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UTICAJ TEMPORANE OKLUZIJE NOSEĆEG KRVNOG SUDA NA ISHOD HIRURŠKOG LEČENJA RUPTURIRANIH CEREBRALNIH ANEURIZMI

Authors Vesna Nikolov*, Miša Radisavljevic*, Boban Jelenkovic*, Marija Andelkovic Apostolovic†, Vojnosanitetski pregled (2018); Online First December, 2018.

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THE INFLUENCE OF TEMPORARY OCCLUSION OF PARENT VESSEL ON OUTCOME OF SURGICAL TREATMENT OF RUPTURED CEREBRAL ANEURYSMS

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Vesna Nikolov*, Miša Radisavljević*, Boban Jelenković*, Marija Anđelković Apostolović†

*Department of Neurosurgery, Clinical Center of Nis, Serbia, † Institute for Pulic Health, Nis, Serbia

Coresponding author: Dr Vesna Nikolov, tel. 0653094135, email: unhnis@gmail.com

Vesna Nikolov-author of a manuscript

Miša Radisavljević- data collection

Boban Jelenković- data collection

Marija Anđelković Apostolović- statistical analysis
Abstract

Background/Aim. Aneurysm rupture followed by subarachnoid or intracerebral haemorrhage is always current and poses a great challenge to neurosurgeons. The aim of the paper was to observe whether applying temporary occlusion before placing a final clip was justified.

Methods. A prospective study was conducted on patients treated at Neurosurgical Clinic in Niš who suffered aneurysm rupture in the period from January 2012 to December 2016. During the research, the patients who belonged to I and II and 1, 2 and 3 grade by the Hunt-Hess and Fisher scale, respectively, were monitored. For statistical data analysis the χ² test was used.

Results. Out of total 182 bleeding aneurysms treated, in 85 the operator decided to apply temporary clipping before placing a final clip. The application of temporary occlusion significantly influenced the presence of the resulting neurological deficit. Conclusion. The application of temporary occlusion facilitates placing the final clip but also affects the presence of the resulting neurological deficit. It is assumed that the reason is provocation of vasospasm, considering that it is a bleeding aneurysm.

Key words: subarachnoid hemorrhage, brain aneurysm, vasospasm.

Introduction

Aneurysms are a distention to the brain blood vessel caused by the weakness of a blood vessel wall. The spots where the arteries branch off are the most common places in which aneurysms can be found. Over time, under the influence of a blood wave in the blood vessel itself, the wall is getting increasingly thinner and the distention becomes sac-shaped...
saccular distention) or spindle-shaped (fusiform distention). Such an aneurysm does not give any symptoms. It is usually detected as a sporadic finding during the examination. A serious manifestation of the aneurysm is its rupture. The annual incidence of bleeding is 10–14/100.000, 15-20% aneurysms bleed in the course of life, most often between the age of 40 and 60.

According to most literature data, total aneurysm-related mortality due to subarachnoid bleeding is 32-67%, decreasing with the advancement of therapy in the last three decades by about 0.5% per year. Studies also say that gender does not affect the patient’s outcome after rupture. The symptoms are a severe headache accompanied by nausea and vomiting, as well as impaired consciousness. The depth of consciousness impairment depends on the magnitude of aneurysm bleeding. Usually, soon after rupture it is temporarily spontaneously closed by a coagulum. The patient’s condition stations at a certain level and then diagnostics can be approached. The method of choice today is brain MSCT with angio scan revealing both the existence of subarachnoid hemorrhage or intracerebral hematoma and the site of aneurysmal enlargement on the blood vessel. The surgeon is to decide whether aneurysm diagnosis using MSCT angio scan is sufficient or it is necessary to approach Digital subtraction angiography (DSA). This diagnostic method enables a better display of localization, size and especially the position of the aneurysm neck in relation to the blood vessel. Diagnosis is followed by aneurysm treatment with two methods used in practice, surgical treatment by aneurysm clipping, or endovascular closing of enlargement using spirals. In this paper, we will focus on the surgical way to treat an aneurysm as well as the frequent dilemma of the operator as to whether to apply temporary occlusion before the final clipping of the aneurysm or not. Elective temporary occlusion in the treatment of intracranial aneurysms was first performed by Jefferson in 1928. Temporary clamping and moderate hypothermia in the treatment of aneurysms were reported by Suzuki et al. in 1969. The authors pointed that intermittent reperfusion allowed prolongation of the total time of temporary occlusion. The technique of safe clipping as generally used depends on the temporary occlusion of the cerebral vasculature during surgery. It may lessen the risk of intraoperative aneurysm rupture and also allows evacuation of intramural calcification and thrombosis before definitive clipping in large aneurysms.

