To Drain or Two Drains: Recurrences in Chronic Subdural Hematomas

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Running title: To Drain or Two Drains: Recurrences in Chronic Subdural Hematomas
Key Words: chronic subdural hematoma, burr hole, drain, recurrence
Abbreviations:
- ACEI, angiotensin converting enzyme inhibitor
- ARB, angiotensin receptor blocker
- cSDH, chronic subdural hematoma
- PFA, platelet function assays
- TEG, thromboelastography
Abstract

Background: Chronic subdural hematoma (cSDH) is a common neurosurgical condition, with an estimated incidence of 3-15.5 per 100,000 people, with significantly higher rates in the elderly population. Recurrence rates range from 2-37% after surgical drainage. Studies have shown that leaving a drain post-operatively can reduce recurrence rates, but studies have not looked at whether there is a difference between leaving one or two drains.

Methods: We analyzed 215 patients undergoing burr hole drainage for 261 cSDH in terms of pre-operative comorbidities and post-operative drain placement.

Results: Recurrences requiring repeat evacuation occurred in 6.1% overall, in 6/110 patients (5.5%) with one burr hole, and 11/151 patients (7.3%) who had two burr holes, which was not significantly different. Recurrences occurred in 1/15 patients (6.7%) with no drain, 13/210 patients (6.2%) with one drain, and in 2/36 patients (5.6%) with two drains, which was also not statistically significant. The only medical comorbidity associated with an increased risk of recurrence was liver disease, p=0.014.

Conclusions: This study demonstrates that neither the number of burr holes nor the number of drains left after a burr hole drainage of cSDH appear to affect recurrence rates, while liver disease does make recurrence more likely.

Introduction

Chronic subdural hematoma (cSDH) is a common neurosurgical problem, particularly among elderly patients. Roughly two-thirds of patients recall a recent trauma, often minor, and the diagnosis is more common in men. Major risk factors for developing cSDH include brain atrophy, epilepsy, Huntington’s disease, alcoholism, having a cerebrospinal fluid shunt, and dehydration. The pathophysiology is
thought to be due to an initial acute subdural hematoma, which subsequently forms fragile neo-
membranes. Micro-hemorrhages into these membranes are thought to cause expansion.

Though small cSDH may resorb without intervention, most cases will require intervention, most
commonly drainage through a burr hole or twist-drill hole, including kits like the Subdural Evacuating
Port System (Medtronic, Minneapolis, MN). Recurrence rates after surgical intervention range widely,
from 2-37%, with higher recurrence rates for intervention with a twist drill as opposed to a burr hole or
a craniotomy. Preoperative predictors of recurrence, based on retrospective studies, include diabetes,
anticoagulant therapy, lack of use of angiotensin converting enzyme inhibitors (ACEI), male gender,
bilateral hematomas, midline shift greater than 1cm and presentation with hemiparesis, though
studies report widely differing results. A variety of operative methods for reducing recurrence have
been identified, including two burr holes, use of greater than 1.4L of irrigation, using irrigation with
thrombin, the use of post-operative drains, and frontal placement of the postoperative drain,
only the last two of which have been studied prospectively. The number of drains left postoperatively
has not been specifically studied. Our goal was to add to this body of knowledge by evaluating the
number of drains left in terms of recurrence, and also to evaluate preoperative medical comorbidities
and medication usage in terms of recurrence.

Methods

We retrospectively analyzed all burr hole drainages performed by two trauma surgeons from 2007 to
2015. Surgery was performed using a 14mm perforator drill to make one or two burr holes, at the
surgeon’s discretion. Typically, one burr hole was used for smaller cSDH, and two were used for larger,
holohemispheric cSDH. A surgery was included if the post-operative diagnosis was chronic subdural
hematoma or hygroma, and either no drain was left, or one or more external ventricular drain-type
catheters were left in place. The number of drains placed was at the operating surgeon’s discretion.
Surgeries were excluded if the post-operative diagnosis was an epidural collection or an infection. Larger craniotomies and procedures with other drain types were also excluded. While cSDH with significant loculations or membranes were not specifically excluded, many of these cases are converted to an open craniotomy at the time of the initial surgery and thus excluded. Post-operatively, all patients were kept flat in bed for at least 24 hours, and all drains were to gravity. Data was collected on demographics, hematoma laterality, patient comorbidities, pre-operative medications, number of burr holes, number of drains left and recurrences. Data was analyzed to evaluate any association with recurrence using the student’s t-test and chi square analysis.

