Clinical study

Early post-operative seizures after burr-hole drainage for chronic subdural hematoma: correlation with brain CT findings

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Summary The incidence of seizures in patients undergoing burr-hole craniostomy with closed-system drainage for chronic subdural hematoma (CSDH) is low. The post-operative use of anticonvulsants is, thus, controversial. In this study, we tried to correlate pre-operative computed tomographic (CT) appearance of the CSDH with the need for post-operative seizure prophylaxis. From April 1998 to November 2001, 128 cases of CSDH surgically treated at our hospital were studied. All patients underwent burr-hole craniostomy with closed system drainage. All CSDHs were classified as low-density, isodense, and mixed-density lesions according to CT findings. The incidence of early post-operative seizures (within 3 weeks of surgery) among all patients was 5.4% (7/128). In the subgroups by lesion density, the incidences were 6.2% (1/16) in the low-density group, 2.4% (2/83) in the isodense group, and 13.7% (4/29) in the mixed-density group (all p < 0.05). The mean age among the seven patients (five males and two females) who had seizures was 71 years. The locations of the CSDHs among the 128 patients were the left side of the brain in 53 (41.4%) patients, right side in 45 (35.2%), and bilateral in 30 (23.4%) patients. Among the seven patients who suffered from post-operative seizures, five (71.4%) had left side CSDHs, one (14.2%) had a right side CSDH, and one (14.2%) had bilateral CSDHs. We concluded that the post-operative seizure rate appeared high in the group with mixed-density type lesions on CT, and in those with left unilateral CSDH. We suggest the use of prophylactic antiepileptic anticonvulsants for patients with mixed-density lesions on pre-operative CT.

Keywords: chronic subdural hematoma, burr-hole drainage, post-operative seizure, antiepileptic prophylaxis

INTRODUCTION

Chronic subdural hematoma (CSDH) is a common disease in our daily practice. The predisposing factors include head trauma, chronic alcoholism, seizure disorders, shunt procedures following hydrocephalus, brain atrophy, and coagulopathy.1,3 The best and simplest method of treatment for CSDH is burr-hole craniostomy with post-operative closed-system drainage.4,5

The occurrence of seizures immediately or during the 2 weeks after burr holes with post-operative closed-system drainage has been well recognized. The incidence of seizures in patients receiving burr-hole drainage for CSDH is reported to be about 5% (Hirakawa et al.,6 5.3%; Kotwica and Brzezinski,7 5.4%). Thus, the prophylactic use of antiepileptic agents among patients after burr-hole surgery is controversial.

Computed tomography (CT) is the most useful tool for the evaluation of CSDH. On CT study, CSDH may have density values of low (similar to CSF), intermediate (similar to gray matter), or mixed type.8 In this study, we tried to determine if the pre-operative CT appearance of CSDH correlated with post-operative seizure activity to justify the use of prophylactic anticonvulsant therapy in some CSDH subgroups.

CLINICAL MATERIALS AND METHODS

From April 1998 to November 2001, 128 patients with CSDH surgically treated at our hospital were studied. All the patients underwent burr-hole craniostomy with closed-system drainage for CSDH. The diagnosis of CSDH was confirmed by the typical neomembranes and liquefied blood during surgery. Brain CT scans were performed on the day before or the day of surgery and the CSDHs were classified as low-density, isodense, and mixed-density lesions (Fig. 1).9 No anticonvulsant was administered before or after burr-hole craniostomy unless there was evidence of seizure. For patients who developed early post-operative seizures, phenytoin was used for controlling the seizures.

For statistical analysis, Fisher’s exact test for independence was performed.

RESULTS

Among the 128 patients, there were 95 men and 33 women (male/female ratio, 2.8:1) whose ages ranged from 23 to 93 years, with an average age of 67 years. The pre-operative CT findings showed that 16 patients had low-density CSDHs, 83 had isodense CSDHs, and 29 had mixed-density CSDHs (Table 1). The isodense type had the highest prevalence rate (65%, 83/128).

