THE EFFECTS OF VASOSPASM AND RE-BLEEDING ON THE OUTCOME OF PATIENTS WITH SUBARACHNOID HEMORRHAGE FROM RUPTURED INTRACRANIAL ANEURYSM

Venko Filipce, Aleksandar Caparoski

University Department of Neurosurgery, Skopje, R. Macedonia

Corresponding Author: Venko Filipce, University Department of Neurosurgery Skopje, R. Macedonia, Tel. +389 (0)2 070 33 43 33; E-mail: venkofilipce@yahoo.com

Abstract
Vasospasm and re-bleeding after subarachnoid hemorrhage from ruptured intracranial aneurysm are devastating complications that can severely affect the outcome of the patients. We are presenting a series of total number of 224 patients treated and operated at our Department due to subarachnoid hemorrhage, out of which certain number developed vasospasm and re-bleeding. We are evaluating the effect of these complications on the outcome of the patients according to the Glasgow Outcome Scale at the day of discharge. In our experience both vasospasm and ReSAH can significantly influence the outcome of patients with subarachnoid hemorrhage from ruptured intracranial aneurysm.

Key words: vasospasm, rebleeding, intracranial aneurysm

Introduction
The incidence of aneurismal re-rupture is up to 30% and it indicated significant morbidity and mortality [1, 5]. It is also a cause for momentarily worsening of the neurological condition, even death. The risk of aneurismal re-rupture is the biggest in the first 24 hours -4% and remains 1–2% per day in the next days for a period of 4 weeks [1, 6, 11]. Vasospasm is another complication of subarachnoid hemorrhage. Its clinical manifestation is called delayed ischemic deficit and does not always correlate with the angiographic vasospasm. [3, 4] It is defined as worsening of the neurological condition that is not due to the intraoperative site hematoma, hydrocephalus, seizures or electrolyte disbalance. [7, 10, 18] In this paper we present our experience with patients who developed re-bleeding and vasospasm after subarachnoid hemorrhage from ruptured intracranial aneurysm.

Materials and methods
At the Department of Neurosurgery in Skopje, 224 patient were treated and operated due to ruptured intracranial aneurysm in the period 2011–2015. At the admission, patients were evaluated according to the Hunt and Hess scale. The diagnosis was performed by non-enhanced CT scan, CT angiography and catheter angiography. Based on the imaging, the patients were divided into seven groups depending on the site of the aneurysm: anterior communicating, posterior communicating, middle cerebral, pericallosal, vertebra-basilar, multiple and ophthalmic artery aneurysms. Intracerebral or intraventricular hemorrhages were considered at admission. During the treatment, the patients were divided in two groups: operated early i.e. in the first 72 hours, or late i.e. 2 weeks after the bleeding. The occurrence of vasospasm and re-hemorrhage was noticed as we evaluated their influence on the outcome
determined by the Glasgow Outcome Scale at the day of discharge.

**Results**

In our study 224 patients with subarachnoid hemorrhage were included; 102 (45.50%) were men and 122 were women. In Table 1 and Graph 1 the shown data refer to the localization of ruptured intracranial aneurysms in comparison with the gender of the patients.

In men, 41 (18.30%) of the aneurysms were located on the Art. Communicans anterior, 26 (11.60%) of the aneurysms were located on the Art. Communicans posterior, 27 (12.10%) of the aneurysms were located on the Art. Cerebri media, 2 (0.90%) of the aneurysms were located on the Art. Pericallosa, 1 (0.40%) of the aneurysms was located on Vertebro-basilar circulation, 4 (1.80%) were multiple aneurysms, and 1 (0.40%) aneurysm was located on Art. Ophthalmica.

In women, 29 (12.90%) of the aneurysms were located on the Art. Communicans anterior, 33 (14.70%) of the aneurysms were located on the Art. Communicans posterior, 43 (19.20%) of the aneurysms were located on the Art. Cerebri media, 2 (0.90%) of the aneurysms were located on the Art. Pericallosa, 4 (1.80%) of the aneurysms was located on Vertebro-basilar circulation, 10 (4.50%) were multiple aneurysms, and 1 (0.40%) aneurysm was located on Art. Ophthalmica.

The evaluation of the correlation of the localization of the ruptured intracranial aneurysms with the gender of the patients with the Fisher's Exact Test = 9.30 and p > 0.05 (p = 0.128/0.120-0.137) showed that there was no statistically significant preference for the localization in comparison to the gender of the patients.

**Table 1**

<table>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>41</td>
<td>26</td>
<td>27</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>102</td>
</tr>
<tr>
<td>%</td>
<td>18.3%</td>
<td>11.6%</td>
<td>12.1%</td>
<td>0.9%</td>
<td>0.4%</td>
<td>1.8%</td>
<td>0.4%</td>
<td>45.5%</td>
</tr>
<tr>
<td>Number</td>
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<td>70</td>
<td>4</td>
<td>5</td>
<td>14</td>
<td>2</td>
<td>224</td>
</tr>
<tr>
<td>%</td>
<td>31.3%</td>
<td>26.3%</td>
<td>31.3%</td>
<td>1.8%</td>
<td>2.2%</td>
<td>6.3%</td>
<td>0.9%</td>
<td>100.0%</td>
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</table>

**Graph 1** – Distribution of the patients according to the gender & Localization of the aneurysm
Out of 38 (17.00%) patients with vasospasm, 16 (7.10%) patients had good outcome, 1 (0.40%) patient had moderate disabilities (was able to perform daily activities by himself), 3 (1.30%) patients had severe disabilities (dependent from another person), 7 (3.10%) patients were in persistent vegetative state and 11 (4.90%) patients died.

