Treatment of chronic subdural hematoma by twist-drill craniostomy with continuous catheter drainage

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The case records of 114 patients were reviewed to ascertain the efficacy of bedside twist-drill craniostomy and continuous closed-system catheter drainage for the treatment of chronic subdural hematomas. Ninety-eight (86%) patients achieved an excellent outcome, and seven (6%) had no significant improvement. The total mortality from all causes was 8% in this group. Successful catheter drainage of the chronic subdural hematoma was accomplished by either one or two catheter placements in 102 (90%) patients. Twelve patients required additional operative procedures. The mean duration of hospitalization for the study group was 16 days. No infections occurred in these patients. Remission of the clinical syndrome did not require the radiographic resolution of the chronic subdural hematoma.

KEY WORDS • chronic subdural hematoma • twist drill • craniostomy

TWIST-DRILL craniostomy, developed at the Montreal Neurologic Institute by Dr. William Cone and his associates, was first reported as a diagnostic procedure in 1966. Rand and co-authors described 1926 patients evaluated for head trauma at the University of Washington. Of the 39 patients discovered to have chronic subdural hematomas, 24 were successfully treated by twist-drill craniostomy and aspiration. In 1977, Tabaddor and Shulman proposed that slow continuous catheter drainage following twist-drill craniostomy offered substantial advantages in the treatment of chronic subdural hematomas compared to the previously reported methods of either craniotomy with membranectomy or evacuation through a burr hole. They suggested that the failure of treatment by craniotomy or burr-hole evacuation in some patients might be due to the inability of a chronically compressed brain to reexpand, and that slow continuous drainage offered substantial advantage by allowing the brain to reexpand sufficiently to obliterate the subdural space.

This paper reports the neurological and radiological outcome of 114 unselected patients treated by this method.

Clinical Material and Methods

The hospital and outpatient records of 114 adult patients whose diagnosis at the time of discharge was chronic subdural hematoma and who were treated by twist-drill craniostomy with continuous catheter drainage were reviewed. Patients found to have subdural collections of xanthochromic cerebrospinal fluid only (representing a subdural hygroma) were excluded from this review. All patients were treated from December, 1976, through March, 1985, by members of the Neurosurgical Department of the Washington University School of Medicine. The selection of the method of treatment was made solely by the attending surgeon.

The treatment protocol closely followed the method described by Tabaddor and Shulman. All procedures were performed at the bedside in the neurosurgical intensive care unit in the following manner. After scalp preparation with alcohol and a povidone-iodine solution, a 0.5-cm scalp incision is made. The twist-drill hole is placed obliquely to the surface of the skull. Usually the tip of the drill bit will lacerate the dura mater and the outer subdural membrane, resulting in the free flow of contents from the subdural cavity. When this does not occur, an opening in the dura mater and the outer subdural membrane is made with a No. 18 spinal needle. This facilitates easy passage of a standard 15-cm ventricular catheter into the subdural space. The drainage system is then closed by attaching the catheter to a ventricular drainage bag and permitting the contents of the subdural cavity to drain with the drip chamber interrupting the fluid column 20 cm below...
All patients

Patients who died

Fig. 1. Age distribution of the 114 patients in the study group.

FIG. 2. Clinical grade of the 114 patients in the study group.

Outcome related to clinical grade in 114 patients

<table>
<thead>
<tr>
<th>Clinical Grade*</th>
<th>Excellent</th>
<th>Poor</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>1</td>
<td>32</td>
<td>97</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>45</td>
<td>94</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>70</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>33</td>
<td>0</td>
</tr>
</tbody>
</table>

* Clinical grading according to the classification of Markwalder, et al.:

1. Grade 1: patient alert and oriented; mild symptoms, such as headache; absent or mild neurological deficit, such as reflex asymmetry
2. Grade 2: patient drowsy or disoriented with variable neurological deficit, such as hemiparesis
3. Grade 3: patient stuporous but responding appropriately to noxious stimuli; severe focal signs, such as hemiplegia
4. Grade 4: patient comatose with absent motor responses to painful stimuli; decerebrate or decorticate posturing.

The neurological grading of all 114 patients in the study group is shown in Fig. 2.

Results

Assessment of outcome was based upon the satisfactory resolution of the patient's neurological syndrome as judged by the attending surgeon. For comparison, the outcome in each case was assessed as either excellent or poor.

