Role of surgery in hypertensive intracerebral hematoma

A comparative study of 305 nonsurgical and 154 surgical cases

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The indications for surgery in hypertensive intracerebral hematoma are still controversial. The reason for this may be: 1) lack of adequate and comparable data in conservative and surgical therapy from the same institution; 2) lack of adequate close follow-up monitoring over an extended period of time; or 3) lack of proper classification of hematomas for comparison of results from different institutions. The authors have treated 459 cases of hypertensive intracerebral hematoma between October, 1975, and July, 1983. The hematomas have been classified according to their mode of extension on computerized tomography. The long-term outcome was assessed on the basis of activity of daily living.

Putaminal hematomas were classified as mild, moderate, severe, and very severe. In general, there was no significant difference in outcome between the surgical and nonsurgical cases; however, the outcome in the moderate and severe hematomas was found to be a little better for the surgical cases in some restricted areas. Thalamic and pontine hemorrhages were classified as mild, moderate, or severe. If the hematoma is localized to the thalamus or pons, if it extends to the midbrain, there is no indication for surgery; however, in patients with moderate hematomas, the prognosis showed a variable outcome, and the indications for surgery were questionable. In cerebellar hematomas, the authors propose that even a hematoma with a diameter greater than 3 cm might show a good outcome with nonsurgical therapy.

KEY WORDS • intracranial hematoma • hypertensive hematoma • putamen • thalamus • pons • cerebellar hematoma

Hypertensive intracerebral hematoma (ICH) is a serious and potentially lethal condition. The introduction of computerized tomography (CT) has made early diagnosis simple and easy, which has led to changing concepts in the management of ICH's. The enthusiastic surgical removal of all types of ICH has resulted in a disappointing overall prognosis. Various factors contributing to a better prognosis are being studied with the help of the ever-increasing array of diagnostic aids and methods.

One of the most important factors influencing the prognosis is proper patient selection. Despite many retrospective and prospective studies, indications for surgical treatment are still controversial. The reasons for this may be: 1) lack of adequate and comparable data on nonsurgical and surgical cases from the same institution; 2) lack of adequate close follow-up monitoring over an extended period of time; or 3) lack of proper classification of hematomas, based on practical and theoretical background, for comparison of results from different institutions.

In this paper we analyze our results in 459 cases of ICH treated surgically and nonsurgically. We have classified the hematomas according to their mode of extension as indicated by the CT findings. Long-term follow-up monitoring has been made possible by the cooperation of a patient support group which was established in 1979 by our patients along with the neurosurgeons at our institute.

Clinical Material and Methods

Clinical Material

This series includes 459 cases of ICH treated in our institution between October, 1975, and July, 1983. There were 265 cases of putaminal hemorrhage, 135
Fig. 1. Computerized tomography scans and brain section showing the mild type of putaminal hemorrhage (80 cases). The hematoma (darkened area) is mainly localized to the external capsule, and extends downward within the external capsule (arrows).

cases of thalamic hemorrhage, 33 cases of pontine hemorrhage, and 26 cases of cerebellar hemorrhage of hypertensive origin. Of these cases, 58.5% were admitted to our hospital within 6 hours of onset of the attack.

The outcome was evaluated on the basis of activity of daily living (ADL), as follows: ADL I = complete return to useful social life; ADL II = partial return to

Fig. 2. Computerized tomography scans and brain section showing the moderate type of putaminal hemorrhage (78 cases). The hematoma (darkened area) is mainly localized to the external capsule, with some encroachment on the internal capsule. Characteristically, it extends to the corona radiata (arrows).
useful social life; ADL III = return to social life not possible; ADL IV = bedridden; and ADL V = vegetative or dead. The hematomas were classified on the basis of the CT findings.

**Putaminal Hemorrhage.** The 265 cases of putaminal hemorrhage were classified as mild, moderate, severe, or very severe. Eighty patients had the mild type of hemorrhage. In this type, the hematoma was mainly localized to the external capsule and extended downward within the external capsule (Fig. 1). The moderate type was found in 78 patients, with the hematoma localized mainly to the external capsule, and with some encroachment on the internal capsule; characteristically this hematoma extended to the corona radiata (Fig. 2). In the 55 patients with the severe type, the hematoma extended medially and downward to the internal capsule (Fig. 3 upper right). This type breaks down into two subtypes (Fig. 3 lower): Subtype I, in which the hematoma extended downward in the internal capsule, but stopped short of the midbrain, and Subtype II, in which the hematoma extended to the midbrain, producing a pressure effect on the midbrain. Fifty-two patients exhibited the very severe type. In these patients, the hematoma extended well into the midbrain, destroying its elements (Fig. 4).

