Safety and Efficacy of CT-Guided Stereotactic Aspiration in Treatment of Thalamic and Intraventricular Hemorrhage

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Abstract

Introduction: At present, there is no consensus on the proper role of surgery in the management of thalamic hemorrhage. Advances in neuroimaging techniques and improvements in stereotactic instrumentations have led to the increasing use of stereotactic surgery in the neurosurgical field. Our primary aim was to assess the feasibility and safety of stereotactic aspiration in treatment of thalamic and intraventricular hemorrhage.

Material and Methods: This is a prospective randomized clinical trial in 36 patients with spontaneous thalamic and intraventricular hemorrhage, 16 of them were treated by stereotactic aspiration with external ventricular drainage and the other 20 patients treated by only external ventricular drainage. Patients were followed-up for 3 months post-operatively with physical examinations and diagnostic imaging.

Results: patients treated by stereotactic aspiration and external ventricular drainage had a lower mortality rate 12.5%, less complications (3 cases) and were less likely to require long-term ventricular drainage (3.2 ± 1.1) compared with those undergoing only EVD where the mortality rate was 25%, complications were detected in 6 cases and ventricular drainage period was 7.6 ± 1.9.

9 out of 16 (56.2%) patients treated by stereotactic aspiration and EVD had achieved a good recovery (Glasgow outcome scale [GOS] score of 5), 3 patients (18.7%) were dependent (GOS 3), and 2 (12.5%) remained vegetative (GOS). In patients treated with EVD only, 5 patients out of 20 (25%) showed a good recovery, 4 patients (20%) were dependent while 6 patients (30%) remained vegetative. Outcome significantly correlated with initial consciousness level, preoperative volume of hematoma and age.

Conclusion: Stereotactic aspiration of thalamic and intraventricular hematoma is a simple, safe and effective method that causes fewer complications.

Key Words: Stereotaxy – Thalamic hemorrhage – Intraventricular hemorrhage.

Introduction

MORTALITY in acute thalamic hemorrhage, varying from 14% to 52%, depends on the severity of stroke, which is well reflected in the level of consciousness and the size and extent of the hematoma seen on initial CT [1-3]. Hemiparesis has been observed in 81% to 100% of patients with thalamic hemorrhage [1,2,4]. When thalamic hemorrhage is accompanied by severe intraventricular hemorrhage, the prognosis is poor [5]. Obstruction of the circulation of cerebro-spinal fluid result in neurological deterioration. The goal of treatment should be to evacuate intraventricular hematoma in the acute stage.

Thalamic hemorrhage and intraventricular hemorrhage usually treated by external ventricular drainage for obstructive hydrocephalus [6]. However, drainage occlusion, meningitis and residual hematoma are often troublesome in actual clinical practice. Several other opinions for thalamic hematoma with intraventricular extension were reported to be frontal trans-cortical approach, neuroendoscopic hematoma evacuation, and EVD with fibrinolysis [7-9].

In our study, we evaluated the outcome, mortality rate and complications in 16 patients treated by stereotactic aspirations with EVD and 20 patients treated by only EVD.

Material and Methods

From March 2007 to September 2010, 36 consecutive patients with acute thalamic hemorrhage and intraventricular extension were admitted to neurosurgery department in Suez Canal University Hospital, Ismailia. The patients were randomly allocated to hematoma evacuations via CT-guided stereotactic aspirations (16 patients) or EVD (20 patients). The criteria for including patients were:
Safety & Efficacy of CT-guided Stereotactic Aspiration in Treatment

• Unilateral thalamic hemorrhage confirmed by clinical examinations and CT performed within 48 hours after ictus.
• Age > 18 years.
• Hematoma volume ≥25ml.
• Glasgow coma scale ≥5 at admission.
• No suspected underlying structural etiology to account for the hemorrhage. No systemic bleeding diathesis and no severe concurrent illness with life expectancy <6 months. Patients with head injury, subarachnoid hemorrhage, previous strokes or hemorrhagic infarctions were excluded.

We compared the two groups with respect to age, sex, pre-operative level of consciousness (Glasgow Coma Scale), location of hematoma (Rt./Lt.), hematoma volume, interval from onset to operation (hours), hematoma evacuation rate (pre-operative hematoma volume-postoperative hematoma volume/preoperative hematoma volume x 100: %), ventricular drainage period (days), complications, hospital stay, and clinical outcome [Glasgow outcome scale, ranging from grade 5 (good recovery) to grade 1 (dead)] [10].

The CRW (Cosman-Roperts-Wells) stereotactic system which is a modification of the arc-radius design of the BRW (Brown-Robert-Wells) stereotactic system was used to localize and verify target data. Pre-coronal entry point was selected and Hematoma evacuation was performed under local anesthesia [11].