**Methods**

A prospective study was conducted on patients treated at Neurosurgical Clinic in Niš who suffered aneurysm rupture in the period from January 2012 to December 2016. According to initial clinical status, we could grade patients using Hunt-Hess scale and brain CT scan findings determined their Fisher scale. During the research, the patients who belonged to I and II and 1, 2 and 3 grade by the Hunt-Hess and Fisher scale, respectively, were monitored. The study covered a total of 182 patients who were surgically treated for aneurysmal change in brain blood vessels. Patients were in all of the cases initially postoperatively treated in the Intensive Care Unit. All of the patients received anti-edematous therapy, analgesics before and after the operation.

**Results**

Out of total 182 bleeding aneurysms treated, in 85 the operator decided to apply temporary clipping before placing a final clip.
Table 1. Localization of surgically treated aneurysms

<table>
<thead>
<tr>
<th></th>
<th>With applied temporary occlusion</th>
<th>Without applied occlusion</th>
<th>( \chi )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.carotis</td>
<td>10</td>
<td>12</td>
<td>0.632</td>
<td>0.959</td>
</tr>
<tr>
<td>a.cer. post</td>
<td>8</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.cer ant</td>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.cer med</td>
<td>38</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.com.ant</td>
<td>24</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>85</td>
<td>97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As far as the localization of treated aneurysms is concerned, no statistical significance was found in relation to the application of temporary clipping before the final placement of a clip (\( \chi = 0.632; p = 0.959 \)).

Ischemic changes diagnosed using brain MSCT with associated neurological deficit were recorded in 12 patients treated with temporary occlusion while the same was present in 32 patients with no temporary occlusion.

Table 2. Neurological deficit

<table>
<thead>
<tr>
<th>Ischemic changes</th>
<th>With applied temporary occlusion</th>
<th>Without applied occlusion</th>
<th>( \chi )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>73</td>
<td>65</td>
<td>8.801</td>
<td>0.003</td>
</tr>
<tr>
<td>yes</td>
<td>12</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>85</td>
<td>97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The application of temporary occlusion significantly influenced the presence of the resulting neurological deficit (\( \chi = 8.801; p = 0.003 \)).

The lethal outcome occurred in 7 patients with applied temporary occlusion while in the group without temporary occlusion, 26 patients succumbed to the effects of the intervention.
Table 3. Lethal outcome

<table>
<thead>
<tr>
<th>Lethal outcome</th>
<th>With applied temporary occlusion</th>
<th>Without applied occlusion</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>no</td>
<td>78</td>
<td>71</td>
<td>10.522</td>
<td>0.001</td>
</tr>
<tr>
<td>yes</td>
<td>7</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>85</td>
<td>97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The lethal outcome was significantly more frequent among patients without applied temporary occlusion ($\chi^2 = 10.522; p = 0.001$).

Table 4. Duration of temporary occlusion

<table>
<thead>
<tr>
<th>Resulting ischemia</th>
<th>Lethal outcome</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 3 min</td>
<td>0</td>
<td>0</td>
<td>0.046</td>
</tr>
<tr>
<td>4-10 min</td>
<td>4</td>
<td>2</td>
<td>0.829</td>
</tr>
<tr>
<td>Over 10 min</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>12</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

The duration of temporary occlusion does not significantly affect the final outcome of the treated patient ($\chi^2 = 0.046; p = 0.829$).

**Discussion**

An early surgical procedure involving aneurysmal change clipping and basal cisterns blood clearing is a significant therapeutic procedure in preventing vasospasm occurrence, as shown by Taned 11 and Solomon 12.

