination with or without irrigation during the surgery.

Methods: A total of 100 patients diagnosed with CSDH underwent burr hole trephination from January 2013 to May 2015. The patients were divided into two groups: those who underwent intra-operative saline irrigation and those who did not. Difference in the rate of symptomatic recurrence requiring second surgery between the two groups was evaluated. Radiographic results were analyzed based on the patients’ follow-up brain CTs taken 1 month after the surgery.

Results: Sixty eight patients underwent intra-operative irrigation while 32 patients did not. The median ages of the two groups were 69.6 years (range, 39-91 years) and 69.1 years (range, 38-86 years), respectively. Among the “irrigated” group, six patients required second surgery due to recurrent hematoma (8.8%) while nine patients in the “not irrigated” group underwent second surgery (28.1%). Difference in the Glasgow coma scale (GCS) between the two groups had no statistical significance.

Conclusion: Upon conducting burr hole trephination surgery for CSDH, saline irrigation is a simple procedure that can reduce the recurrence rate.

Key Words: Chronic subdural hematoma • Trephining • Therapeutic irrigation

INTRODUCTION

Chronic subdural hematoma (CSDH) is one of the most common conditions encountered concerning neurosurgical interventions. Although CSDH is a curable disease with low morbidity and mortality rates, the high rate of symptomatic recurrence is a challenge in the neurosurgical practice. The rate of recurrence of CSDH after surgery is known to be around 9.2% to 26.5%. The treatment of choice for symptomatic CSDH is surgical evacuation, which usually results in marked neurologic and radiographic improvement. Although the modes of surgical treatment ranges widely from burr hole trephination to complex craniotomy with membranectomy, in the recent years, burr hole trephination has replaced the conventional craniotomy in most of the CSDH cases for many reasons such as minimal invasiveness, lower mortality and morbidity, and shorter length of hospital stay. There have been many attempts to reduce the recurrence rate of CSDH following burr hole surgery.

In the present study, the authors have compared the postoperative recurrence rates of burr hole trephination depending on the inclusion of intraoperative saline irrigation procedure. The extent of hematoma resolution based on the follow-up CT scans has also been compared.

MATERIALS AND METHODS

The charts of all adult CSDH patients above 18 years of age who underwent surgical evacuation in a single center were retrospectively reviewed. Initial diagnoses of 100 patients with symptomatic CSDH were made by computed tomography (CT) scans. All the patients had previous history of head trauma. We categorized the patients under two groups, “irrigated” and “not irrigated” depending on the inclusion of intra-operative saline irrigation of the CSDH.

All the patients underwent burr-hole trephination, dura incision and subdural catheter placement. As for the “irrigated” group, warm sterile saline was irrigated through the subdural catheter, about 20 to 50 mL at a time, and then let to drain. The irrigation process was repeated until the drained irrigant...
Table 1. Comparison of retreatment and radiographic resolution rates between the “irrigated” and “not irrigated” groups

<table>
<thead>
<tr>
<th></th>
<th>Patient number (%)</th>
<th>Patient number (%)</th>
<th>Total</th>
<th>p(\dagger)</th>
<th>(B) (SE(\ddagger))</th>
<th>OR**</th>
<th>95% CI††</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not irrigated</td>
<td>Irrigated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>9 (28.1)</td>
<td>6 (8.8)</td>
<td>15 (15.0)</td>
<td>0.0170*</td>
<td>1.397</td>
<td>0.581 1.23-12.6*</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>23 (71.9)</td>
<td>62 (91.2)</td>
<td>85 (85.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiographic results</td>
<td>Resolution</td>
<td>16 (50.0)</td>
<td>50 (73.5)</td>
<td>66 (66.0)</td>
<td>0.0205††</td>
<td>1.022</td>
<td>0.448 2.78 1.16-6.68†</td>
</tr>
<tr>
<td></td>
<td>Residual†</td>
<td>16 (50.0)</td>
<td>18 (26.5)</td>
<td>34 (34.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(\dagger\): Statistical analysis was performed with Fisher’s exact test, \(\ddagger\): Statistical analysis was performed with Chi-square test, \(\ast\): For statistical analysis, we used the binomial logistic regression analysis. \(\ddagger\): p-value, \(\ddagger\): SE: standard error, \(\ast\): OR: odds ratio, \(\ddagger\): CI: confidence interval.

Table 2. Comparison of GCS* improvement between “irrigated” and “not irrigated” groups

<table>
<thead>
<tr>
<th></th>
<th>Initial GCS</th>
<th>Final GCS</th>
<th>GCS improvement (mean±SD†)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not irrigated</td>
<td>13.2</td>
<td>14.6</td>
<td>1.41±0.62</td>
<td>0.444†</td>
</tr>
<tr>
<td>Irrigated</td>
<td>13.0</td>
<td>14.6</td>
<td>1.54±0.92</td>
<td></td>
</tr>
</tbody>
</table>

\(*\): GCS: Glasgow coma scale, \(†\): SD: standard error, \(†\): Statistical analysis was performed with T-test.

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Fig. 1. Computed tomography of a 80-year-old male with chronic subdural hematoma treated by burr hole trephination with saline irrigation. (A) Preoperative CT shows chronic subdural hematoma. (B) Immediate-postoperative CT shows diluted residual subdural fluid after irrigation. (C) Postoperative CT 1 month after surgery shows total resolution.

Fig. 2. Computed tomography of a 66-year-old male with chronic subdural hematoma treated by burr hole trephination without saline irrigation. (A) Preoperative CT shows chronic subdural hematoma. (B) Immediate postoperative CT shows residual hematoma. (C) Postoperative CT 1 month after surgery shows recurrent CSDH with mass effect.