For statistical analysis, categorical variables were assessed by using the chi-square test and mean values of quantitative variables were compared by unpaired t-test.

Results

36 patients, including 23 men and 13 women aged 60 to 77 (mean 66.5 years) underwent surgery for thalamic hematoma with intraventricular hemorrhage. Patients were divided into 2 groups. Group A, including 16 patients treated by stereotactic aspiration and EVD. Group B, including 20 patients and treated by only EVD. The mean ages of group A were 59.8±11.8 with ten males and six females while the mean ages of group B were 60.5±13.0 with thirteen males and seven females. (Table 1).

There were no significant differences between the two groups with respect to the pre-operative level of consciousness, hematoma volume, interval from onset to operations and the location of hematomas. (Table 1).

Group A had a lower mortality rate 12.5% as compared with group B 25% 6 cases of group B representing (30%) had ventriculitis while 3 cases of group A had ventriculitis (18.75%). (Table 2).

Patients in group A showed a good hematoma evacuation rate (57.5±13) while the rate was (12.5±9.7) in group B. also they were less likely to require long-term ventricular drainage (3.2±1.1) than patients in group B (7.6±1.9). (Table 2).

At 3 months after the procedure, 9 out of 16 (56.2%) patients of group A had achieved a good recovery (GOS 4 or 5), 3 patients (18.7%) were dependent (GOS 3), and 2 (12.5%) remained vegetative. In patients of group B, 5 patients out of 20 (25%) showed a good recovery, 4 patients (20%) were dependent while 6 patients (30%) remained vegetative. (Table 3).

Significant good prognostic factors were found in our study to be young age, small preoperative hematoma volume and high GCS. (Table 4).

Table (1): Demographic and clinical characteristics of study populations.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs.)</td>
<td>59.8±11.8</td>
<td>60.5±13.0</td>
<td>0.31</td>
</tr>
<tr>
<td>Sex (Male/Female)</td>
<td>10/6</td>
<td>13/7</td>
<td>0.48</td>
</tr>
<tr>
<td>Preoperative GCS</td>
<td>8.4±3.3</td>
<td>8.1±3.1</td>
<td>0.28</td>
</tr>
<tr>
<td>Hematoma (Rt/Lt)</td>
<td>7/9</td>
<td>8/12</td>
<td>0.46</td>
</tr>
<tr>
<td>Hematoma volume (ml)</td>
<td>51.6±11.9</td>
<td>49.8±11.1</td>
<td>0.51</td>
</tr>
<tr>
<td>Interval from onset To operations (hrs)</td>
<td>23±14.2</td>
<td>20±13.9</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Data presented mean ± S.D (standard deviation).
yrs: Years, Rt: Right, Lt: Left, hrs: Hours, GCS: Glasgow coma scale.

Table (2): Clinical comparison of procedures.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hematoma evacuation Rate%</td>
<td>57.5±13.0</td>
<td>12.5±9.7</td>
<td>0.0006</td>
</tr>
<tr>
<td>Ventricular drainage Periods (days)</td>
<td>3.2±1.1</td>
<td>7.6±1.9</td>
<td>0.004</td>
</tr>
<tr>
<td>Ventriculitis</td>
<td>2</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Rebleeding</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mortality Rate</td>
<td>12.5</td>
<td>25</td>
<td></td>
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</table>

Table (3): Clinical outcomes at 3 months after procedures.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Group A</th>
<th>Group B</th>
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</thead>
<tbody>
<tr>
<td>Good recovery</td>
<td>9 (56.2%)</td>
<td>5 (25%)</td>
</tr>
<tr>
<td>GOS 5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>GOS 4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Fair recovery</td>
<td>3 (18.7%)</td>
<td>4 (20%)</td>
</tr>
<tr>
<td>GOS 3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Bad recovery</td>
<td>4 (25%)</td>
<td>11 (55%)</td>
</tr>
<tr>
<td>GOS 2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>GOS 1</td>
<td>2</td>
<td>5</td>
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</tbody>
</table>
Table (4): Investigated prognostic factors.

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th></th>
<th>Group B</th>
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<tbody>
<tr>
<td></td>
<td>GOS 3-5</td>
<td>GOS 1-2</td>
<td>p-value</td>
<td>GOS 3-5</td>
</tr>
<tr>
<td>Age (yrs.)</td>
<td>58.2</td>
<td>63.6</td>
<td>0.33</td>
<td>59.6</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>0.58</td>
<td>0.61</td>
<td>0.56</td>
<td>0.59</td>
</tr>
<tr>
<td>Pre-volume (ml)</td>
<td>35.1</td>
<td>52.6</td>
<td>0.79</td>
<td>38.3</td>
</tr>
<tr>
<td>Pre GCS score</td>
<td>10.9</td>
<td>7.3</td>
<td>1.18</td>
<td>10.2</td>
</tr>
</tbody>
</table>

Fig. (1): Sequential images before and after stereotactic aspiration.

