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tytuł pracy: „*Kliniczne i radiologiczne aspekty tętniaków wewnątrzczaszkowych  
a wybór metody leczenia*”

### Summary

An aneurysm is a localized, abnormal distended lumen of the vascular vessel or the heart. The classification of aneurysms is based on their morphology, number, size, location, and the mechanism of formation. Intracranial aneurysms are the most common (75%) type of vascular malformations of the brain. Their prevalence in the population is estimated at about 3.2% (14). In most cases, they remain clinically silent, however, when they rupture they cause intracranial bleeding (subarachnoid and/or intracerebral), which is dangerous to life and health. Based on their shape, aneurysms are divided into two types: saccular (80% of all aneurysms) and fusiform, which are rare. The causes of aneurysm formation are complex. The *pathomechanism* of the formation is connected with congenital developmental cerebrovascular disorders, defects in the construction of the walls of the arteries and the influence and distribution of hemodynamic forces of the blood flow. The following factors predispose to the formation of aneurysms of the brain: the female gender, the positive family history (genetic), polycystic kidney disease, atherosclerosis, and inflammation of the vascular wall. The risk factors of formation and rupture include: hypertension, smoking, alcohol consumption, and cocaine addiction. Aneurysms usually occur at the division of the vessels; they increase with age, and usually break at about 50 years of age. In 85% they are located in front of the circle of Willis, mostly on the anterior communicating artery, and anterior cerebral artery (30-35%). About 20% of patients have multiple aneurysms. Increasingly, *unruptured* aneurysms are diagnosed as an incidental find. However, the most common manifestation of the aneurysm is rupture with the subsequent subarachnoid bleeding and all its consequences.

Until the nineties of the last century, the main way to treat aneurysms was surgery. The development of interventional radiology has opened a new possibility of the

aneurysm treatment. The introduction of detachable thrombogenic spiral by Guglielmi contributed to the faster development of endovascular therapy. The extension of this method by balloon remodelling or the introduction of a stent is now an alternative or even a leading treatment of intracranial aneurysms.

The aim of my work was to answer the following questions:

1. What clinical and radiological data influenced the choice of treatment of intracranial aneurysms using the surgical method?
2. What clinical and radiological data influenced the choice of treatment of intracranial aneurysms using the endovascular method?
3. The comparison of hospitalization duration depending on the method of treatment of intracranial aneurysms.
4. The comparison of methods of treatment for early complications.

The study, which was determined by the topic of the work, was a retrospective analysis of the medical records of patients, the results of cerebral angiography and computed tomography angiography. The study group included 131 patients (90 women and 41 men) aged 25-82 years (median 53 years) admitted to the Department of Neurosurgery, University Hospital in Bialystok due to the treatment of 142 intracranial aneurysms in the period from 1<sup>st</sup> January 2011 to 31<sup>st</sup> December 2012. On admission, the symptoms presented/reported by the patients were thoroughly evaluated, together with their clinical condition, morphological picture and the location of intracranial aneurysms.

The traditional method (neurosurgical) provided 44 aneurysms; the remaining 98 changes were eliminated from the circulation via the intravascular embolization, which gave rise to a division of the patients into two groups.

The comparison of the patients from both groups revealed that they vary significantly in terms of dimension of the neck of the aneurysm, the aneurysm/neck rate, the length of stay in hospital after surgery; other parameters were not significantly statistically different.

A correlation has also been shown between the above factors and the choice of treatment. In patients whose neck of the aneurysm was 4 mm or less the endovascular treatment was carried out over three times more often than surgery ( $p < 0.001$ ). The

patients whose aneurysm/neck rate was  $< 1.5$  (aneurysms with the wide neck) were treated surgically 2.5 times more likely than using the endovascular method ( $p < 0.001$ ). The location of the aneurysm also significantly influenced the choice of the treatment ( $p < 0.001$ ). Aneurysms located on the anterior communicating artery and internal carotid artery were in the vast majority of cases (93% and 90%) treated using the endovascular method. In contrast, aneurysms located on the middle cerebral artery were more often (82%) treated surgically.

The rupture of aneurysm, meningeal symptoms, the appearance of subarachnoid haemorrhage independently from each other also appealed for the choice of the intravascular method ( $p = 0.041$ ,  $p = 0.039$ ,  $p = 0.042$ ).

The relationship between the type of treatment and the patient's discharge from the hospital ( $p = 0.016$ ) was noticed quite surprisingly, and was probably associated with the worse clinical status of patients treated using the intravascular method. Among patients treated with the endovascular method 52.0% were discharged home, and 42.9% were referred to the neurology department, while among surgical patients 72.7% went home and 18.2% to the neurology department. The treatment of multiple aneurysms was more often performed by neurosurgeons (58.8%), while single aneurysms were more frequently supplied by interventional radiologists (72.8%) - this was statistically significant ( $p = 0.008$ ).

