A Comparative Study of Treatments for Chronic Subdural Hematoma: Burr Hole Drainage versus Burr Hole Drainage with Irrigation

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Summary: Although chronic subdural hematoma (CSDH) is one of the most common entities encountered in neurosurgical practice, optimal surgical treatment for CSDH remains controversial. This study retrospectively compared results for CSDH between burr hole drainage alone and burr hole drainage with irrigation. Ninety-two patients with CSDH underwent surgery at our institution from January 1998 through December 2009. Fifty-eight patients received burr hole drainage alone (Group A), while 34 patients were treated using burr hole drainage with irrigation (Group B). Outcomes, recurrence rates, and death rates for the two groups were analyzed. Age, sex ratio, consciousness level on admission, radiodensity of hematoma on computed tomography before surgery, and duration of hospitalization were nearly the same in both groups. No significant differences were seen in good outcomes or death rates between groups, but poor outcomes were significantly more frequent in Group A (p=0.009). The recurrence rate was higher in Group A compared to Group B (10.3% vs. 2.9%). The authors used logistic regression analysis to identify factors associated with the outcome of CSDH, and found that duration of hospital stay, anti-coagulant therapy, presence of dementia and burr hole drainage alone were significantly associated with poor outcome of CSDH. These results indicate that burr hole drainage with irrigation has a significantly stronger association with good outcomes compared to drainage alone, and could be a reliable and effective operative method for the treatment of CSDH with a lower recurrence rate.

Key words chronic subdural hematoma, computed tomography, recurrence, burr hole surgery, drainage, irrigation

INTRODUCTION

Chronic subdural hematoma (CSDH) is a well-known clinical entity among elderly patients and is encountered in daily neurosurgical practice. Although surgical therapy is generally accepted for treatment (e.g., twist drill craniostomy, burr hole craniostomy and craniotomy or craniectomy), optimal surgical procedures remain contentious [1,2].

Burr hole drainage has recently been reported to be the method of choice for the initial treatment of CSDH [3] and some reports have described low recurrence rates for burr hole irrigation followed by drainage [4,5]. However, few studies compared results for CSDH between burr hole drainage alone and burr hole drainage with irrigation [2,7,10,15].

This retrospective study examined whether any differences exist in outcomes, recurrence rates and death rates between surgical treatment involving drainage alone and drainage with irrigation.

PATIENTS AND METHODS

Subjects comprised 92 patients (59 men, 33 women)
who underwent surgery for CSDH at our institution between January 1998 and December 2009. Median age was 78.6 years (range, 52-95 years). Incidence gradually increased with age, peaking in the seventh decade (Fig. 1). The 92 patients were classified into 2 groups according to a randomly allocated operative procedure: Group A (n=58), one burr hole with closed system drainage without irrigation; and Group B (n=34), one burr hole with closed system drainage after irrigation. Baseline characteristics of patients in each group are given in Table 1. Patients were neurologically evaluated using the Japan Coma scale [6] and mental state was analyzed with the revised Hasegawa Dementia Scale [7]. Postoperative condition was assessed at discharge using the Glasgow Outcome Scale (GOS) [8]. Patients with GOS showing good recovery or moderate disability were considered to have good outcomes. Patients with GOS showing severe disability, vegetative state or death were judged as having poor outcomes. Patients who had dementia or neurological deficits due to cerebrovascular disease preoperatively and regained their previous condition after surgical intervention were considered to show good outcomes.

For Group A, a burr hole was drilled under local anesthesia and a drainage catheter was inserted and connected to a bag (FORTE GROW MEDICAL VIETNAM CO., LTD, TINH DUONG, VIETNAM). For Group B, a burr hole was drilled under local anesthesia, then a 5-Fr Nelaton tube was inserted into the cavity and the subdural hematoma was washed out with warm sterile saline until the irrigation fluid ran clear. A drainage catheter was then inserted and connected to a collection bag. All patients were in bed in a supine position with a collection bag on the bed. Drainage was extracted when ineffectiveness in reducing residual hematoma was noted 1 or 2 days postoperatively.