Out of 186 (83.00%) patients without vasospasm, 121 (54.00%) patients had good outcome, 31 (13.80%) patient had moderate disabilities (was able to perform daily activities by himself), 12 (5.40%) patients had severe disabilities (dependent from another person), 10 (4.50%) patients were in persistent vegetative state and 12 (5.40%) patients died.

The statistical analysis of vasospasm and the outcome according to the Glasgow Outcome Scale for Fisher's Exact Test = 2.10 and p < 0.001 (p = 0,000/0,000-0,000) showed significant difference.

Table 2

<table>
<thead>
<tr>
<th>Vasospasm</th>
<th>Glasgow Outcome Scale</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Yes</td>
<td>Count: 16</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>% of Total: 7.1%</td>
<td>0.4%</td>
</tr>
<tr>
<td>No</td>
<td>Count: 121</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>% of Total: 54.0%</td>
<td>13.8%</td>
</tr>
<tr>
<td>Total</td>
<td>Count: 137</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>% of Total: 61.2%</td>
<td>14.3%</td>
</tr>
</tbody>
</table>

Glasgow Outcome Scale
1. Good; 2. Patient had moderate disabilities (was able to perform daily activities by himself); 3. Patients had severe disabilities (dependent from another person); 4. Persistent vegetative state; 5. Death
Out of 34 (15.20%) patients with ReSAH, 13 (5.80%) patients had good outcome, 1 (0.40%) patient had moderate disabilities (was able to perform daily activities by himself), 2 (0.90%) patients had severe disabilities (dependent from another person), 7 (3.10%) patients were in persistent vegetative state and 11 (4.90%) patients died.

Out of 190 (84.80%) patients without ReSAH, 124 (55.40%) patients had good outcome, 31 (13.80%) patient had moderate disabilities (was able to perform daily activities by himself), 13 (5.80%) patients had severe disabilities (dependent from another person), 10 (4.50%) patients were in persistent vegetative state and 12 (5.40%) patients died.

The statistical evaluation of ReSAH and the outcome according to the Glasgow Outcome Scale for Fisher's Exact Test = 28.88 and \( p < 0.001 \) (\( p = 0.000/0.000-0.000 \)) showed significant difference.

Table 3

<table>
<thead>
<tr>
<th>ReSAH</th>
<th>Glasgow Outcome Scale</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Count</td>
<td>1</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>124</td>
</tr>
<tr>
<td>Total</td>
<td>% of Total</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

Glasgow Outcome Scale
1. Good; 2. Patient had moderate disabilities (was able to perform daily activities by himself); 3. Patients had severe disabilities (dependent from another person); 4. Persistent vegetative state; 5. Death

Graph 3 – ReSAH & Glasgow Outcome Scale
The effects of vasospasm and re-bleeding on the outcome…

Discussion

Vasospasm occurs in 10–15% of the patients with subarachnoid hemorrhage and is related to the bad outcome [4, 7, 15]. Angiographic vasospasm is a narrowing of the arterial blood vessel seen on angiography. Its clinical manifestation is called Delayed Ischemic Deficit and means worsening of the neurological condition of the patient that is not due to intraoperative site hematoma, hydrocephalus, seizures or metabolic disturbance [14, 18]. The distribution of the vasospasm is either focal or diffuse. It is most severe on the large blood vessels proximally from the ruptured aneurysm. Angiographically, it is proven that the vasospasm is not worsened by surgical manipulation with the vessels [20]. The predictive factors of vasospasm are huge advantage compared to other forms of stroke in terms of therapeutic window for early or preventive treatment. The well-known Triple H therapy or endovascular angioplasty are both well-established methods to treat vasospasm [3].

The incidence of aneurysmal re-rupture is up to 30% and it indicated significant morbidity and mortality [6, 12, 13]. It is also a cause for momentarily worsening of the neurological condition, even death. The risk of aneurysmal re-rupture is biggest in the first 24 hours -4% and remains 1–2% in the next days for a period of 4 weeks [11, 16]. For clinical condition, posterior circulation aneurysm, relief of huge amount of CSF and imbalanced hemostasis are risk factors for re-rupture. More than 70% of patients who re-bleed, die [21].

Early surgery reduces the risk of poor outcome in patients with subarachnoid hemorrhage from ruptured intracranial aneurysm. Prompt aneurysm obliteration followed by eventual immediate angioplasty for patients presenting with vasospasm offers reasonable chance for good neurological recovery for these patients who otherwise might progress to cerebral infarction [9, 11, 13].

In our experience, re-bleeding and vasospasm have significant influence on the outcome of the patients. However, early surgery reduces this risk.

REFERENCES

The effects of vasospasm and re-bleeding on the outcome…