The Prognostic Value of the CT Scan in Conservatively Treated Patients With Intracerebral Hematoma

ISRAEL STEINER, M.D.,* JOHN M. GOMORI, M.D.,† AND ELDAD MELAMED, M.D.*

SUMMARY Prognostic factors for survival and neurological recovery were assessed in 42 patients with nontraumatic intracerebral hematoma (ICH) diagnosed by CT scan. None underwent surgical evacuation of hematoma. CT scans were used to determine location and volume of ICH and presence or absence of intraventricular hemorrhage (IVH). Only 11 patients (26%) died and 17 patients (40.5%) recovered fully. Mortality was associated with: 1) loss of consciousness as a presenting symptom (63.5% mortality rate versus 13% when there was no loss of consciousness at the onset; \( p < 0.01 \)), 2) extension of the bleeding into the ventricular system (45% mortality rate versus 9% when hemorrhages were confined to brain parenchyma; \( p < 0.01 \)), and 3) location of hematoma in the posterior fossa (mortality rate of 43% versus 23% for intrahemispheric hematomas). Mortality was unaffected by age of patients and size of ICH. Full neurological and functional recovery occurred mainly when estimated volume of hematomas was less than 15 cc and with lobar hematomas regardless of size. In survivors there is CT evidence of complete resolution of ICH. Our data indicates a favourable outcome in a relatively large percentage of patients with ICH treated conservatively and therefore questions the need for surgical evacuation of hematoma.

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NE THE CT SCAN ERA, intracerebral hematoma (ICH) is readily^1 and more frequently diagnosed.2-3 CT scan offers an accurate in vivo diagnosis of hematoma,4 5 defines its exact localization and enables follow-up of its natural history. In addition, use of CT scan in the evaluation of ICH broadens its clinical spectrum since previous cases with relatively benign symptomsatology and outcome were probably misdiagnosed as suffering from cerebral ischemia-infarction. This new knowledge changed previous notions about the grave prognosis of ICH. In recent years, efforts were directed mainly towards establishing specific clinical entities associated with site of ICH, i.e. lobar,5-7 thalamic,8-9 putaminal,10 pontine11,12 and cerebellar.13 The indications for surgical intervention and evacuation of ICH are still undetermined. More data is therefore required concerning the natural history of ICH and factors predicting its outcome. In order to assess the prognosis of ICH, to identify those factors predicting outcome and to further define surgical indications, we reviewed our experience with this disorder in 42 conservatively treated patients.

Materials and Methods

The study included 42 consecutive patients with ICH admitted in the period between January 1981 and October 1982. Diagnosis was confirmed in each case by CT scan. Patients with evidence of head trauma or intracerebral tumor were excluded. Charts of patients were reviewed for age, sex, past history, presenting symptoms and signs, treatment, and outcome. In all patients except for three (who were transferred from another hospital where no CT scan was available) the first CT scan was performed within 12 hours of admission. Using Polaroid or multiframed camera images from either an EMI 1010 or Elscint 710 computer tomography units, hematomas were reviewed and evaluated for location, size and intraventricular extension. Hematomas were visually categorized according to form into three groups: spherical, ellipsoid and rectangularly piped. Measurements of ICH volumes corrected to scale were made. The volumes were then approximately estimated by the following formulae: \( 4/3 \pi r^3 \) for the sphere, \( 4/3 \pi ABC \) for the ellipsoid and DEF for the rectangularly piped where A, B, C are the varius radii and D, E, F, the lengths. Such estimations were only useful for intrahemispheric hematomas and they did not apply for posterior fossa hematomas.

In recent years the policy of the Department of Neurology was to treat patients with ICH conservatively and avoid surgical evacuation of hematoma or ventricular drainage in cases of intraventricular hemorrhage (IVH). In addition to the general supportive medical care, all patients were treated with parenteral dexamethasone (16–32 mg/day) for 4–7 days. None underwent surgical evacuation. Patients were divided into three groups according to outcome: Those who died during hospitalization, those who survived but were left with severe incapacitating neurological deficit and those who completely recovered or were left with a minor neurological impairment and could fully return previous way of life. In 20 out of 31 survivors, follow-up CT scans (2–5 in each patient) were performed within 3- to 308 days after the acute event (mostly during the first months). Data was statistically analysed by the \( X^2 \) method.

