ABSTRACT

Background: Spontaneous intracerebral hemorrhage (sICH) causes severe disability and high mortality. Today it is still an unresolved medical problem. The choice of optimal management - surgical or conservative, remains a difficult and controversial one. Early evacuation may restrict hematoma expansion and limit the secondary brain damage, improving the outcome for the patient.

Objective: To compare the effectiveness of surgical to conservative treatment of sICH.

Material and Methods: We examined 94 patients with sICH admitted to the Neurology Clinic within 24 hours of onset. Forty seven patients underwent surgical evacuation and the remaining 47 received conservative medical therapy. Neurological deficit and clinical outcome were assessed by Glasgow Coma Scale (GCS), National Institutes of Health Stroke Scale (NIHSS) and Glasgow Outcome Scale (GOS). Each patient was assessed on two occasions, the first on admission and the second after one month. The statistical analysis was performed with the Statistical Package for Social Sciences, version 13.0 (SPSS).

Results: Neurological deficit, hematoma volume and location displayed correlation with GOS in the conservative group (p>0.05), while no statistical significance between GOS and hematoma volume in the surgical group (p<0.05) was observed. Surgically treated patients with a baseline GCS>12 had a better final GOS relative to conservatively treated ones. There was no statistically significant difference in GOS on the 30th day of treatment for both groups. The mortality of 4.3% was significantly lower in the surgical group (p<0.05).

Conclusion: Early surgery for sICH might be a safe and effective treatment, especially for large hematomas (>60cc) in male patients with progressive impairment of consciousness.

Keywords: Spontaneous intracerebral hemorrhage, surgical treatment, conservative management.

INTRODUCTION

Spontaneous intracerebral hemorrhage (sICH) is the second most common type of stroke due to a leakage of blood into the brain parenchyma caused by a vessel rupture [1]. Although sICH accounts for only 15-20% of all strokes, it is associated with the highest mortality and disability rate [2]. Regardless of modern achievements in neuroimaging techniques and advanced therapeutic options of neurovascular reanimation, the parameters of sICH morbidity and mortality remain unchanged [3]. Almost 40% of the patients die before the 30th day of sICH, 66% of the survivors suffer severe and permanent disability and only 20% recover their functionality by the 6th month [2]. According to the AHA (American Heart Association) guidelines, the modern sICH treatment is mainly symptomatic and has been one of the greatest challenges in the neurological practice [4]. Making the right decision as to whether and when the hematoma should be evacuated has been incredibly difficult and controversial. Early surgical treatment could minimise mechanical compression of the brain parenchyma and eventually prevent the toxic effects of blood degradation products thus limiting the secondary brain damage. On the other side, the risk for the patient from continuous bleeding could be greater, and the craniotomy itself could further damage healthy brain parenchyma. According to some authors, early evacuation of the hemorrhage shortens the hospital stay, lowers financial costs and hastens the patients’ return to their daily routine [5]. Still the results from International Surgical Trial in Intracerebral Hemorrhage (STICH) failed to prove significant advantages of early surgical evacuation compared to the conservative treatment [6, 7]. Up to now, multiple surgical approaches as conventional craniotomy, stereotactic guidance with aspiration and thrombolysis, image guided stereotactic endoscopic aspiration and decompressive craniotomy, have presented with varying degree of success. Although hematoma evacuation may be lifesaving, the efficacy of surgical treatment of sICH is still under debate due to the fact it does not improve functional outcome.

The aim of the present study was to compare clini-
cal outcome and effectiveness of early surgical intervention to conservative treatment of patients with sICH.

**MATERIAL AND METHODS**

**Patients**

The current research involved 94 patients with sICH, admitted to the Neurology Clinic, UMHAT “Dr Georgi Stranski”, Pleven within 24 hours after clinical symptoms onset. Forty seven of them underwent surgical evacuation and the remaining 47 received conservative medical therapy. All the patients were selected following strict inclusion criteria such as: sICH confirmed by CT scan, hemorrhage volume over 30 ml, severe neurological deficit and above 18 years of age. Patients with secondary hemorrhage, infratentorial hematoma location, blood intrusion into the ventricles and subarahnoid space, hemorrhagic transformation of ischemic stroke, trauma anamnesis, AV-malformations, aneurisms or anticoagulant treatment induced hemorrhage, were excluded from the study.

All experiments were conducted in accordance with the rules and regulations approved by the University Research Ethics Committee. Informed consent was obtained by all the patients or their authorised relatives.

**Neurological assessment**

Data concerning demographic and risk factors, concomitant diseases and current treatment was prospectively collected in a specially designed questionnaire. Clinical evaluation of the consciousness alterations by Glasgow Coma Scale (GCS) [8] and the severity of neurological deficit by National Institutes of Health Stroke Scale [9] were performed on two occasions the first on admission and then on the 30th consecutive day. Stroke clinical outcome was assessed by Glasgow Outcome Scale (GOS) [10] one month after the treatment. Complete blood tests including biochemistry parameters and coagulation profile were also performed to exclude any other medical reasons for bleeding.