Age, the diameter of aneurysm, the assessment of patients in the Hunt-Hess scale and GCS do not differ significantly between the two groups of patients. The following parameters had no statistically significant effect on the choice of treatment: gender, the mode of carrying out the procedure (emergent/elective), the symptoms on admission to the hospital, accompanying cerebral oedema.

The patients who develop complications, such as headache, dizziness, vomiting differ significantly from those who do not have these complications. They differ in terms of the value obtained in the H-H scale and the length of stay in the hospital after the surgery. The median for the assessment of the clinical condition in the H-H scale in patients with complications is 1 degree, and for patients with no complications 0 degrees ( $p = 0.019$ ). The worse condition of the patients on admission caused the more frequent appearance of complications and the length of hospital stay after surgery. The patients

with complications are hospitalized longer after the treatment than those without complications ( $p = 0.008$ ) (the median of stays amounts to 8 and 6 days, respectively). Rupture of the aneurysm, meningeal symptoms, SAH and brain oedema also influence the occurrence of complications. They occurred more frequently (28.8%) in patients with ruptured aneurysm than in those with *unruptured* aneurysm (8.7%) ( $p = 0.002$ ). In patients with the meningeal symptoms, pain occurred in 30%, whereas in the absence of meningeal symptoms it occurred in 8.3% of cases ( $p = 0.001$ ). In cases of SAH, complications occurred in 30.3% of patients, whereas if there was no bleeding in only 9.3% ( $p = 0.002$ ). Complications occurred in 31.5% of patients with brain oedema and in a far smaller proportion (11.4%) in patients with no brain oedema ( $p = 0.003$ ).

The mode of carrying out the procedure also significantly influenced the occurrence of complications ( $p = 0.002$ ). Among patients treated on an emergency basis 28.6% of cases had complications, and in patients undergoing an elective procedure this percentage was significantly lower and amounted to 7.7%. The patients with complications were more frequently discharged to the neurology department (34.0%) than home (10.8%) ( $p = 0.004$ ).

There was no statistically significant correlation between the way of treatment and the incidence of complications, such as headache, dizziness, and vomiting. In the endovascular and surgical treatment the complication rate was similar and amounted to 19.4% and 18.2%, respectively.

There was no evidence of the impact of any factors on the emergence of peri-operative complications, and the correlation between them and the choice of the method of treatment. The univariate analysis calculated that the patients with peri-operative complications longer remained in the hospital after surgery by an average of 38% than patients without peri-procedural complications.

The patients, who are treated using the intravascular method, remain shorter in the hospital after the procedure than surgically treated patients (the median 5 and 8 days, respectively).

Nicotine addiction, coexistence of hypertension, atherosclerosis, diabetes, thyroid disease, heart condition, the prior embolization of cerebral aneurysm, as well as the treatment of more than one aneurysm at the same time had no significant effect on

the appearance of complications, such as headache, dizziness, or vomiting.

Age, gender, the state of consciousness, the assessment in the GCS scale, diameter, the width of the neck, the aneurysm/neck rate and the location of aneurysm in patients with and without complications did not significantly differ.

The conclusions presented below are based on the group of patients treated in the Department of Neurosurgery, University Hospital in Białystok:

1. The choice of treatment of intracranial aneurysms using the surgical method included: the presence of multiple aneurysms, the location of aneurysms on the middle cerebral artery, the wide neck of aneurysm, ruptured aneurysm with the concomitant intracranial hematoma requiring surgical intervention.
2. The choice of treatment of intracranial aneurysms using the endovascular method was influenced by: the severe clinical condition of the patient, the location of aneurysm on the internal carotid artery and the anterior communicating artery, the anterior cerebral artery and in the basilar artery basin, the narrow neck of the aneurysm, the high aneurysm/neck rate, ruptured aneurysm with or without intracranial hematoma does not requiring surgical intervention.
3. The patients being treated due to intracranial aneurysms using the intravascular method were hospitalized shorter than the patients treated using the surgical method, and because of the less invasive procedure, most patients with intracranial aneurysms were treated using the intravascular method.
4. The patients treated on an emergency basis using surgical and endovascular method had more complications than those treated on an elective basis, which was also associated with the longer hospital stay.

In short period of time both methods of treatment of intracranial aneurysms are comparable in terms of effectiveness and complications.

The choice of therapeutic method is not always unambiguous. It depends on the size, location, morphology of aneurysm, the clinical condition of the patient, and his/her age. Each way of supplying cerebral aneurysms has its advantages and disadvantages, and both treatments are excellent alternatives for themselves. However, in my group of patients most aneurysms were treated using the intravascular method because of the low invasiveness of the procedure as compared to the surgical operation method.