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Case study

Which surgical procedure is effective for refractory chronic subdural hematoma? Analysis of our surgical procedures and literature review

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ABSTRACT

Refractory chronic subdural hematoma (CSDH) is rare but remains a difficulty for neurosurgeons, and no consensus on treatment procedures has been established. To discuss effective surgical procedures for refractory CSDH, we analyzed our surgical procedures and outcomes for refractory CSDH. We defined patients with refractory CSDH as those who presented with two or more recurrences. Fourteen patients with refractory CSDH were analyzed. Eight patients underwent burr-hole irrigation and closed-system drainage alone, four patients received embolization of the middle meningeal artery (MMA), and two patients with organized CSDH underwent large craniotomy with outer membranectomy as the third surgery. Two of the eight patients (25%) treated with burr-hole irrigation and drainage alone showed a third recurrence. No further recurrences were identified in patients treated with embolization of the MMA or craniotomy. However, statistical analysis showed no significant difference in cure rate between patients treated with burr-hole irrigation and drainage alone and patients treated with burr-hole irrigation and drainage with embolization of the MMA (P = .42). Similarly, no significant differences in cure rate were seen between patients treated with burr-hole irrigation and drainage alone and patients treated with craniotomy (P = .62). When selecting a surgical procedure, assessing whether the CSDH is organized is crucial. Embolization of the MMA may be considered as one of the optional treatments for refractory CSDH without organized hematoma. On the other hand, for refractory cases of organized CSDH, hematoma evacuation and outer membranectomy with large craniotomy or mini-craniotomy assisted by an endoscope may be suitable, as previous reports have recommended.

1. Introduction

Chronic subdural hematoma (CSDH) is one of the most common diseases seen by neurosurgeons, and is usually associated with good recovery after treatment with burr hole-irrigation and drainage under local anesthesia [1–7]. Despite this, approximately 10% of patients experience recurrence and require re-operation [1–5,8,9]. Although recurrence is usually single, repeated recurrences and refractory CSDH occur on rare occasions. Burr-hole irrigation with drainage has been widely performed as the gold standard of treatment [4,5,10–12]. When the first recurrence occurs, burr-hole irrigation and drainage are usually selected again. However, neurosurgeons will surely entertain some doubt regarding whether repetitive burr-hole irrigation and drainage can achieve cure when refractory CSDH is encountered. In fact, several surgical procedures for refractory CSDH have been reported; these include Ommaya reservoir placement [13], subdural-peritoneal shunt [14], hematoma evacuation and removal of the outer membrane using craniotomy [15], endoscopic surgery [16,17], and endovascular embolization of the middle meningeal artery (MMA) [9,18–28]. Among these techniques, the utility of endoscopic surgery and embolization of the MMA have recently been reported [9,16–22]. These surgical procedures appear effective with a low degree of operative invasiveness and can be performed under local anesthesia.

This cohort study analyzed our surgical procedures and outcomes for refractory CSDH and reviewed the literature to discuss effective surgical procedures for refractory CSDH.

2. Material and methods

The study was approved by the institutional review board of our hospital. The prospectively maintained database of Eisyokai Yoshida Hospital was searched for patients treated for CSDH

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between January 2010 and December 2015. Medical records, radiographic studies, operative reports, and clinical follow-up evaluations were reviewed retrospectively.

2.1. Definition of CSDH recurrence and refractory CSDH

We defined CSDH recurrence as ipsilateral hematoma identified on follow-up computed tomography (CT) and causing neurological deficits within 3 months after the last operation. Using this criterion, we then defined patients with refractory CSDH as those individuals presenting with recurrence on two or more occasions.

2.2. Patients

We surgically treated 563 patients (360 men, 203 women) for primary CSDH at our institution between January 2010 and December 2015. Subsequently, 75 of the 563 patients (13.3%) experienced recurrent CSDH. Fourteen of the 563 patients (2.4%) experienced two or more recurrences. These 14 patients were analyzed.

2.3. Surgical procedure

We performed burr-hole irrigation with closed-system drainage for initial and secondary operations. Saline or artificial cerebrospinal fluid was used as irrigation solution, based on the decision of the attending neurosurgeon.

For refractory CSDH, we performed repetitive burr-hole irrigation and closed-system drainage, burr-hole irrigation and closed-system drainage immediately after embolization of the MMA, or hematoma evacuation and removal of the outer membrane using large craniotomy.