Results

There were 215 patients with a total of 261 chronic subdural hematomas treated by burr-hole drainage. The patients were 72% male, with a mean age of 66. The initial hematomas were bilateral in 25.3%. Overall recurrence rate was 6.1%. These measures were compared between the two surgeons, using a t-test for age and a chi square analysis for other parameters, in order to justify combining the two groups of patients (see Table 1). One attending had a noticeably lower recurrence rate than the other (3.1 vs 7.9%), but this was not statistically significant.

Pre-operative comorbidities (Table 2) and medication usage (Table 3) were noted and compared for association with recurrences. A majority of the patients had at least one medical comorbidity; hypertension and diabetes were the most common (63.2% and 27.2%, respectively). The only medical comorbidity associated with a higher risk of recurrence was liver disease (p=0.014), including a pre-existing diagnosis of cirrhosis, chronic hepatitis B or C. Among the patients with liver disease, neither pre-operative coagulopathy nor transfusion were different between those who recurred and those who did not. Patients with an abnormal albumin level had a tendency to recur, and all patients with an albumin level less than 3 (normal 3.9-5) did recur. Isolated coagulopathy, identified by an elevated
prothrombin time (PT), partial thromboplastin time (PTT), thrombocytopenia, or thromboelastogram consistent with a recommended transfusion, was not associated with an increased recurrence risk. No class of medication was correlated with the risk of recurrence.

Fifteen (5.7%) had no drain left at surgery, 210 (80.5%) had one subdural drain left, and 36 (13.8%) had two subdural drains left. In those patients with no drain left, it was typically noted that the brain had expanded to such an extent that it was deemed unsafe to leave a drain. There was no difference in recurrence rates between those patients with a drain and those without (p=0.929), or between those who had one or two drains left (p=0.934), (see Table 4) although there was a slight trend toward fewer recurrences in those who had two drains left.

Discussion

It is impossible to randomize patients to have a pre-existing medical comorbidity or to take a medication prior to developing a cSDH, thus the data we have in this area is retrospective. ACEIs are one class of medications which were thought to reduce cSDH recurrences due to antiangiogenic properties, though a study by Neidert et al found higher recurrences in those patients, possibly due to elevated bradykinin causing increasing vascular permeability. A randomized trial by Poulsen et al found that starting an ACEI at the time of diagnosis did not affect recurrence rates. Our study found no difference in recurrences based on the pre-operative use of ACEI/ARB.

There have not been studies specifically focusing on patients with liver disease and cSDH, though there is some data suggesting that patients with coagulopathies, including those caused by liver disease, have higher rates of recurrences. In our population, liver disease was associated with an increased risk of recurrence, regardless of coagulopathy or transfusion status, although coagulopathy in the absence of liver disease was not. Among these patients, a lower albumin level was associated with recurrence.

Thromboelastography (TEG) and platelet function assays (PFA) were not routinely performed in our
patient population, though these functional assays might prove to be predictive of recurrences in this population.

Although the ideal surgical procedure has yet to be determined, many studies have completed looking at individual factors affecting burr-hole surgery. The number of burr holes placed is one such example, with conflicting results. Taussky et al\textsuperscript{10} found that recurrence was significantly more likely after the placement of only one burr hole, while Han et al\textsuperscript{19} found a trend toward more recurrences in those patients treated with two burr holes. There have also been two larger retrospective studies\textsuperscript{20,21} which found no difference between the uses of one or two burr holes. Our findings are consistent with this group.

In a prospective, randomized controlled trial, Santarius et al\textsuperscript{12} demonstrated the utility of leaving a post-operative drain to decrease recurrences after surgery for cSDH, which was later confirmed in the meta-analysis by Alcalá-Cerra et al\textsuperscript{22}. Our study did not find a difference in recurrence rates between those patients who had a drain left and those who did not. This is likely due to our institutional bias to leave a drain unless it is judged unsafe to do so, thus only 15 patients had no drain left, decreasing the utility of this comparison in our study. The size and type of the drainage catheter are other areas for exploration.