An excellent outcome included complete resolution of all neurological symptoms not attributable to a known preexisting neurological condition or a nearly complete resolution with minimal persistent neurological findings that did not impair premorbid functional capacity. A poor outcome signified minimal or no improvement in the neurological syndrome, resulting in significant intellectual and functional impairment. The results were based on the neurological examination performed on the day of discharge from the hospital or during a subsequent outpatient visit.

Twist-drill craniostomy and catheter drainage resulted in an excellent outcome in 98 patients (86%). Seven patients (6%) realized no significant improvement and were thus assigned to the "poor" outcome category. Table 1 presents the outcome of therapy in relation to the clinical grade at the time of admission. Both the deterioration of the level of consciousness and significant focal motor signs were associated with an increased incidence of a poor outcome or mortality.

The total number of deaths in the study group was nine (8%). The majority of the patients who died were in clinical Grades 3 or 4 (Fig. 2). Table 2 lists the age, neurological condition at the time of admission, clinical grade, and cause of death of each patient who died. The mean age of these patients was 71 years, which did not significantly differ from the study group as a whole.
Twist drill drainage of chronic subdural hematoma

### TABLE 2

Clinical characteristics of nine patients who died

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs)</th>
<th>Neurological Condition on Admission</th>
<th>Clinical Grade*</th>
<th>Cause of Death</th>
<th>Autopsy Confirmation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>82</td>
<td>coma; no evidence of brain-stem function</td>
<td>4</td>
<td>herniation</td>
<td>no</td>
</tr>
<tr>
<td>2</td>
<td>96</td>
<td>dense hemiparesis; aphasia</td>
<td>3</td>
<td>herniation†</td>
<td>no</td>
</tr>
<tr>
<td>3</td>
<td>89</td>
<td>dense hemiparesis; aphasia</td>
<td>3</td>
<td>renal failure</td>
<td>no</td>
</tr>
<tr>
<td>4</td>
<td>74</td>
<td>gait impairment</td>
<td>2</td>
<td>aspiration pneumonia; lung abscess</td>
<td>no</td>
</tr>
<tr>
<td>5</td>
<td>55</td>
<td>headache; normal neurological examina-</td>
<td>1</td>
<td>metastatic breast carcinoma to liver, lungs, &amp; bone</td>
<td>no</td>
</tr>
<tr>
<td>6</td>
<td>66</td>
<td>coma; hemiplegia</td>
<td>4</td>
<td>cardiac arrest</td>
<td>yes‡</td>
</tr>
<tr>
<td>7</td>
<td>67</td>
<td>coma</td>
<td>4</td>
<td>cardiac arrest</td>
<td>no</td>
</tr>
<tr>
<td>8</td>
<td>94</td>
<td>coma; hemiplegia</td>
<td>4</td>
<td>gastrointestinal hemorrhage 5 wks after successful drainage</td>
<td>no</td>
</tr>
<tr>
<td>9</td>
<td>84</td>
<td>hemiparesis; aphasia</td>
<td>3</td>
<td>cardiac arrest</td>
<td>no</td>
</tr>
</tbody>
</table>

* Clinical grading according to the classification of Markwalder, et al.2 see text.
† Following initial catheter placement, the patient's family refused further treatment.
‡ Complete resolution of the subdural hematoma was confirmed.

Successful catheter drainage of the chronic subdural hematoma was accomplished by either one or two catheter placements in 102 (90%) patients (Fig. 3). The catheters were allowed to drain from 1 to 7 days, with a mean duration of 2.1 days. Bilateral hematomas were drained simultaneously. There were no infections in the study group. The only complication attributable to catheter placement occurred when a catheter tip broke and a craniotomy was required to remove it from the epidural space.

Failure to adequately drain the chronic subdural hematoma by the catheter method resulted in additional operative procedures in 12 cases (10.5%). Seven patients required craniotomy and membranectomy. Three patients were successfully treated by trephination, drainage, and irrigation. Two additional patients requiring craniotomy harbored solid hematomas that were not amenable to catheter drainage. Patients who required secondary operative procedures achieved a clinical outcome comparable to that of the study group. Ten (83.3%) of the 12 patients enjoyed complete or nearly complete resolution of their neurological syndrome. The mean duration of their hospital stay was 21 days, compared to 16 days for the entire study group. This difference was not statistically significant.