**Fig. 3. Upper:** Computerized tomography scans and brain section showing the severe type of putaminal hemorrhage (55 cases). The hematoma (darkened area) extends downward to the internal capsule (arrow), but does not reach the midbrain. **Lower:** Two subtypes were identified in this severe type. In 45 cases there was no extension to the midbrain (left). In the other 10 cases, the hematoma extended almost to the midbrain within 6 hours after the attack. These 10 cases were considered as a fulminant type.

**Fig. 4.** Computerized tomography scans and brain section showing the very severe type of putaminal hemorrhage (52 cases). The hematoma (darkened area) extends into the internal capsule (arrows), destroying the midbrain.
FIG. 5. Computerized tomography scans, brain section, and angiogram showing the mild type of thalamic hemorrhage (54 cases). The hematoma (darkened areas) extends obliquely upward in the thalamus.

FIG. 6. Computerized tomography scans and brain section in the moderate type of thalamic hemorrhage (44 cases). The hematoma (darkened area) extends laterally to the internal capsule (arrow).

FIG. 7. Computerized tomography scans and brain section showing the severe type of thalamic hemorrhage (37 cases). The hematoma (darkened area) extends to the internal capsule and downward (arrow), destroying the midbrain.
Treatment of hypertensive intracerebral hematoma

Thalamic Hemorrhage. The 135 cases of thalamic hemorrhage were classified as mild, moderate, or severe, according to the mode of hematoma extension. Fifty-four patients exhibited the mild type, in which the hematoma extended obliquely upward within the thalamus (Fig. 5). This pattern of extension results from the thalamic vascular distribution: the hematoma extends along the watershed area. In the 44 patients with the moderate type, the hematoma extended beyond the confines of the thalamus into the internal capsule (Fig. 6). The severe type was seen in 37 patients. In this type, the hematoma extended into the internal capsule and downward into the midbrain, destroying it (Fig. 7).

Pontine Hemorrhage. The 33 cases of pontine hemorrhage were classified as mild, moderate, or severe, according to the mode of hematoma extension. In the 11 patients with the mild type, the hematoma was localized to the pons (Fig. 8). Eleven patients had the moderate type of pontine hematoma, with unilateral upward extension to the midbrain (Fig. 9). In the 11 patients with the severe type, there was bilateral upward extension to the midbrain (Fig. 10). It is interesting to note that the hematoma does not extend downward into the medulla oblongata, even when it is large. This may be because of the morphological narrowing between the pons and medulla.

Cerebellar Hemorrhage. In the survey of 26 cases of cerebellar hemorrhage, it was found that the hematoma usually began in the area of the dentate nucleus and extended into the cerebellar hemisphere. Since there were no particular characteristics of mode of extension, we classified these cases into mild and severe, depending on the size of the hematoma. The mild type was less than 3 cm in diameter and the severe type 3 cm or more (Fig. 11). In the severe type, the hematoma extended to the pons.

Outcome

The ADL in surgical and nonsurgical groups was evaluated in each type of hematoma. Surgical treatment

FIG. 8. Computerized tomography scans and brain section showing the mild type of pontine hemorrhage (11 cases). The hematoma is localized in the pons.

FIG. 9. Computerized tomography scans and drawing of a brain section showing the moderate type of pontine hemorrhage (11 cases). The hematoma (darkened area) extends unilaterally upward to the midbrain (arrow).
FIG. 10. Computerized tomography scans and drawing of a brain section showing the severe type of pontine hemorrhage (11 cases). The hematoma (darkened area) extends bilaterally upward to the midbrain (arrows).

consisted of direct removal of the hematoma under general anesthesia. Nonsurgical treatment involved intensive care of patients in the stroke unit of our rescue center for at least 3 days after the attack. Patients who received ventricular drainage or ventriculoperitoneal shunting were included in this group. In putaminal and cerebellar hemorrhages, the outcome in relation to the timing of the surgery was also evaluated.

Putaminal Hemorrhage. Among putaminal hemorrhage patients, 75% of those with the mild type recovered to ADL I, which is an excellent figure. In the operated group, 44.4% recovered to ADL I, 40% to ADL II, 7.4% to ADL III, 3.7% to ADL IV, and 3.7% to ADL V. Of the patients who underwent surgery within 6 hours of the hemorrhage, 22 (45%) recovered to ADL I and 40% to ADL II. No improvement in outcome was demonstrated in this early-operated group. In the nonsurgical group, 56.6% recovered to ADL I, 26.4% to ADL II, 7.5% to ADL III, 1.9% to ADL IV, and 7.5% to ADL V. There is no significant difference between the surgical and nonsurgical groups.