Results

Age of the patients ranged from 14 to 86 years with the majority clustering from 50–79 years. No correlation was found between age and outcome. All six patients with ICH who were older than 79 years survived.
The worst prognosis was carried by posterior fossa and large deep intrahemispheric hematomas (those involving the thalamus and basal ganglia). All cases with posterior fossa hematomas had intraventricular extension. All patients with deep-seated hemispheric hematomas who died, had hematomas larger than 100 cc and evidence of IVH. Only 3 out of 23 patients with "lobar" hematomas (those which occur in the subcortical white matter of cerebral lobes) (7) died. None of this group had evidence of intraventricular hemorrhage. Hemorrhages in the dominant and the non-dominant hemispheres were associated with a similar prognosis. IVH carried poor prognosis. In 35 patients with intrahemispheric hematomas (lobar and deep-seated), mortality rate was relatively low when there was no accompanying IVH, i.e. 2 out of 22 (9%) and was much higher in the presence of IVH, i.e. 6 out of 13 (46%); (p < 0.01).

Posterior fossa ICH was always associated with IVH and carried a mortality rate of 43%. Two out of four patients with brain stem hematoma and one out of three patients with cerebellar hematoma died. The overall mortality rate of ICH with extension of the bleeding into the ventricular system was 45% (9/20); (p < 0.01). The overall full recovery in our series was high, reaching 40.5%. Best prognosis was associated with: 1) lobar hematomas (mainly frontal and occipital), 2) small hematomas (mainly those with estimated volume of less than 15 cc). Repeated CT scans in 20 out of 31 survivors showed disappearance of high density from site of hematoma within two months (and sometimes as early as after 4 weeks) regardless of size and location of hematoma. This could indicate either a complete resolution of ICH or that hematoma became iso-dense. However, the first possibility seems more plausible since mass effect of ICH also disappeared in most of the cases. Atrophic lesions replacing the hematomas were found in 12 patients. In 8 patients, repeated CT scans were normal.

**Discussion**

In our study, the overall mortality associated with ICH was 26% which is somewhat lower than rates reported in other series, e.g. 32%,7 40%,2-3 50%.

This rather low percentage may be attributed, at least in part, to the inclusion of the previously unrecognized cases with benign ICH and to the improvement of intensive care during the acute phase of the disease. However, our series, based on CT scan diagnosis, does not include fatal cases who die before they reach the hospital.

In the present investigation we evaluated the contribution of various factors to the outcome of ICH. For

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**Table 1** Correlation between Presenting Signs and Symptoms and Outcome in ICH

<table>
<thead>
<tr>
<th>Presenting symptoms and signs</th>
<th>No. of patients</th>
<th>Died</th>
<th>Fully recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>focal neurological deficit*</td>
<td>20</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>drowsiness</td>
<td>13</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>loss of consciousness</td>
<td>11</td>
<td>7</td>
<td>—</td>
</tr>
<tr>
<td>confusion</td>
<td>8</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>vomiting</td>
<td>7</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>headache</td>
<td>7</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>generalized seizures</td>
<td>4</td>
<td>—</td>
<td>2</td>
</tr>
</tbody>
</table>

*Including: hemiplegia, aphasia, hemianopsia, hemibalismus.

There were 25 males and 17 females. Sex had no influence on mortality or recovery rates. Possible causative factors for the ICH included: arterial hypertension (19 patients), arteriovenous malformation (2), coagulation abnormalities (2) and emboli (1). It should be mentioned that angiography was performed in seven patients only. Other associated disorders included: diabetes mellitus (5 patients), ischemic heart disease (8), obesity (3) and bronchial asthma (1). In 13 patients, previous history was non-revealing and no specific etiology for the ICH was discovered. Predisposing and causative factors had no significant effect on the outcome. The initial clinical presentation was varied (table 1). Sudden loss of consciousness as the presenting symptom was associated with a grave prognosis. Seven out of eleven such patients died, (as compared to 4 deaths among 31 patients without loss of consciousness at the onset; p < 0.01). All had CT scan evidence of extension of the bleeding into the ventricles. In the four survivors, hemorrhage was confined to the parenchyma and did not involve the ventricular system, but they had poor recoveries.