Surgical treatment of brain blood vessel aneurysms requires a wealth of experience, precision and good manual capability of the operator. To well observe the aneurysmal change, preserve all the surrounding branches, do good neck preparation and prepare it for putting the final clip require serious and painstaking work. Bleeding aneurysms are especially difficult to manage due to the condition of the very brain mass that is swollen, tense, prone to frequent bleeding, preventing the preparation of supply vessels and access to the very aneurysmal change.

Roganović et al. described the main artery occlusion in 4 patients and in 3 more patients the posterior communicating artery was asymptptomatically occluded along with the aneurysm. ACI (acute cerebral infarction) was occluded in two patients while distalACA segment (parasagittal frontal and frontobasal infarction) and the final branch of ACM (temporoparietal infarction) 13 were occluded in one patient each. The risk of re-rupture in the course of work is also high. Postoperative complications in the form of incomplete closure of the aneurysm, perforator occlusion, occlusion (subocclusion) of the main artery stem are also present. It is suggested that another clip should be previously placed distally in relation to the aneurysm in order to prevent filling of the fundus 14,15.
During our research, out of the total 182 bleeding aneurysms, in 85 of them the operator decided to apply temporary clipping before placing the final clip (Figure 1). As far as the localization of treated aneurysms was concerned, no statistical significance was found in relation to the application of temporary clipping before the final clip placement ($\chi^2 = 0.632; p = 0.959$).

Placement of a temporary clip on the supply blood vessel with an aneurysm enables reduced blood flow through the blood vessel and therefore through the aneurysm. Aneurismal change volume reduces making the aneurysm easier for manipulation and enabling better preparation and separation of the surrounding branches. In the case of aneurysm rupture, the blood quantity is lower and under lower pressure, therefore clip placement is facilitated. However, our study showed that the application of temporary occlusion significantly influenced the presence of the resulting neurological deficit ($\chi^2 = 8.801; p = 0.003$), while the lethal outcome was significantly more frequent among patients who were not treated with temporary occlusion ($\chi^2 = 10.522; p = 0.001$). Some studies have shown that postoperative complications in terms of ischemic lesions and neurologic defects are associated with the duration of temporary occlusion. The prolonged use of temporary clips and vasospasm was the cause of ischemia in 13.9% and 8.3% of the patients, (16.17). The works of other authors do not show that there is a connection between the duration of occlusion and the occurrence of ischemia \textsuperscript{a,b}. During our study, we did not record the effect of temporary occlusion duration on the outcome of treated patients ($\chi^2 = 0.046; p = 0.829$). Also, independently of placing temporary occlusion, vasospasm can occur as a postoperative complication leading to a neurological deficit and lethal outcome. Whether ischemia will develop is affected by the following factors: reduction of blood vessel lumen by at least 50%, blood pressure values, intracranial pressure and blood viscosity. Also, atherosclerotic changes and the concentration of oxygen, carbon dioxide and haemoglobin in blood significantly influence the occurrence of vasospasm. The length of the stenosis caused by vasospasm and the quality of anastomoses on the base and in the Circle of Willis is also significant\textsuperscript{c}. Contrary to this, the research of Malinova and her associates showed that the use of temporary occlusion does not lead to provocation of vasospasm and they believe that we should not hesitate in using elective temporary clipping if it is considered appropriate \textsuperscript{d}. Therefore, surgical treatment of aneurismal processes requires a wealth of experience, knowledge, precision, and with all this effort made, the prognosis of healing is uncertain. There still remains a dilemma on whether it is desirable to place a temporary clip.
Conclusion

The application of temporary occlusion enables easier placement of the final clip. The application of temporary occlusion influenced the presence of the resulting neurological deficit. There still remains a dilemma: to apply temporary occlusion or not? Our research has showed that it is necessary to avoid the use of elective temporary occlusion, but if the situation requires, it is not disputed to apply it. It is assumed that it may be one of the causes of vasospasm provocation, since it is a bleeding aneurysm.

REFERENCES