**Treatment**

The conservative treatment was performed by osmotic diuretics and under strict blood pressure control. Prophylaxis of convulsions and deep venous thrombosis was done and maintenance of normoglycemia and fluid balance was ensured.

Patients selected for neurosurgical treatment underwent decompressive craniotomy with hemorrhage evacuation.

**Neuroimaging measurements**

Computer tomography scan of the brain was performed upon hospitalisation with General Electric Bright Speed 4-Helical MDCT (Multi Detector Computed tomography). As per localisation the sICH were classified in two groups: deep (basal) and lobar. The hemorrhage volume was calculated by a simplified formula for ellipsoid volume calculation, \((AxBxC)/2\) (Fig. 1, 2) [11], where \(A\) is the maximum diameter of the hemorrhage on the CT slice with the largest area of hemorrhage, \(B\) is the maximum diameter \(90^\circ\) to \(A\) on the same slice, and \(C\) is the number of axial slices multiplied by the slice thickness. As per the hemorrhage volume the patients were divided in three groups: <30ml; 30-60ml; >60ml. Presence of brain edema, ventricular compression and midline shift were also assessed.

**Fig. 1.** CT of 76 years old patient with sICH treated conservatively
Statistical analysis was carried out via Statistical Package for Social Sciences, version 13.0 (SPSS). Pearson coefficient was used to prove statistically important differences between the two groups with regard to the comparable parameters. (Table 1)

Table 1. Comparison between surgical and conservative treatment groups of patients with sICH.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Surgical group n=47</th>
<th>Conservative group n=47</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years) (SD)</td>
<td>60,1 (11,2)</td>
<td>63,3 (6,3)</td>
<td>0,089</td>
</tr>
<tr>
<td>Male sex, n (%)</td>
<td>27 (57,4)</td>
<td>23 (49)</td>
<td>0,291</td>
</tr>
<tr>
<td>Arterial hypertension, n (%)</td>
<td>36 (76)</td>
<td>40 (87)</td>
<td>0,112</td>
</tr>
<tr>
<td>Localization of sICH, n (%)</td>
<td></td>
<td></td>
<td>0,293</td>
</tr>
<tr>
<td>Basal ganglia</td>
<td>27 (55,3)</td>
<td>37 (79)</td>
<td></td>
</tr>
<tr>
<td>Lobar</td>
<td>20 (41,7)</td>
<td>10 (21)</td>
<td></td>
</tr>
<tr>
<td>GCS on admission, n (%)</td>
<td></td>
<td></td>
<td>0,221</td>
</tr>
<tr>
<td>&lt;8 p.</td>
<td>9 (19,1)</td>
<td>25 (53)</td>
<td></td>
</tr>
<tr>
<td>9-12 p.</td>
<td>13 (27,7)</td>
<td>11 (23)</td>
<td></td>
</tr>
<tr>
<td>12-15 p.</td>
<td>25 (53,2)</td>
<td>11 (23)</td>
<td></td>
</tr>
<tr>
<td>GOS, n (%)</td>
<td></td>
<td></td>
<td>0,759</td>
</tr>
<tr>
<td>1-3 p.</td>
<td>30 (63,8)</td>
<td>29 (62)</td>
<td></td>
</tr>
<tr>
<td>4-5 p.</td>
<td>17 (36,2)</td>
<td>18 (38)</td>
<td></td>
</tr>
<tr>
<td>Hemorrhage volume, n (%)</td>
<td></td>
<td></td>
<td>0,095</td>
</tr>
<tr>
<td>&lt;30 ml</td>
<td>8 (17)</td>
<td>16 (34,1)</td>
<td></td>
</tr>
<tr>
<td>30-60 ml</td>
<td>20 (42,6)</td>
<td>25 (52,3)</td>
<td></td>
</tr>
<tr>
<td>&gt;60 ml</td>
<td>19 (40,4)</td>
<td>6 (13,6)</td>
<td></td>
</tr>
<tr>
<td>Outcome, n (%)</td>
<td></td>
<td></td>
<td>0,005</td>
</tr>
<tr>
<td>Survivors</td>
<td>45 (95,7)</td>
<td>34 (72)</td>
<td></td>
</tr>
<tr>
<td>Patients with lethal outcome</td>
<td>2 (4,3)</td>
<td>13 (28)</td>
<td></td>
</tr>
</tbody>
</table>