CSDH was defined as the presence of a typical neomembrane and liquefied blood in the hematoma cavity. These findings were confirmed during surgery in all patients. Patients showing reappearance of neurological symptoms with increasing hematoma cavity volume on the operated side within a few months after surgery were considered to have recurrence and underwent a repeated operation.

Rates of good and poor outcomes, recurrence and death were compared between surgical groups. Statistical analysis was conducted using univariate and multiple logistic regression analysis.

RESULTS

Group A consisted of 58 patients (40 men, 18 women) and Group B consisted of 34 patients (19 men, 15 women). Median age in Group A was 77.9±8.5 years (range, 52-95 years), compared to 79.1±10 years (range, 59-94 years) in Group B (Table 1-1).

On preoperative computed tomography (CT), hematomas in Group A showed low density in 8 patients, iso-density in 15, high density in 24, and mixed density in 11. In Group B, hematomas showed low density in 3 patients, iso-density in 12, high density in 10, and mixed density in 9. CSDHs were unilateral in 52 patients in Group A and 31 patients in Group B and bilateral in 6 patients in Group A and 3 patients in Group B. No significant differences between groups were seen for clinical characteristics such as age, sex, preoperative hematoma density on CT, or duration of hospitalization (Table 1-1, 2). Good outcomes were obtained in 48 of 58 patients (82.0%) in Group A and in all 34 patients (100%) in Group B. Poor outcomes were noted for 10 patients (18.0%) in Group A and no patients (0.0%) in Group B. Two patients (3.4%) died in Group A. No deaths were directly related to surgery, but 1 patient died of recurrent acute myocardial infarction 3 days after surgery and the other died due to aspiration pneumonia 1 year postoperatively. No patients had died of the final follow-up after surgery in Group B. No significant differences in rates of good outcomes and deaths were apparent between groups. However, poor outcomes (including the 2 deaths) were significantly more frequent in Group A (p=0.009) (Table 1-2). The authors analyzed factors associated with the outcome of CSDH by logistic regression analysis, and found that duration of hospital stay, anticoagulant therapy, presence of dementia and burr hole drainage alone were significant independent risk factors in CSDH (Table 2-1, 2). Thus, drainage with irri-
gation had a stronger association with good outcomes as compared with drainage alone.

Recurrence was identified in 1 patient in Group B (2.9%) and 6 patients in Group A (10.3%). All except one recurrence occurred within 3 weeks after surgery, with residual hematomas found on CT within a few days after surgery in 5 of 7 recurrences. Although no significant difference was noted between groups, the recurrence rate was 3-fold higher in Group A (10.3%) than in Group B (2.9%, p=0.191) (Table 1-2).

**DISCUSSION**

Burr hole surgery is currently the most common therapeutic surgical treatment for CSDH and burr hole drainage has been reported to be superior to burr hole irrigation [9]. However, whether drainage alone or drainage with irrigation is better for patients with CSDH remains unclear [1,2,4,5,10-17].

Zakararia et al. [2] reported good outcomes in 83.3% of patients who underwent drainage and 87% of patients who received drainage with irrigation. Muzii et al. [1] stated that 90.9% of patients who received drainage and 70.8% of patients who underwent drainage with irrigation showed complete recovery. No significant differences in good outcomes between the two surgical techniques were identified in either report. In the present study, good outcomes were seen

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**TABLE 1-1.**
Baseline characteristics of 92 patients with CSDH