Therefore, we do not think that there is any indication for surgery in this mild type of putaminal hemorrhage (Fig. 12).

In the moderate type, 37% of patients recovered to ADL II, which is a fairly good outcome. In the surgically treated group, 8.3% recovered to ADL I, 28.3% to ADL II, 30% to ADL III, and 16.7% each to ADL IV and V. In the nonsurgical group, 5% recovered to ADL I, 45% to ADL II, 25% to ADL III, 15% to ADL IV, and 10% to ADL V. This shows a slightly better result in the surgical group. The outcome in the surgical group with regard to time of operation reveals that the patients who were operated on within 6 hours after the onset did better (26.3% showed ADL I, Table 1). Therefore, we think that surgery is indicated when it can be performed within 6 hours of the attack (Fig. 13).

Of patients with severe putaminal hemorrhage, 43% recovered to ADL II, 33% to ADL III, and 13% to ADL V. Nonsurgical treatment showed a better outcome than the surgical group in general (Fig. 14 left). The outcome in patients who underwent surgery within 6
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hours revealed that 18% recovered to ADL II. On the other hand, of the patients who were operated on more than 7 hours after the attack, 13% recovered to ADL I and 13% to ADL II. There was no advantage in early operation. This severe category was separated into two subtypes: in the first subtype the hematoma did not extend to the midbrain, and in the other the hematoma extended to the midbrain but did not destroy it. All 10 hematomas in this second subtype reached the midbrain within 6 hours after the attack. We designated this second subtype as "fulminant," and the prognosis was very poor (Fig. 14 right). The first subtype showed a better prognosis with surgical treatment. We now think that surgery is indicated for all hematomas of the severe type, excluding the fulminant cases.

The prognosis in the very severe type of putaminal hemorrhage is bad: 90% of cases were categorized ADL

TABLE 1

Correlation between the timing for surgery and ADL I*

<table>
<thead>
<tr>
<th>Time</th>
<th>Cases with Surgery</th>
<th>ADL I</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 6 hours</td>
<td>19 (44.2%)</td>
<td>5 (26.3%)</td>
</tr>
<tr>
<td>7-12 hours</td>
<td>3 (7.0%)</td>
<td>0</td>
</tr>
<tr>
<td>13-24 hours</td>
<td>9 (21.0%)</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 24 hours</td>
<td>12 (27.8%)</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>43</td>
<td>5</td>
</tr>
</tbody>
</table>

* ADL = activity of daily living; see text.

V, including 86.2% of the surgically treated and 95.7% of nonsurgically treated patients. The outcome of patients operated on within 6 hours of hemorrhage was also poor: 79% in ADL V, 10% in ADL IV, and 10% in ADL III. There is no difference between the outcome

Fig. 12. Outcome in cases with mild putaminal hemorrhage shows no difference between surgical and nonsurgical treatment. Thus, there is no indication for surgery. ADL = activity of daily living; see text.

Fig. 13. Outcome in cases with moderate putaminal hemorrhage shows no difference between surgical and nonsurgical treatment. However, in the patients who were operated on within 6 hours after the attack, there was a high incidence of excellent outcome (see Table 1). ADL = activity of daily living; see text.

Fig. 14. Left: Outcome in patients with severe putaminal hemorrhage treated surgically and nonsurgically. Better results were obtained in the nonsurgical group. Right: The outcome in the fulminant subtype was poorer after surgical therapy, and surgery is therefore considered to be contraindicated. Excluding the fulminant type, the outcome was slightly better in the surgical group. ADL = activity of daily living; see text.
of surgical and nonsurgical groups, and there is no advantage in early operation. Therefore, there is no indication for surgery in this very severe type (Fig. 15).

**Thalamic Hemorrhage.** In only three of 135 cases was direct surgical removal of the thalamic hematoma performed. Therefore, a comparison of the outcome of surgical and nonsurgical treatment is impossible in this report. Generally, 55.6% of nonsurgical patients with the mild type recovered to ADL I, and 89.2% with the severe type were in ADL V (Table 2). Recovery in the moderate category was distributed equally. There is a clear tendency toward a worse prognosis when the hematoma is of the severe type.

**Pontine Hemorrhage.** Pontine hemorrhage was also treated nonsurgically. Outcome showed that 45.5% of patients with the mild type recovered to ADL I, 54.5% of those with moderate type were in ADL IV, and 81.8% of those with the severe type were in ADL V (Table 3). Therefore, patients with the mild and moderate types should receive intensive nonsurgical therapy.

