Various Surgical Treatments of Chronic Subdural Hematoma and Outcome in 172 Patients: Is Membranectomy Necessary?

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BACKGROUND
The initial surgical management of chronic subdural hematoma (CSDH) is still controversial, and a standard therapy does not exist. Because of the advanced age and multiple medical problems of the patients, surgical therapy is frequently associated with complications.

METHODS
A retrospective study was performed on 172 patients with CSDH, comparing the efficacy of three different primary surgical methods: drainage of hematoma through two different burr-holes without membranectomy (Group A, n = 38); enlarged craniectomy with a size of about 30 mm craniotomy with partial membranectomy and drainage (Group B, n = 121); and extended craniotomy with partial membranectomy and drainage (Group C, n = 13).

RESULTS
Independent of surgical method, the general outcome of the patients was good. The rate of reoperation in the group of burr-hole drainage was 16%, slightly lower than in partial membranectomy with enlarged craniectomy or extended craniotomy with 18% and 23%, respectively. In patients with coagulopathy, the rate of reoperation was 41% (16/43), significantly higher than the rate in noncoagulopathic patients 12% (15/129).

CONCLUSIONS
In this study, an extended surgical approach with partial membranectomy has no advantages regarding the rate of reoperation and the outcome. As initial treatment, burr-hole drainage with irrigation of the hematoma cavity and closed-system drainage is recommended. Extended craniectomy and extended craniotomy have also been advocated for excision of inner and outer parts of the membrane.

KEY WORDS
Chronic subdural hematoma, surgical treatment, hematoma recurrence.

C hronic subdural hematoma (CSDH) represents one of the most frequent types of intracranial hemorrhage in a neurosurgical department. Because of the advanced age and multiple medical problems of patients, surgical therapy is frequently associated with complications. For the initial management of CSDH, numerous surgical treatments have been proposed [3,4,12,13,17,19,21,22,27]. However, the extent of surgical treatment of CSDH is still controversial, and a standard therapy does not exist [1,2,4,6,9,16–19,22,23,26,29]. Though simple burr-hole evacuation and irrigation of the subdural cavity has become generally accepted in the last 20 years, this technique is associated with a considerable rate of recurrent hematoma—between 2.7 and 37% [4,6,9,11,13,17,19,22,23]. Many authors have recommended partial resection of the thick hematoma membranes to reduce the incidence of recurrent hematoma [4,5,17,22]. Large craniectomy and extended craniotomy have also been advocated for excision of inner and outer parts of the membrane.

In the present study, the efficacy of three different primary surgical methods were retrospectively investigated in 172 patients with CSDH: burr-hole drainage without membranectomy (Group A); enlarged craniectomy with a diameter of about 30 mm and partial membranectomy (Group B); and larger craniotomy with a gross membranectomy (Group C).

Patients and Methods
Between 1996 and 2000, 172 patients with CSDH received surgical treatment at the Department of Neurosurgery, University of Cologne in Germany. CSDH was defined as a subdural hematoma surrounded by capsule (hematoma membrane) and consisting of dark reddish liquefied blood at oper-
Surgical Methods and Rate of Reoperation

<table>
<thead>
<tr>
<th>SURGICAL METHODS</th>
<th>N</th>
<th>REOPERATION</th>
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<tbody>
<tr>
<td>Burr hole without membranectomy (Group A)</td>
<td>38</td>
<td>6 (16%)</td>
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<tr>
<td>Cranectomy with membranectomy (Group B)</td>
<td>121</td>
<td>22 (18%)</td>
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<tr>
<td>Large craniotomy with membranectomy (Group C)</td>
<td>13</td>
<td>3 (23%)</td>
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Male/female ratio was 106/66. The mean age was 69 years with a range from 27 to 92 years. Pediatric subdural hematoma was excluded. Diagnosis of CSDH was confirmed by computed tomography (CT) in 157 patients and by magnetic resonance imaging (MRI) in 15 patients. Operation was performed under general anesthesia in 165 patients, and with local anesthesia in 7 patients. According to the experience and preference of the surgeon, 3 different surgical procedures were performed: two different burr-holes without membranectomy (Group A, n = 38), enlarged craniectomy with a size of about 30 mm (Group B, n = 121), and larger craniotomy (Group C, n = 13) (Tables 1 and 2). In Groups B and C, the parietal and the visceral capsule of the hematoma were opened and resected as far as possible. After irrigation of the hematoma cavity with physiologic saline solution, all patients received 1 or 2 closed-system drains for an average of 3 days. Patient’s clinical scores were classified comparing the preoperative and the postoperative status at the time of discharge from the hospital (Table 3), using the most common neurologic grading system for CSDH as proposed by Markwalder [11].