Eleven patients (26%) died. In the majority of cases (7), death occurred within three days after onset of the disease. Relations of outcome to localization and estimated volume of the ICH is detailed in tables 2 and 3. The worst prognosis was carried by posterior fossa and large deep intrahemispheric hematomas (those involving the thalamus and basal ganglia). All cases with posterior fossa hematomas had intraventricular extension. All patients with deep-seated hemispheric hematomas who died, had hematomas larger than 100 cc and evidence of IVH. Only 3 out of 23 patients with "lobar" hematomas (those which occur in the subcortical white matter of cerebral lobes) (7) died. None of this group had evidence of intraventricular hemorrhage. Hemorrhages in the dominant and the non-dominant hemispheres were associated with a similar prognosis. IVH carried poor prognosis. In 35 patients with intrahemispheric hematomas (lobar and deep-seated), mortality rate was relatively low when there was no accompanying IVH, i.e. 2 out of 22 (9%) and was much higher in the presence of IVH, i.e. 6 out of 13 (46%); (p < 0.01).

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**Table 2** Correlation between Localization of ICH to Outcome

<table>
<thead>
<tr>
<th>Localization</th>
<th>No. of patients</th>
<th>Died</th>
<th>Patients with severe residual neurological impairment</th>
<th>Fully recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>lobar</td>
<td>23</td>
<td>3</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>frontal</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>parietotemporal</td>
<td>16</td>
<td>2</td>
<td>(12.5%)</td>
<td>7</td>
</tr>
<tr>
<td>occipital</td>
<td>4</td>
<td>1</td>
<td>(25%)</td>
<td>—</td>
</tr>
<tr>
<td>basal ganglia and thalamus</td>
<td>12</td>
<td>5</td>
<td>(41.5%)</td>
<td>5</td>
</tr>
<tr>
<td>posterior fossa*</td>
<td>7</td>
<td>3</td>
<td>(42.8%)</td>
<td>2</td>
</tr>
<tr>
<td>total</td>
<td>42 (100%)</td>
<td>11</td>
<td>(26.2%)</td>
<td>14 (33.3%)</td>
</tr>
</tbody>
</table>

*Four hematomas were located in the brain stem and three were cerebellar hematomas.
instance, age was previously considered to be associated with a higher mortality rate in patients with ICH.\textsuperscript{14, 15} This was not confirmed in our study.

We evaluated mainly the correlation between the outcome of ICH and its size, location and presence or absence of intraventricular extension as visualized by CT scan. 1) Size — it was generally assumed that death occurs more frequently in patients with the larger hematomas.\textsuperscript{3, 7, 10} Our study differs from the results of those reports in that no correlation was found between size of hematoma and outcome. However, those studies did not consider separately the presence or absence of intraventricular hematomas in relation to the size of ICH. Although mortality was rather high (45%) in patients with hematomas larger than 100 cc, all those in this group who had no IVH survived, while five out of seven such patients with associated intraventricular blood died. Moreover, there was no significant difference in survival when size of hematoma increased from 5 to 100 cc (table 3). 2) Location — deep-seated hemispheric hematomas, localized within basal ganglia and thalamus, were associated with poor prognosis (five out of seven patients died). However, hematomas located deep within brain parenchyma frequently (in 50%) extended into the ventricles and only those who had IVH died. There was no mortality when ICH in the same location did not extend into the ventricular system. In lobar hematomas, i.e. — those that occurred in the subcortical white matter, mortality was low (only 13%), and was unaffected by their location in the various hemispheric regions. In this group there was a much lower incidence of IVH (26%). Mortality was high in posterior fossa hematoma — 43% (3/7). Two out of four patients with brain stem hematoma and one out of three patients with cerebellar hematoma died. All seven patients with hematoma in the posterior fossa had CT scan evidence of IVH. 3) IVH — apparently, presence of IVH was associated with the worst outcome. IVH occurred in 20 of our patients and 9 of them died (45%), as compared with only 9% mortality in patients with no CT evidence of bleeding into the ventricular system. Loss of consciousness as a presenting symptom in patients with ICH was a bad prognostic sign; seven out of eleven patients died. IVH was present in all of them but it was absent in the four survivors. Other studies (2) have also demonstrated grave outcome in patients with IVH. Taken together, all the above data suggest that IVH is the major factor determining survival from ICH.