**Cerebellar Hemorrhage.** The mild type of cerebellar hemorrhage is associated with a fairly good outcome with nonsurgical treatment. Therefore, there is no indication for surgery in this type of hemorrhage. The outcome in the severe type varied widely (Fig. 16). The outcome of surgical and nonsurgical treatment in this severe type shows no significant difference in the percentage of patients recovering to ADL I and II (Table 4). Also, early operation within 6 hours resulted in only 20% of patients in ADL I. Thus, there appears to be no advantage to early operation. The indication for surgery is still debatable in this type.

**Discussion**

The choice of treatment in hypertensive intracerebral hematoma (ICH) has always been controversial. The addition of CT to the diagnostic armamentarium has helped in the diagnosis of ICH at an earlier stage. This has led neurosurgeons to adopt a more aggressive attitude in the treatment of ICH. However, this enthusiasm has not always been rewarded. Many techniques and procedures are now available to evaluate these patients for proper treatment, but the controversy persists. A retrospective analysis of one's own results with proper classification can serve as a good guide. In this study, we have classified the hematomas on the basis of the CT findings and analyzed the results according to the long-term recovery.

**TABLE 2**

*Outcome in 135 cases of thalamic hemorrhage*

<table>
<thead>
<tr>
<th>Type*</th>
<th>No. of Cases</th>
<th>Activity of Daily Living (ADL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>mild</td>
<td>54</td>
<td>55.6%</td>
</tr>
<tr>
<td>moderate</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>severe</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

*Mild: localized mainly to the thalamus; moderate: hematoma extends to the internal capsule; severe: destruction of midbrain.

**TABLE 3**

*Outcome in 33 cases of pontine hemorrhage*

<table>
<thead>
<tr>
<th>Type*</th>
<th>No. of Cases</th>
<th>Activity of Daily Living (ADL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>mild</td>
<td>11</td>
<td>45.5%</td>
</tr>
<tr>
<td>moderate</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>severe</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

*Mild: localized to the pons; moderate: unilateral extension to the midbrain; severe: bilateral extension to the midbrain.
TABLE 4
Outcome in 26 cases of cerebellar hemorrhage

<table>
<thead>
<tr>
<th>Type*</th>
<th>No. of Cases</th>
<th>Activity of Daily Living (ADL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>mild</td>
<td>9</td>
<td>55.5%</td>
</tr>
<tr>
<td>severe</td>
<td>17</td>
<td>17.6%</td>
</tr>
</tbody>
</table>

* Mild: hemorrhage less than 3 cm in diameter; severe: hemorrhage 3 cm or greater in diameter.

In putaminal hematoma, in general, there is no significant difference between surgical and nonsurgical treatment, as expected. Since there is no difference in the good recovery from the mild type by surgical or nonsurgical therapy, we believe that surgery is not indicated. In the moderate and severe types, the recovery varies widely both in surgical and nonsurgical therapy. Surgical patients have achieved a slightly better outcome. We found that prognosis was better when the operation was done within 6 hours of onset of the moderate type of hemorrhage. In general, nonsurgical treatment results in a better outcome in the severe type. In the subgroup in which the hematoma does not extend to the midbrain, a better outcome is achieved with surgical treatment. In the very severe type in which the hematoma extends to the midbrain and destroys it, the outcome is uniformly worse, both in the surgical and nonsurgical groups. Here again, surgical therapy does not seem to be indicated.

We have treated almost all of our cases of thalamic hemorrhage without direct hematoma removal, although we have placed ventricular drainage or a ventriculoperitoneal shunt in some cases. The outcome was proportional to the severity of the type of hematoma. In the moderate type in which the hematoma extends outward and destroys the internal capsule, the outcome was distributed over ADL II, III, IV, and V. Although surgery is not clearly indicated in the mild and severe types, surgical treatment could be seriously considered for moderate hematomas.

The outcome in the mild and moderate types of pontine hematomas is encouraging. Nonsurgical therapy could be intensified to achieve better results. The outcome in the severe type is so poor that we think even nonsurgical intensive therapy is of no avail.

Our experience with cerebellar hematomas is variable. We found a good outcome with nonsurgical therapy in the mild type. Even in the severe type where the size of the hematoma was 3 cm or more, the outcome from nonsurgical therapy was not so bad. This needs more elucidation and evaluation.

Our experience in these 459 cases has left us with a rather pessimistic attitude toward the surgical treatment of hypertensive ICH's. One has to be highly selective to achieve good results with surgical therapy.

References

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