To our knowledge, this is the first study looking specifically at the number of drains left after surgical evacuation of cSDH. While we found a slight trend toward fewer recurrences in those patients with two drains, this was not significant, and requires further investigation. Though Nakaguchi et al demonstrated lower rates of recurrence with a frontally-placed drain\textsuperscript{15} in patients treated with a single burr hole and post-operative drainage, many of our drains are placed aiming posteriorly or in the middle fossa, under the assumption that fluid will collect in dependent areas. Additional studies on drain placement are needed to verify whether drain location matters in patients with two drains.
This is a small, retrospective, single institution study, with the associated biases. Additionally, the hospital is in a common vacation destination, so a number of our patients did not follow up locally. A prospective, randomized controlled trial would be needed to further evaluate whether the number of post-operative drains affects recurrences, and a cohort study would be needed to evaluate the liver disease aspect.

Conclusions

In this retrospective study of chronic subdural hematoma treated with burr hole drainage, the overall recurrence rate was 6.1%. Those patients with liver disease were significantly more likely to have a recurrence, 21.4%, regardless of preoperative coagulation status, while no other medical comorbidities were associated with recurrence rates. No class of preoperative medication was found to have a significantly increased risk of recurrence. Although there was a slight trend toward higher recurrence rates in patients with only one drain (6.2 versus 5.6%), this was not significant. Neither the number of burr holes placed nor the number of drains left post-operatively affected the recurrence risk.

Acknowledgements:

We appreciate the help of Leo Harris, PA, in editing this manuscript.

Funding:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
References


Table 1: Demographics and inter-surgeon comparison

<table>
<thead>
<tr>
<th></th>
<th>Surgeon 1, n=164</th>
<th>Surgeon 2, n=97</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years, mean ± SD</td>
<td>69 ± 11</td>
<td>64 ± 16</td>
<td>0.206</td>
</tr>
<tr>
<td>Male gender, n (%)</td>
<td>119 (72.6)</td>
<td>69 (71.1)</td>
<td>0.886</td>
</tr>
<tr>
<td>Unilateral left, n (%)</td>
<td>67 (40.9)</td>
<td>36 (37.1)</td>
<td>0.707</td>
</tr>
<tr>
<td>Unilateral right, n (%)</td>
<td>61 (37.2)</td>
<td>31 (32.0)</td>
<td>0.528</td>
</tr>
<tr>
<td>Bilateral, n (%)</td>
<td>18 (22.0)</td>
<td>15 (30.1)</td>
<td>0.279</td>
</tr>
<tr>
<td>Recurrences, n (%)</td>
<td>13 (7.9)</td>
<td>3 (3.1)</td>
<td>0.116</td>
</tr>
</tbody>
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Table 2: Medical comorbidities and recurrences

<table>
<thead>
<tr>
<th>Comorbidity</th>
<th>No recurrence, n (%)</th>
<th>Recurrence, n (%)</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>Hypertension</td>
<td>157 (95.2)</td>
<td>8 (4.8)</td>
<td>0.258</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>41 (91.1)</td>
<td>4 (8.9)</td>
<td>0.396</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>66 (93)</td>
<td>5 (7)</td>
<td>0.707</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>36 (94.7)</td>
<td>2 (5.3)</td>
<td>0.81</td>
</tr>
<tr>
<td>End-stage renal disease, on hemodialysis</td>
<td>7 (100)</td>
<td>0 (0)</td>
<td>0.493</td>
</tr>
<tr>
<td>Liver disease*</td>
<td>11 (78.6)</td>
<td>3 (21.4)</td>
<td>0.014</td>
</tr>
<tr>
<td>Seizure history</td>
<td>22 (88)</td>
<td>3 (12)</td>
<td>0.198</td>
</tr>
<tr>
<td>Significant psychiatric diagnosis</td>
<td>14 (100)</td>
<td>0 (0)</td>
<td>0.326</td>
</tr>
<tr>
<td>Dementia</td>
<td>20 (95.2)</td>
<td>1 (4.8)</td>
<td>0.785</td>
</tr>
<tr>
<td>Other intracranial pathology</td>
<td>32 (97)</td>
<td>1 (3)</td>
<td>0.427</td>
</tr>
<tr>
<td>Substance abuse</td>
<td>22 (95.7)</td>
<td>1 (4.3)</td>
<td>0.709</td>
</tr>
<tr>
<td>Cancer</td>
<td>23 (88.5)</td>
<td>3 (11.5)</td>
<td>0.226</td>
</tr>
<tr>
<td>HIV</td>
<td>10 (83.3)</td>
<td>2 (16.7)</td>
<td>0.119</td>
</tr>
<tr>
<td>Coagulopathy**</td>
<td>113 (91.9)</td>
<td>10 (8.1)</td>
<td>0.204</td>
</tr>
</tbody>
</table>