**Discussion**

The results of treatment of chronic subdural hematomas in our study support the hypothesis of Tabaddor and Shulman3 that slow continuous drainage of the hematoma allowing for brain expansion represents the optimal surgical therapy. Furthermore, this study confirms the suggestion of Markwalder and his colleagues2,12 that twist-drill craniostomy with the closed-system catheter drainage method should be considered as the initial procedure of choice.

Consideration of appropriate alternative treatment modalities must include the neurological improvement attributable to treatment, the incidence of recurrence, and the complications associated with the proposed treatment. Also, cost considerations and length of hospital stay are becoming increasingly important in the current medical economic climate. Although the problem of comparing groups of patients treated at different institutions and at different times is acknowledged, it is useful to compare directly the results achieved in this study group with those achieved by either burr-hole craniostomy with a continuous closed-system drainage method or twist-drill craniostomy with aspiration.

Several papers have reported the results obtained by burr-hole craniostomy with continuous catheter drainage.2,4,6 Each of these reports demonstrated adequate radiographic resolution of the chronic subdural hematomas in most cases, with comparable morbidity and mortality results. Two of these studies2,4 provided data regarding the resolution of neurological signs and symptoms, and their results were similar to ours. Although the twist-drill craniostomy with slow continuous catheter drainage and the burr-hole craniostomy with closed continuous catheter drainage appear to achieve similar
results, the twist-drill method is probably preferable based upon its simplicity and the ability to perform it at the bedside.

Serial twist-drill craniostomy without closed continuous catheter drainage has been studied by Burchiel and Taylor as an alternative therapy (personal communication, 1985). In their study, of 131 patients treated exclusively by twist-drill craniostomy with aspiration only, 96 (73%) achieved significant neurological improvement. Thirty-nine (29%) patients required an additional operative procedure, and only 16 (39%) of these patients were significantly improved. The average duration of hospitalization was 23 days, which differed significantly from our study group \((p < 0.01)\). Therefore, serial twist-drill craniostomy with aspiration only does not appear to offer any therapeutic advantages compared to craniostomy with slow continuous catheter drainage.

A significant finding in our study is that the remission of the clinical syndrome either preceded or did not appear to require radiographic resolution of the chronic subdural hematoma. At the time of discharge from the hospital, CT scans of 45 patients showed incomplete resolution of the chronic subdural hematoma. Forty-one (91%) of these patients demonstrated complete or nearly complete resolution of their neurological syndrome, despite the radiographic evidence of incomplete resolution of the hematoma. Follow-up outpatient CT scans in five of these patients who were neurologically normal at the time of discharge from the hospital demonstrated a reduced but significant extracerebral collection with accompanying mass effect. In spite of the radiographic finding of mass effect, none of these five patients required further treatment. Only one patient in the entire series required secondary hospitalization for an additional twist-drill craniostomy and catheter placement because of recurrent neurological symptoms. This finding suggests that persistence of neurological symptoms or signs should be used as a guide for additional surgery. The radiographic finding of a persistent subdural fluid collection in patients whose neurological syndrome has resolved does not appear to warrant additional surgical intervention. Subsequent CT examination may be used to assure both the patient and surgeon of the continued resolution of the hematoma. In nine patients of this group, CT scans were obtained as part of their outpatient care. In all cases, CT demonstrated complete resolution of the hematoma by 2 to 3 months following discharge from the hospital (Fig. 4).

While the initiating event in most cases of chronic subdural hematoma is thought to be traumatic, the nature of the process that encourages enlargement remains uncertain. Our finding that complete drainage of the hematoma appears to be unnecessary suggests that osmotic and oncotic pressure gradients do not account for the progressive enlargement of chronic subdural hematomas. Another hypothesis suggests that multiple small hemorrhages arising from the outer neovascular membrane are responsible for the progressive enlargement. Undoubtedly, both major and minor hemorrhages will occur into a well-encapsulated chronic subdural hematoma. It is possible that the outer subdural membrane becomes progressively less hypervascular with time, reducing the number and degree of hemorrhages inside the hematoma capsule. This may partially explain why incompletely drained chronic subdural hematomas appear to progressively resorb without further clinical or radiographic evidence of rebleeding.
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References


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