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group A (n=58)</th>
<th>Group B (n=34)</th>
<th>Total (N=92)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>77.9 (8.5)</td>
<td>79.1 (10.0)</td>
<td>78.7 (9.5)</td>
<td>0.579</td>
</tr>
<tr>
<td>Sex (male%)</td>
<td>40 (68.9)</td>
<td>19 (55.9)</td>
<td>59 (64.1)</td>
<td>0.150</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>29.2 (25.2)</td>
<td>25.0 (20.2)</td>
<td>27.6 (23.4)</td>
<td>0.412</td>
</tr>
<tr>
<td>Hypertension</td>
<td>18 (31.0)</td>
<td>18 (52.9)</td>
<td>36 (39.1)</td>
<td>0.032</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>7 (12.1)</td>
<td>4 (11.8)</td>
<td>11 (11.9)</td>
<td>0.621</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>5 (8.6)</td>
<td>6 (17.6)</td>
<td>11 (11.9)</td>
<td>0.169</td>
</tr>
<tr>
<td>Renal failure</td>
<td>3 (5.2)</td>
<td>2 (5.9)</td>
<td>5 (5.4)</td>
<td>0.613</td>
</tr>
<tr>
<td>Cardiac arrhythmia</td>
<td>13 (22.4)</td>
<td>4 (11.8)</td>
<td>17 (18.5)</td>
<td>0.161</td>
</tr>
<tr>
<td>Cerebral infarction</td>
<td>10 (17.2)</td>
<td>3 (8.8)</td>
<td>13 (14.1)</td>
<td>0.212</td>
</tr>
<tr>
<td>Cerebral hemorrhage</td>
<td>2 (3.4)</td>
<td>0 (0.0)</td>
<td>2 (2.2)</td>
<td>0.390</td>
</tr>
<tr>
<td>Anticoagulant drug</td>
<td>6 (10.3)</td>
<td>2 (5.9)</td>
<td>8 (8.7)</td>
<td>0.374</td>
</tr>
<tr>
<td>Antiplatelet drug</td>
<td>5 (8.6)</td>
<td>3 (8.8)</td>
<td>8 (8.7)</td>
<td>0.626</td>
</tr>
</tbody>
</table>

(Values in parentheses represent standard deviation or percentage)

**TABLE 1-2.**
Baseline characteristics of 92 patients with CSDH

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group A (n=58)</th>
<th>Group B (n=34)</th>
<th>Total (N=92)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dementia</td>
<td>26 (44.8)</td>
<td>9 (26.5)</td>
<td>35 (38.0)</td>
<td>0.062</td>
</tr>
<tr>
<td>Low density on CT</td>
<td>8 (13.8)</td>
<td>3 (8.8)</td>
<td>11 (12.0)</td>
<td>0.362</td>
</tr>
<tr>
<td>Consciousness disturbance</td>
<td>13 (22.4)</td>
<td>4 (11.8)</td>
<td>17 (18.5)</td>
<td>0.161</td>
</tr>
<tr>
<td>Recurrence</td>
<td>6 (10.3)</td>
<td>1 (2.9)</td>
<td>7 (7.6)</td>
<td>0.191</td>
</tr>
<tr>
<td>Good outcome</td>
<td>48 (82.0)</td>
<td>34 (100)</td>
<td>82 (89.1)</td>
<td>0.058</td>
</tr>
<tr>
<td>Poor outcome</td>
<td>10 (18.0)</td>
<td>0 (0.0)</td>
<td>10 (10.9)</td>
<td>0.009</td>
</tr>
<tr>
<td>Death</td>
<td>2 (3.4)</td>
<td>0 (0.0)</td>
<td>2 (2.1)</td>
<td>–</td>
</tr>
</tbody>
</table>

(Values in parentheses represent percentage)
in 82% of Group A patients and 100% of Group B patients, comparable to previous reports. In contrast, 18% of patients in Group A and no patients in Group B showed poor outcomes. Poor outcomes were significantly more frequent in Group A (p=0.009) (Table 1-2) and furthermore, the logistic regression analysis indicated that drainage with irrigation had a significantly stronger association with good outcomes as compared to drainage alone. Duration of hospital stay, anti-coagulant therapy, and presence of dementia were also significant factors associated with poor outcomes of CSDH.

Despite various surgical treatment options, CSDH recurs in some patients. Muzii et al. [1] reported recurrence rates of 4.5% for the group with drainage alone and 20% for the group with drainage and irrigation, showing no significant difference. Zakararia et al. [2] demonstrated recurrence rates of 14.3% in the drainage group and 10% in the drainage with irrigation group, again showing no significant difference. Kuroki et al. [11] reported recurrence rates of 1.8% with drainage alone and 11.1% with drainage and irrigation. The recurrence rate was significantly lower for drainage alone than for drainage with irrigation. In the present study, although no statistical difference was noted between groups, the recurrence rate was 3-fold higher in drainage alone (10.3%) than in drainage with irrigation (2.9%, p=0.191) (Table 1-2). The present findings thus support the efficacy of irrigation followed by drainage for the treatment of CSDH with a lower recurrence rate.