RESULTS

SYMPTOMS

Table 4 shows that head trauma was the most common cause of CSDH in 113 patients (66%). Most traumas were minor. The average interval from head injury to the initial CT scan was 6 weeks (1 week to 6 months). The hematoma was located on the left side in 66 cases, on the right side in 68 cases, and bilaterally in 38 cases. The leading initial symptoms were headache (n = 67), hemiparesis (n = 61), and deterioration of level of consciousness (n = 50).

A history of head injury was unclear in most patients who presented with associated coagulopathy.

CT FINDINGS

CSDH was primarily classified into 4 groups according to its density and appearance on initial CT scans: high, mixed, iso, and low. Its distribution in the three operative groups was similar (Table 2). In all groups, the most frequent CT-density of the CSDH was mixed (52–61%) and low (20–43%). In 85% of the cases, the CT scan showed a marked midline shift.

In patients who required reoperation (n = 31), the density of the recurrent hematoma on CT scan was: low (46%), mixed (39%), and high (15%). The majority of hyperdense recurrent hematomas on CT scan were found in patients with coagulopathy, in whom the average thickness of hematoma was 2 cm, whereas the majority of hypodense lesions were found in patients without coagulopathy, with an average thickness of 1.3 cm (Table 5).
OPERATIVE METHODS
Operation was routinely performed under general anesthesia. In 7 cases from Group A, the operation was carried out in local anesthesia.

Two burr-hole craniectomy (diameter 12 mm), one of which was anterior to the coronal suture and the other one on the posterior portion of the CSDH, was performed in 38 patients (Group A). This procedure was carried out without membranectomy. There were 121 patients treated by enlarged craniectomy, with a diameter of about 30 mm (Group B). There were 13 patients who received extended craniotomy (Group C). The craniectomy and craniotomy were performed on the thickest part of the hematoma as determined by CT or MRI. In both Groups B and C, the outer and inner membranes of the hematoma were resected as far as possible (Tables 1 and 2).

In all cases, closed-system drainage was placed into the hematoma cavity for an average of 3 days (range 1–8 days) after irrigation with physiologic saline solution.

OUTCOME
In most cases, neurologic status improved after the surgical treatment. The general outcome was good; 82 patients could be postoperatively classified as Grade 0 or 1—presenting only mild or no neurologic deficits (Table 3). Subdural empyema as a postoperative complication was seen in 2 cases from Group B. Operative mortality rate, defined as death within 30 days after surgery was 5% (n = 8). The deaths were related to accompanying diseases and not a result of cerebral decompensation.

REOPERATION
Indications for reoperation were rebleeding, increase in the volume of residual subdural fluid within the hematoma cavity, and compression of the brain surface observed on CT scans with neurologic deterioration.

There were 31 patients who underwent reoperation, at an average of 12 days after the first operation (0–51 days): 6 patients (16%) from Group A, 22 patients (18%) from Group B, and 3 patients (23%) from Group C (Table 1).

The average age was 69 years (range 36–83 years). In 11 cases (35%) the hematoma was bilateral. Male/female ratio was 20/11. In 67% of the cases the subdural hematoma showed mixed density on primary CT scan, in 24% it was hypodense, and in 9% isodense (Table 6). The interval from head injury to the initial CT scan was 4 weeks on average (1–8 weeks)—much shorter than patients not requiring reoperation.

Extended craniotomy and membranectomy was performed in 11/31 reoperated cases. The other patients were treated with reopening of the burr-holes or enlarged craniectomy and drainage. For one patient from Group B, 2 reoperations were needed.

COAGULOPATHY
Coagulopathy (n = 43) included thrombocytopenia caused by leukemia (n = 9), and use of coumadin (n = 15) and aspirin (n = 19). In cases with coagulopathy the rate of reoperation was significantly higher and the interval to reoperation was much shorter than in patients without coagulopathy; 16/43 patients (41%) were reoperated on the 4th day postoperative on average (Day 1–25 postoperative) (Table 5). The CT scans showed high- or mixed-density and hematoma thickness of 2.5 cm on average.

There were 6 patients primarily treated with burr-hole drainage (Group A), 22 patients with enlarged craniectomy with membranectomy (Group B), and 3 patients with large craniotomy with membranectomy (Group C).

Acute rebleeding within 24 hours postoperatively was observed in 5 patients from Group B and C.


**Discussion**

Although CSDH is well known as a curable disease in the elderly, the rate of reoperation varies between 2.7% and 30% [9,11,13,19,22,23]. In the previous years, various surgical treatments of CSDH have been reported [3–5,12,13,17,19,27]. However, the extent of surgical therapy is still controversial, and a standard therapy does not exist [1,2,5,6,9,16–19,22,26,19].