* Liver disease including pre-existing cirrhosis, chronic hepatitis B or C.

**Coagulopathy as defined by laboratory values: elevated prothrombin or partial thromboplastin time, thrombocytopenia, abnormal thromboelastogram consistent with a transfusion recommendation.
Table 3: Pre-operative medications and recurrences

<table>
<thead>
<tr>
<th>Medication</th>
<th>No recurrence, n (%)</th>
<th>Recurrence, n (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACEI/ARB</td>
<td>81 (93.1)</td>
<td>6 (6.9)</td>
<td>0.715</td>
</tr>
<tr>
<td>Beta blocker</td>
<td>75 (96.2)</td>
<td>3 (3.8)</td>
<td>0.315</td>
</tr>
<tr>
<td>Diuretic</td>
<td>56 (94.9)</td>
<td>3 (5.1)</td>
<td>0.704</td>
</tr>
<tr>
<td>Other anti-hypertensive</td>
<td>61 (95.3)</td>
<td>3 (4.7)</td>
<td>0.580</td>
</tr>
<tr>
<td>Statin</td>
<td>43 (93.5)</td>
<td>3 (6.5)</td>
<td>0.903</td>
</tr>
<tr>
<td>Anti-epileptic</td>
<td>75 (94.9)</td>
<td>4 (5.1)</td>
<td>0.636</td>
</tr>
<tr>
<td>Blood thinning (all)</td>
<td>147 (93.6)</td>
<td>10 (6.4)</td>
<td>0.644</td>
</tr>
<tr>
<td>Aspirin</td>
<td>45 (90)</td>
<td>5 (10)</td>
<td>0.205</td>
</tr>
<tr>
<td>Plavix</td>
<td>24 (96)</td>
<td>1 (4)</td>
<td>0.641</td>
</tr>
<tr>
<td>Coumadin</td>
<td>11 (100)</td>
<td>0 (0)</td>
<td>0.386</td>
</tr>
<tr>
<td>NSAID</td>
<td>10 (100)</td>
<td>0 (0)</td>
<td>0.410</td>
</tr>
<tr>
<td>Other</td>
<td>57 (93.4)</td>
<td>4 (6.6)</td>
<td>0.874</td>
</tr>
</tbody>
</table>
Table 4: Drains and recurrences

<table>
<thead>
<tr>
<th>Drains</th>
<th>No recurrence, n (%)</th>
<th>Recurrence, n (%)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No drain</td>
<td>14 (93.3)</td>
<td>1 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Any drain</td>
<td>231 (93.4)</td>
<td>15 (6.1)</td>
<td>0.929</td>
</tr>
<tr>
<td>1 drain</td>
<td>197 (93.8)</td>
<td>13 (6.2)</td>
<td></td>
</tr>
<tr>
<td>2 drains</td>
<td>34 (94.4)</td>
<td>2 (5.6)</td>
<td>0.934</td>
</tr>
</tbody>
</table>
Highlights

Drain number in chronic subdural hematoma does not affect recurrence rates.

Pre-morbid liver disease is associated with a higher recurrence rate after drainage.

Hypertension, diabetes and epilepsy are not associated with higher recurrence rates.

Pre-operative medication use does not affect recurrence rates.
Abbreviations:
ACEI, angiotensin converting enzyme inhibitor
ARB, angiotensin receptor blocker
cSDH, chronic subdural hematoma
PFA, platelet function assays
TEG, thromboelastography
The authors of this manuscript have no financial conflicts of interest to disclose.