Seven (5.4%) of the 128 patients developed seizures within 3 weeks after the operation. Their mean age was 71 years; five were men and two were women (male/female ratio, 2.5:1). Five (71%) of the seven patients suffered from seizures within 3 days after surgery. In four (57%) of the seven patients, the seizures were of the generalized tonic-clonic type; the other three patients (43%) had partial seizures with motor symptoms (Table 2).

Among the seven patients with early post-operative seizures, pre-operative CT showed low-density CSDHs in 6.2% (1/16),...
isodense CSDHs in 2.4% (2/83), and mixed-density CSDHs in 13.7% (4/29). The post-operative seizure rate was high in the mixed-density group findings indicative of recent hemorrhage (p < 0.05).

Among the 128 patients, 53 (41.4%) had CSDHs on the left side of the brain, 45 (35.2%) had CSDHs on the right side, and 30 (23.4%) had bilateral CSDH (Table 3). Among the seven patients who suffered from post-operative seizures, there were five (71.4%) with left side CSDHs, one (14.2%) with a right side CSDH, and one (14.2%) with bilateral CSDHs. Early post-operative seizure also had a high incidence in patients with left unilateral CSDH, based on pre-operative CT findings.

DISCUSSION

Subdural hematomas between 3 days and 3 weeks old are considered to be subacute.10 After 2–3 weeks, these subacute subdural hematomas are considered to be chronic.11 Subdural hematomas were found to be isodense on CT in 70% of the subacute group and were of low density in 70% of the chronic group.12 Kostanian et al.9 divided 84 CSDHs into three major groups according to pre-operative CT density values. They reported that 61 (71%) were low-density, nine (13%) were isodense, and 14 (16%) were mixed-density lesions, with the low-density type having the highest prevalence (71%). However, Lee et al.13 in Korea, reported that the isodense type had the highest prevalence rate (86.7%) in their study. In our study, 16 (12%) of the CSDHs were low-density lesions, 83 (65%) were isodense, and 29 (23%) were mixed-density lesions, with most of the patients having the isodense type. One possible explanation for these differences in CSDH density may be due to race differences. Another possible reason may be due to different definitions of isodense and low density for CT findings. In addition, the isodense type is difficult to diagnose, especially in the case of bilateral CSDHs.

The CSDHs in our 128 patients were found bilaterally in 30 (24%) patients, in the left side of the brain in 53 (41%) patients, and in the right side in 45 (35%) patients. Smely et al.25 reported that of 66 patients with CSDHs, 10 (15.3%) had bilateral CSDHs, 32 (48.4%) had left unilateral, and 24 (36.3%) patients had right unilateral CSDHs. In our study, among the seven patients who suffered from post-operative seizures, the CSDHs were in the left side of the brain in five (71.4%) patients, the right side in one (14.2%), and were bilateral in one (14.2%). These data suggest that early post-operative seizures occurred more frequently in patients with left unilateral CSDHs, based on pre-operative CT findings.

The attenuation of the CSDHs as seen on CT correlated with their macroscopic appearance. Low-density hematomas are typically golden yellow or bile colored on CT, isodense hematomas are cherry red or reddish brown, and mixed-density hematomas are reddish brown with soft fresh clots.14 The microscopic features of mixed-density CSDHs reveal many fresh erythrocytes, and higher fibrinogen composition,8 indicating recurrent hemorrhage.15,16 The concentration of tissue plasminogen activator (t-PA) is highest and the concentration of plasminogen activator inhibitor (PAI) is lowest in mixed-density CSDHs.17 This suggests that fibrinolytic activity is highest in mixed-density CSDHs. High-molecular weight fibrin degradation products (FDPs) inhibit coagulation, platelet aggregation, fibrin polymerization, and promote the activity of t-PA.17 The FDPs also have angiogenic activity and stimulate fibroblast proliferation, possibly contributing to CSDH membrane formation.18 The FDP level is highest in the mixed-density group. CSDHs are thought to form in the layer of dural border cells in the hematoma cavity that is surrounded by outer and inner membranes.19 There are few blood vessels in the inner membrane,20 whereas the outer membrane contains many fragile sinusoidal vessels that often are the source of repeated multifocal bleeding.19-21 The outer membrane has higher vascular congestion and vascular permeability.22,23