The present study was a non-randomized, retrospective study. Therefore, the authors could not deny the possibility of bias in selection of surgical technique. It is conceivable that patients in Group A might have been selected for treatment with drainage alone rather than drainage with irrigation because of poorer clinical conditions, as drainage without irrigation is

<table>
<thead>
<tr>
<th>Variables</th>
<th>Regression coefficient</th>
<th>Standard error</th>
<th>p-value</th>
<th>Relative risk (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>0.042</td>
<td>0.035</td>
<td>0.227</td>
<td>1.043 (0.974-1.116)</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>0.348</td>
<td>0.590</td>
<td>0.555</td>
<td>1.417 (0.446-4.504)</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>-0.023</td>
<td>0.011</td>
<td>0.003</td>
<td>1.023 (1.002-1.045)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>-0.172</td>
<td>0.604</td>
<td>0.776</td>
<td>0.842 (0.258-2.751)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>-0.648</td>
<td>1.092</td>
<td>0.553</td>
<td>0.523 (0.062-4.444)</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>0.245</td>
<td>0.842</td>
<td>0.771</td>
<td>1.278 (0.245-6.655)</td>
</tr>
<tr>
<td>Renal failure</td>
<td>1.427</td>
<td>0.964</td>
<td>0.139</td>
<td>4.167 (0.629-27.584)</td>
</tr>
<tr>
<td>Cardiac arrhythmia</td>
<td>1.117</td>
<td>0.640</td>
<td>0.081</td>
<td>3.056 (0.872-10.712)</td>
</tr>
<tr>
<td>Cerebral infarction</td>
<td>1.121</td>
<td>0.690</td>
<td>0.104</td>
<td>3.067 (0.794-11.849)</td>
</tr>
<tr>
<td>Cerebral hemorrhage</td>
<td>1.859</td>
<td>1.448</td>
<td>0.199</td>
<td>6.417 (0.376-109.581)</td>
</tr>
<tr>
<td>Anticoagulant drug</td>
<td>2.011</td>
<td>0.783</td>
<td>0.011</td>
<td>7.400 (1.594-34.352)</td>
</tr>
<tr>
<td>Antiplatelet drug</td>
<td>1.382</td>
<td>0.799</td>
<td>0.084</td>
<td>3.982 (0.832-19.052)</td>
</tr>
</tbody>
</table>

C.I., Confidence interval.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Regression coefficient</th>
<th>Standard deviation</th>
<th>p-value</th>
<th>Relative risk (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dementia</td>
<td>2.644</td>
<td>0.803</td>
<td>0.001</td>
<td>14.348 (2.973-69.247)</td>
</tr>
<tr>
<td>Low density on CT</td>
<td>0.648</td>
<td>1.092</td>
<td>0.553</td>
<td>1.912 (0.225-16.241)</td>
</tr>
<tr>
<td>Consciousness disturbance</td>
<td>1.117</td>
<td>0.640</td>
<td>0.081</td>
<td>3.056 (0.872-10.712)</td>
</tr>
<tr>
<td>Drainage with irrigation</td>
<td>-2.255</td>
<td>1.063</td>
<td>0.034</td>
<td>0.105 (0.013-0.842)</td>
</tr>
</tbody>
</table>

C.I., Confidence interval.
surgerically and quicker than drainage with irrigation.

As the subject cohort in this series was insufficient

to reach definitive conclusions regarding the optimal
surgical technique for CSDH, investigations using a
larger group of patients are needed to confirm these
preliminary data.

CONCLUSION

These results indicate that burr hole drainage with
irrigation has a significantly stronger association with
good outcomes compared to drainage alone, and could
be a reliable and effective operative method for the
treatment of CSDH with a lower recurrence rate.

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