Fig. (2): Lt. Computed tomography scan showing thalamic and IV hematoma. Rt. Computed tomography scan showing adequate removal.

Discussion

The surgical technique for removing thalamic hemorrhage has not sufficiently advanced and remain controversial. On the other hand, patients with hydrocephalus caused by ventricular perforation of a thalamic hemorrhage are proven to benefit from treatment because severe intraventricular hemorrhage is associated with secondary brain damage owing to increased ICP, inflammation, and oedema [12]. In addition to its pathophysiological effects in the acute stage, intraventricular hemorrhage causes communicating hydrocephalus in the chronic stage [13].

In order to maintain ICP, shortening the patient’s stay in the intensive care unit, external ventricular drainage of intraventricular hemorrhage is essential to control acute hydrocephalus and preventing the communicating hydrocephalus [12]. However, EVD alone has little effect on hematoma clearance, because the catheter frequently becomes obstructed by blood and carries a risk of infection [14].

Several other opinions for thalamic hemorrhage with IVH were reported to be neuro-endoscopic hematoma evacuation, frontal craniotomy and EVD with fibrinolysis [15]. Use of neuroendoscopy has recently been increasing for hematoma evacuation. However, the surgeon must be skilled at using the neuroendoscope and few facilities have neuroendoscope systems [16]. Use of frontal craniotomy is restricted as it needs corticotomy with more complications. Several authors have recommended intraventricular fibrinolysis with EVD [17]. However, tissue plasminogen activator and urokinase are not commonly used intracranially in Egypt. The main advantage of CT-guided stereotactic surgery is that it can be done under local anaesthesia and may substantially decrease hematoma volume while avoiding the morbidity of major craniotomy procedure [18,19].

Several authors reported the bleeding rate in CT-guided stereotactic surgery to be 3% to 16% [19-21]. The factors contributing to recurrent hemorrhage include excessive hematoma aspiration, intraoperative or postoperative hypertension and a bleeding tendency. Because of the rebleeding
risk that could potentially be increased by early aspiration suggest not doing the stereotactic aspiration before 6 to 24 hours after onset [2a]. Hando et al. reported a bleeding risk of only 4% when aspiration had been carried out between 5 and 48 hours after the hemorrhage [22]. In our study, the rebleeding rate was 5.1% in stereotactic group and 5% in EVD group and seems to be not related to early aspiration. Two patients of stereotactic group and five patients of EVD group developed ventriculitis due to ventricular drainage. These were the only treatment related complications.

Mortality has been the primary end point of therapeutic studies in most published studies and it has ranged from 30% to 90% [23,24]. This reflects in part patient inclusion and exclusion criteria, and to a lesser extent the treatment rendered in individual studies. In our series, there was 12.5% mortality in stereotactic group and 25% in EVD group. Relative low mortality rate was because of excluding cardiac and pulmonary compromised patients and deeply comatose patients.

Volume of ICH is consistently shown to be a powerful predictor of poor outcome [23]. Larger hematomas results in more profound and lasting alterations in adjacent brain parenchyma, attributed in part to mass effect and focal edema. The rationale for evacuation of ICH is that reduction of clot volume may indeed improve neurological recovery and clinical outcome. Removal of focal mass effect may improve perfusion of compromised brain parenchyma and prevent intracranial hypertension. It also may enhance the clearance of blood breakdown products, hence preventing secondary brain edema and other potential neurotoxicity [25,26]. In this study, which is well in line with other series [15,19,21], hematoma evacuation rate was 57.5% in stereotactic group compared to 12.5% in EVD group. However, EVD alone has little effect on hematoma clearance; because the catheter frequently becomes obstructed by blood.

The main prognostic factors affecting the outcome were the age, the size of hematoma and the level of consciousness [20]. 75% of patients in stereotactic group and 45% of patients in EVD group had good recovery (GOS 3-5). They had pre GCS score of 10.9 and 10.2, preoperative hematoma volume of 35.1 and 38.3 and age below 60 years in both group. On the other hand, 55% of EVD group and 25% of stereotactic group had GOS 1-2. They had pre GCS score around 7, preoperative hematoma volume >50ml and age >60 years. Our results in agreement with two studies which report the main predictive parameter to be the severity of neurologic presentation and size of hematoma.

Conclusion:

Stereotactic aspiration for hematoma evacuation achieved a lower mortality rate and improved the functional outcome compared with patients undergoing EVD alone. Patients with GCS >9 on initial presentation, small preoperative volume and age below 60 years demonstrate a better outcome with this minimally invasive method.

References

13- Yadav Y.R., Mukerji G. and Sheoy R.: Endoscopic management of hypertensive intraventricular hemorrhage with