Our study indicates a favourable prognosis in a large percentage of patients suffering from ICH who are treated conservatively. Seventy-four percent of our patients survived and 55% of those who stayed alive could return to previous activity; the best prognosis was observed with lobar hematomas (87% survival rate and 65% complete recovery in survivors) and with hematomas of an estimated volume of less than 15 cc (89% survived and 67% of them recovered completely). It is likely that the neurological deficit caused by the hematoma is largely due to mass effect, tissue destruction and edema. Our study provides evidence that in patients who survive, the hematoma in brain parenchyma gradually resolves until its complete disappearance, and in some cases without CT scan evidence of residual tissue damage. This may explain, in part, the relatively high percentage of patients who recover with minimal or no neurological deficit. Since the natural history of ICH includes spontaneous resolution of hematoma with good chances for complete recovery, in a large number of patients, the need for surgical evacuation during the acute phase of the disease is to be questioned. The overall reported mortality rate in patients treated surgically ranges from 24% to 50%, which, at the best, is similar to that found in recent studies utilizing nonsurgical measures.\textsuperscript{3, 7} The series dealing with surgical evacuation of hematoma were reported mainly before the introduction of CT scan for the diagnosis and evaluation of patients with ICH. In addition, they were concerned mainly with mortality and survival rates and did not take into consideration neurological and functional recovery. Therefore, comparison of data concerning prognosis of patients with ICH who were treated conservatively versus those who underwent surgical evacuation is difficult and inadequate. In view of the relatively good prognosis for both survival and full recovery in conservatively treated patients with ICH, it seems that surgical evacuation of hematoma is unnecessary in most of the patients and should be restricted only to the few cases where large ICH causes rapid deterioration with imminent danger of herniation.

**Acknowledgment**

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**References**


Cerebrovascular Complications Associated with Idiopathic Hypertrophic Subaortic Stenosis

ANTHONY J. FURLAN, M.D., ATANASE R. CRACIUN, M.D., NAMBURU R. RAJU, M.D.*, AND NEIL HART, M.D.*

SUMMARY One hundred fifty patients with idiopathic hypertrophic subaortic stenosis (IHSS) were followed-up for an average of 5.5 years. There were 95 males and 55 females with a mean age of 51 years. Patients usually presented with cardiac symptoms or syncope; no patient presented with stroke. Eight patients (5%) died during follow-up, all from cardiac causes. Eleven patients (7%) developed cerebrovascular complications; 5 (3%) had a stroke and 6 (4%) had TIA only. Patients with IHSS and atrial fibrillation have a much greater stroke risk. Mitral annulus calcification may also increase stroke risk in IHSS.

THE LINK between mitral valve prolapse and stroke has key interest in other cardiac conditions not previously thought to increase stroke risk. In two recent studies of the role of echocardiography in the evaluation of stroke,1, 2 no cases of asymmetric septal hypertrophy (ASH) or more severe forms of idiopathic hypertrophic subaortic stenosis (IHSS) were discovered. Nonetheless, we recently saw a patient with unexplained stroke in whom two-dimensional echocardiography revealed unexpected IHSS, and the question arose whether this was the cause of the event or a coincidental finding. Since the hemodynamic and myocardial changes associated with IHSS create potential conditions for cerebrovascular complications, we undertook this study to assess the risk of stroke in patients with this disorder.

Methods

Between 1967 and 1981, 180 patients with IHSS confirmed by cardiac catheterization were seen at the Cleveland Clinic. The catheterization criteria for diagnosis were: left ventricular hypertrophy; systolic anterior motion of the mitral valve; asymmetric septal hypertrophy; small left ventricular cavity; vigorous contraction of all wall segments. The presence of a ventricular outflow tract gradient at rest and after stimulation with isoproterenol or amyl nitrite was also recorded.

Follow-up dated from the time of cardiac catheterization and was accomplished using available medical records, telephone interviews and standardized questionnaires addressed to the patient and/or referring physician.

Results

An average follow-up of 5.5 years was achieved in 150 patients (83%). There were 95 males and 55 females with a mean age of 51 years (range, 7 months to 77 years). The clinical presentation included syncope or near syncope in 32 patients (21%), non-specific dizziness and/or lightheadedness in 31 patients (21%) and palpitations in 37 patients (25%). Two patients had a remote history of transient ischemic attacks and no patient presented with a stroke. A list of associated conditions is given in table 1. None of the patients had mural thrombus, including those with left atrial enlargement.
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