Score improvement in the “irrigated” group was 1.54±0.92, whereas the value was 1.41±0.62 in the “not irrigated” group. However, there was no statistical significance (p=0.45). The data is specified in Table 2, and illustrative cases from each group are presented in (Fig. 1 and 2.)

DISCUSSION

Chronic subdural hematoma (CSDH) is one of the most common conditions encountered in neurosurgical interventions. The number of CSDH is increasing in developed countries, and it is common among elderly patients, and its incidence is 58/100,000 for elderly population aged above 70 years, about 12 times higher than the general population. About 60-80% of the patients with CSDH had history of head injuries. However, variation is possible because most head injuries leading to CSDH are trivial; these events are easily forgotten or not actually considered important by patients. Treatment of choice for symptomatic CSDH is surgical evacuation, which usually results in marked neurologic and radiographic improvement. The modes of surgical treatment ranges from burr hole trephination to complex craniotomy with memranectomy. The most common surgical treatments include twist drill craniostomy, burr hole trephination, and craniotomy, result in differing degrees of reoperation rates from 5% to 27.8%.

The rate of recurrence varied in many literature reviews. In the literature, the re-operation rate for CSDH treated with burr hole trephination was 6.6%, which proved significant from the 24.1% among craniotomy patients. Secer et al. presented that symptomatic recurrence of CSDH has been noted in 8%-37%. Generally, burr hole trephination reduced recurrence and re-operation, and it has been the most preferred technique in treating patients with CSDH. In the recent years, burr hole trephination has replaced the conventional craniotomy in most of the CSDH cases for many reasons such as less invasiveness, lower mortality and morbidity, shorter length of hospital stay, and overall patient satisfaction.

The recurrence rate of CSDH may differ according to individual characteristics of each patient, pathogenesis of CSDH, and surgical procedure. Patients’ characteristics include factors such as age, alcoholism, and coagulation disorders.

There have been many attempts to reduce the recurrence rate of CSDH, and various surgical and post-operative management styles and techniques are practiced by many neurosurgeons according to their preference. These include one or two burr hole trephination, using or not using intra-operative saline irrigation, open or closed drainage system, etc.

In the present study, the primary goal was geared towards comparison of burr-hole trephination with and without intra-operative irrigation in treating CSDH. Several papers analyzed the outcomes of CSDH treatment depending on whether or not irrigation was done. Kumar et al. reported that burr hole trephination with saline irrigation is a simple, fast, and safe procedure for treating CSDH with a favorable outcome. In the other literature, Gurelik et al. reported that there was no significant difference between the recurrence rates in the irrigation group and in the no-irrigation group. Erol et al. stated that there was no difference in recurrent rates between the two groups, but burr hole with irrigation was more effective when recovery rates and postoperative complication are concerned.

Although there were differences in the results of previous studies, the authors found statistically significant differences in the retreatment rates between both groups of patients undergoing burr hole trephination to treat CSDH.

There are several factors associated with increased recurrence rate. Firstly, the thick remnant hemorrhagic fluid may act as a dead space, and this can cause an impaired adhesion between the inner and outer neo-membranes and promote the recurrence of CSDH. After this subdural space had been created, cells in the dural border begin to proliferate, representing the first step in the pathogenesis of CSDH. Mori et al.
presented that persistence of an enlarged subdural space, or poor re-expansion of the brain, in patients undergoing evacuation of CSDH creates the potential for reaccumulation of the hematoma. By irrigation, the authors speculated that quicker drainage of the diluted hemorrhagic fluid and elimination of dead space would be possible, in turn would result in quicker brain re-expansion and thus lower the chance of recurrence.

Secondly, the contents of the hematoma itself may act as inducing factors for recurrent hematoma formation. Shono et al. explained that the high concentration of VEGF within the hematoma could induce neovascularization with abnormally dilated sinusoids and incomplete basement membrane which allows excessive permeability and hence increase the rebleeding risk. The CSDH fluid is also rich in inflammatory mediators such as kallikrein, bradykinin, and platelet-activating factor. After initial trauma, the sequence of events in the natural course of the CSDH consists of local inflammation. Further inflammation caused by the release of these proinflammatory factors create a self-enhancing vicious cycle that is responsible for frequent rebleeding and enlargement of the CSDH. High levels of fibrin degradation products (FDP) within the CSDH fluid is also known to promote recurrent hematoma formation by increasing tissue plasminogen activator and affecting the coagulation cascade; activated plasmin depletes coagulation factors to produce more FDPs and the vicious cycle is continued, resulting in increased bleeding risk of the defective neovascularature. By intra-operative hematoma irrigation with saline, much of these angiogenic, proinflammatory and anticoagulatory factors are physically washed away, and their effect in promoting rebleeding are expected to be minimized.

There are a number of limitations in our study. First, the study was conducted retrospectively and is therefore subject to potential sources of bias and variation. Secondly, the choice of the procedure was decided by each surgeon’s preference rather than by randomization. Second, some of the widely accepted predisposing factors such as the patient age and underlying conditions such as alcoholism and diabetes mellitus, and other coagulopathies have not been taken into consideration in the present study. Thus, further well-designed randomized prospective studies with larger study samples may be needed to further support our arguments and reach other important findings concerning the recurrence of CSDH.

**CONCLUSION**

Intra-operative saline irrigation reduced recurrence and retreatment rate, as well as the resolution rate in the CT scan. However, there was no significance concerning the GCS change between the two groups. Consequently, it can be implied that burr hole trephination with irrigation may be a simple and effective method in reducing recurrence and retreatment in CSDH.

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**REFERENCES**