According to experience and preference of the surgeons in our department, 3 different surgical procedures were performed: burr-hole drainage without membranectomy (Group A), enlarged craniectomy with a diameter of about 30 mm and partial membranectomy (Group B). Putnam and Cushing and the others advocated extended craniotomy because of the better exposure. The better exposure it provides for treatment of the solid components of the SDH [4,13,17,22,24,26]. Therefore, in 13 cases in this study a larger craniectomy with gross excision of thickened space occupying hematoma membrane, which was seen on CT scans, was performed (Group C). The patient’s data and neuroradiological findings of the three groups are shown in Table 2.

Independently of surgical method, in most cases the neurologic status improved after the surgical treatment. The general outcome was good. In 69% of all cases, postoperatively the patients could be classified as Grade 0 or 1 presenting no or only mild neurologic deficits (Table 3).

According to other authors, the rate of reoperation in their studies was between 16 and 23%, depending partly on the surgical method, and the reoperation was done on average on the 12th postoperative day (ranging 0–51 days) [4,6,9,11,13,17,19,22,23]. In our group of burr-hole drainage without membranectomy (Group A, n = 38), the rate of reoperation (16%) was considerably lower than in Groups B and C, which had partial membranectomy, in whom the reoperation rate was 18% and 23%, respectively (Table 1). Consequently, extended surgical approach with partial membranectomy has no advantages regarding the rate of reoperation and the outcome.

It is well accepted that the development and enlargement of a CSDH is a result of both local hyperfibrinolysis as the cause for liquefaction of the subdural blood clot, and continuous micro-hemorrhages from the sinusoidal vessels of the parietal membrane [7,12,14]. Therefore, for the initial treatment of CSDHs, complete withdrawal of the subdural fluid, which contains the fibrinolytic agents, by adequate rinsing of the hematoma cavity, is more important than partial resection of membrane.

On the basis of clinical observation of subdural hematomas and histologic study of the hematoma membrane, CSDH runs through a development from a proliferative to a degenerative stage, which is shown in follow-up CT scans in a few cases of spontaneous resolution of CSDH [25]. Nakaguchi et al [14] reported higher rate of recurrence and reoperation in the proliferative stage of the CSDH. Nomura et al [15] concluded that mixed-layered density hematomas had a greater tendency to rebleed. Consistent with these observations, we found in this study that in cases with reoperation, the interval from head injury to the initial CT scan and primary operation was within 4 weeks on average, which corresponds to the proliferative stage, significantly shorter than patients without reoperation. The primary CT scans showed mixed density in 67% of patients requiring reoperation.

Older age of a patient and bilateral sites of CSDH have also been considered to be risks for recurrence by some authors [19,25]. In this study, no difference was found between recurrent and non-recurrent groups regarding average age, sex, and localization of the hematoma (Table 6).

As expected, the rate of reoperation in the group with coagulopathy was significantly higher (41%), and the average time of reoperation was much shorter (Day 4 postoperatively), than in cases without coagulopathy. In most patients with coagulopathy a history of head injury was unclear. In cases of head injury the interval to the initial CT scan was 10 days on average (2–28 days). Five patients with coagulopathy treated by either enlarged craniectomy or larger craniotomy with membranectomy (Group B and C) required reoperation within 24 hours postoperatively because of acute rebleeding with massive midline shift. In these cases, the density on CT scans was high, and the average thickness was about 2 cm.

It is well known that the parietal membrane of the hematoma contains several layers of capillaries with large lumens and many thin new vessels deriving from the middle meningeal artery. These are thought to play an important role in the expansion of the subdural hematoma. Therefore, these blood vessels, in the presence of coagulopathy, are more vulnerable and can easily rebleed [10]. Thus, partial membranectomy or any mechanical manipulation of the hematoma membrane in patients with coagulopathy seemed to carry a distinctly higher risk of rebleeding.
Conclusions

For the initial treatment of chronic subdural hematoma, burr-hole drainage with irrigation of the hematoma cavity and closed-system drainage is recommended. It is safe and timesaving and can be performed, for elderly patients and/or those with multiple medical problems, at the bedside using local anesthesia. Classification of CSDH according to internal architecture, intracranial extension and density on CT or MRI scans may be useful for predicting the risk of hematoma recurrence [14,15]. For the patients at risk, meticulous perioperative management is also necessary to reduce postoperative recurrence or other surgical complications. Enlarged craniectomy and extended craniotomy with membranectomy are reserved for instances of acute rebleeding with solid hematoma.

References


Commentary

I was pleased to have the opportunity to review the paper of Dr. Lee et al regarding appropriate surgical management of chronic subdural hematoma. This is one of the more common surgical problems for