Burr-hole irrigation and drainage under local anesthesia was performed via the previous burr hole. If necessary, another burr hole was created. After the outer membrane of the CSDH was opened, a silicone catheter was inserted into the hematoma cavity and irrigation with saline was performed. A closed-system drain was then placed in the hematoma cavity. The drain was removed within 2 days.

Embolization of the MMA was performed as described below. Under local anesthesia, a 5-F guiding catheter was inserted from the right femoral artery and placed in the external carotid artery on the affected side. A microcatheter was advanced into each of the anterior and posterior branches of the MMA. Subsequently, superselective angiography and a provocation test with 1% lidocaine injection were performed. When a negative result was confirmed from the provocation test, embolization using 10% n-butyl-cyanoacrylate (NBCA) was undertaken. Conversely, when a positive result from the provocation test was confirmed, embolization using platinum coils was performed. We occluded both anterior and posterior branches of the MMA.

Craniotomy was performed for organized CSDH. We diagnosed organized CSDH based on previous operative findings. When acute or subacute hematoma is mixed with CSDH, the rigid hematoma melts over time and can be washed out during the second operation. As a result, when the hematoma was too rigid to be washed out by irrigation with saline during the first and second operations, we diagnosed organized CSDH. Under general anesthesia, a question-mark skin incision was made and fronto-temporo-parietal craniotomy was performed. After incision of the dura mater, hematoma evacuation and outer membranectomy were performed. Inner membranectomy was not performed, because of the possibility of injury to the cortical brain surface. No drain was placed in the hematoma cavity.

2.4. Postoperative management

In all cases, ambulation was reintroduced early. Patients without complications were generally discharged within 10 days. Antiplatelet or anticoagulant agents were discontinued before surgery in all cases, but were usually restarted 1 week after the last surgery. We did not use adjunctive drugs to prevent recurrence after the second recurrence.

After discharge, patients received regular follow-up CT in our ambulatory practice every month during the first 3 months after the last operation. When follow-up CT showed disappearance of hematoma, we considered CSDH to have been cured and ceased follow-up. If residual hematoma lasted over 3 months in the absence of neurological deficits, we planned on continuing follow-up. However, no patient displayed and such condition. When recurrence was identified, the patients underwent further operation and follow-up cure was achieved.

2.5. Clinical patient factors

We investigated medical history and the use of anticoagulant or antiplatelet medications in all patients based on self-reporting from patients and guardians.

2.6. Outcome measures

We assessed the 3-month recurrence rate after the third surgery. All 14 patients were able to be assessed. We also investigated the total number of operations and surgical procedures until cure, surgical complications, and modified Rankin Scale (mRS) score as of the last follow-up in all patients.

2.7. Statistical analysis

Statistical analysis was performed using Fisher's exact test. Differences were considered significant for probability values of $P < .05$. All statistical analyses were performed using Statcel version 4 software (OMS Publishing, Saitama, Japan).

3. Results

Table 1 shows a summary of the 14 patients with refractory CSDH. These patients were predominantly male (13 men, 1 woman), with a mean age of 71.8 years (range, 45–88 years). A significant male predominance in patients with refractory CSDH was seen compared with patients without refractory CSDH ($P = .02$). In term of medical history, three patients had diabetes mellitus, one patient showed blood coagulopathy, and four patients were taking anticoagulant or antiplatelet medications. No patient showed chronic alcoholism, hepatic dysfunction, hemodialysis, or conditions after cerebrospinal fluid shunt. At the second recurrence, eight patients underwent burr-hole irrigation and drainage alone, four patients received burr-hole irrigation and drainage immediately after embolization of the MMA, and two patients with organized CSDH underwent hematoma evacuation and removal of the outer membrane using large craniotomy as the third surgery. Fig. 1 shows the surgical results. Two of the eight patients (25%) who were treated with burr-hole irrigation and drainage alone developed a third recurrence. No further recurrences were identified in those patients treated with embolization of the MMA or craniotomy. However, statistical analysis showed no significant difference in the cure rate between patients treated with burr-hole irrigation and drainage alone and patients treated with burr-hole irrigation and drainage with embolization of the MMA ($P = .42$). Likewise, no significant difference in cure rate was seen

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