GCS- Glasgow coma scale; GOS Glasgow outcome scale
RESULTS
In the study, there was 94 patients enrolled with sICH admitted to the Neurology Clinic within 24 hours from onset that fulfilled all the inclusion criteria. The conservative group included 23 men (49%) and 24 women (51%), whilst in the group of surgically treated patients 57.4% were men. No statistically significant differences were found with regard to age and concomitant risk factors within the two studied groups. GCS score in 53.2% of the surgically treated patients was >12, while in the conservative group 53% had GCS< 8. Patients with lobar hematoma in the surgical group were double that of those with lobar hematoma in the conservative group. In the medical treatment group, 34.1% had hematoma volume<30 ml and only 13.6% had hematoma volume >60 ml, while 42.6% of the surgically treated patients had hematoma volume between 30-60 ml. The severity of neurological deficit, hemorrhage volume and localisation in the group of conservatively treated patients correlated with GOS (p<0.05) but no statistical importance was found between GOS and the hemorrhage volume in the patients treated surgically (p>0.05). Those who were operated on with GCS>12 had better final GOS compared to those treated conservatively. No statistically important difference with regard to the clinical outcome was found in both patient groups assessed with GOS on the 30th day from onset. A high percentage (40.4%) of patients with progressive clinical deterioration and hematoma volume >60ml underwent surgical evacuation of the sICH. Lethality of 4.3% was significantly lower in the operated group (p<0.05).

DISCUSSION
There has been uncertainty and lack of definitiveness regarding the best therapeutic approach to a patient with sICH. Usually the choice of treatment, surgical or conservative, is mainly dominated by the initial subjective decision of the consulting neurologist. The multiplicity of factors affecting the clinical condition and outcome must be taken into account when choosing the optimal therapeutic approach. Conservative medication is mostly symptomatic, and the clinical outcome in post-stroke patients is usually poor with severe disability.

The results of the present study have not found any significant differences in the clinical outcome of the two groups of patients that could distinguish the advantages of early hematoma evacuation. Schwarz et al. [12] emphasised on the advantages of neurosurgical treatment of patients with progressive deterioration in view of prevention of clinical impairment but not improvement of the outcome. Our results showed that early hemorrhage evacuation was safe and effective treatment for patients with hemorrhage volume >60ml, especially males who had progressive consciousness alterations [13]. The significantly lower lethality of 4.3% that we found in the operated group (p<0.05) is probably due to the patient selection in the study, presenting with a GCS score on admission >12 in 53.5% of the cases. All the surgically treated patients underwent decompressive craniotomy within 24 hours from onset. The results of Bhaskar et al. were in favor of surgical treatment among the patients presenting with GCS 4–8, hematoma volume 31–60 ml, midline shift of more than 5 mm, and intraventricular extension of the hematoma [14, 15]. Some minimally invasive techniques that have been applied for hematoma evacuation could also improve prognosis of sICH, but more studies are needed [16, 17, 18].

The choice of optimal treatment of sICH is often a controversial topic for discussion between neurologists and neurosurgeons. Although there are more than 10 random studies on the issue of the best and appropriate therapeutic option, conservative or surgical, it is still hard and strictly personal decision for each patient with sICH [18]. Apparently, a careful selection of patients eligible for surgery is mandatory. The recommended optimal timing falls into a time-window ranging between 7 and 24 hours after ictus. Minimal invasive techniques are valuable surgical techniques for patients with poor GCS score or harboring large deep-seated hemorrhages [19, 20, 21].

Obviously, future extensive clinical research involving more patients must be conducted in order to find the correct answer of the eternal issue: what is the best treatment for every individual patient with sICH, conservative or surgical? Maybe identification of early and objective predictors could help the proper selection of patients with high risk for hematoma expansion thus the therapeutic results and prognosis of sICH could be improved.

CONCLUSION
Early surgery for sICH might be a safe and effective treatment, especially for large hematomas (>60cc) in male patients with progressive impairment of consciousness. The decision whether or not to evacuate the sICHis still difficult and depends on the precise analysis of many factors influencing the final outcome. Surgical treatment benefits mortality but does not improve clinical outcome on the 30th day from onset. Our study results, despite some limitations, confirm the prognostic value of clinical and neuroimaging parameters for the 30th day clinical outcome after. Complex neurological assessment by the means of GCS and NIHSS, hematoma volume and localisation provide unique opportunities to neurologists for early and exact prediction of sICH clinical course and outcome. This is especially useful for three reasons: for early stratification of patients who could improve under intensive care (from those with suggested poor outcome), in choosing the best individual therapeutic approach, surgical or conservative, and for better communication with patients and their relatives.

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Address for correspondence:

Emilia Ovcharova, Department of Neurology and Neurosurgery, Medical University - Pleven; 1, St. Kliment Ochridski Str., Pleven, 5800, Bulgaria
E-mail: emilia_ovcharova@abv.bg


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