Kotwica and Brzezinski7 suggest that the capsule of the CSDH plays an important role in the incidence of seizure after surgical

Table 1 Pre-operative computed tomography (CT) findings in 128 total cases and seven post-operative seizure cases of chronic subdural hematoma

<table>
<thead>
<tr>
<th>Pre-operative CT</th>
<th>Low-density</th>
<th>Isodense</th>
<th>Mixed-density</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients</td>
<td>16</td>
<td>83</td>
<td>29</td>
<td>128</td>
</tr>
<tr>
<td>Post-operative</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

Fig. 1 Computerized tomography demonstrating examples of three types of chronic subdural hematomas: isodense (A), low-density (B), and mixed-density (C).
treatment of CSDH. How to explain the highest incidence of post-operative seizures occurred in the mixed-density group? The possible mechanism is that higher FDP concentration levels pass through the higher permeability of the CSDH outer membrane to influence the brain parenchyma to induce a seizure. The volumes of CSDHs on brain CT were largest among mixed-density CSDHs. W. Kwon et al.24 reported that mixed-density CSDHs had the lowest mean post-operative drainage volume of 151 ± 86 ml compared with 413 ± 269 ml for low-density and 348 ± 257 ml for isodense CSDHs. This indicates that mixed-density lesions occupied larger spaces and had larger mass effects on brain parenchyma. This may be another mechanism for mixed-density CSDHs having the highest incidence of post-operative seizures.

In our seven cases of post-operative seizure, five (71.4%) patients suffered from seizures within 3 days after surgery, while the longest time to seizure was 20 days post-surgically. After a post-operative seizure was noted, phenytoin was used for seizure control for 6 months. No further seizures were noted after 6 months of follow-up. Kotwica and Brzezinski7 reported that the seven patients who suffered from post-operative seizures among 122 patients with CSDHs had good early results with anticonvulsant therapy.

In our study, the incidence of post-operative seizure (5.4%) was similar to that of other reports.26–28 The real effectiveness of antiepileptic prophylaxis to reduce the occurrence of post-operative seizure is controversial. Sabo et al.29 reported that antiepileptic prophylaxis occurred in 1 of 42 (2.4%) patients who received antiepileptic prophylaxis and in 16 of 50 (32%) patients who did not receive antiepileptic prophylaxis (p < 0.001). Thus, they recommended the use of phenytoin prophylaxis for patients treated surgically for CSDH. Nonetheless, Rubin and Rappaport30 reported post-operative seizures in 4.8% (4/83) of the patients treated with antiepileptic prophylaxis, compared with only 3.4% (2/55) of those who did not receive medication. They, therefore, did not recommend antiepileptic prophylaxis. Prophylactic anticonvulsant therapy is generally recommended when the risk of seizure exceeds 10% to 15%.31,32 In our study, early post-operative seizures occurred in 13.7% (4/29) of mixed-density CSDHs, based on pre-operative CT. Thus, we suggest prophylaxis for post-operative seizures in patients with mixed-density CSDHs.

CONCLUSIONS

In this study and in a review the literature, the incidence of post-operative seizure after burr-hole drainage for CSDH was very low. Nonetheless, the post-operative seizure rate was relatively high among patients with mixed-density CSDHs, based on pre-operative CT. Although the real effectiveness of antiepileptic prophylaxis to reduce the occurrence of post-operative seizure is controversial, we propose the addition of at least short-term antiepileptic prophylaxis with phenytoin for patients with mixed-density CSDHs on pre-operative CT. It seemed that early post-operative seizures also had a high incidence among patients with left unilateral CSDHs based on pre-operative CT finding.

REFERENCES