

# Abstract

The aim of the study was to assess the clinical, radiological and socio-economic results of the treatment of patients with middle cerebral artery aneurysms who were treated by classical craniotomy and clipping or using intravascular embolization techniques, determination of optimal therapeutic management in patients with ruptured and unruptured middle cerebral artery aneurysms, and determination of predilection factors that would allow to predict in which cases we should qualify patients with MCA aneurysms for embolization and in which for clipping.

The study included a group of patients with MCA aneurysms, which in terms of anatomical conditions and aneurysm structure were suitable for treatment with both methods. The study was not randomized. Of the 109 patients enrolled in the study were 71 women and 38 men, K: M = 1.87. The mean age of patients was 57.11 (SD  $\pm$  10.86, median 58 years). The study excluded patients who did not meet the inclusion criteria or belonged to one of the groups listed in the exclusion criteria. The assessment of the patient's condition at admission to the ward was based on the five-point Hunt and Hess scale. The majority of enrolled patients were patients with unruptured aneurysms - 74 (67.9%), while patients with ruptured aneurysms were 35 (32.1%). 54 patients with 54 aneurysms were subjected to the embolization procedure, and 55 patients with 55 aneurysms were subjected to the clipping procedure. Of the patients with ruptured aneurysms, six were in the 4th group of HH scale. Four of them died within 30 days of admission. The vast majority of aneurysms (88.07%) were located in the MCA division. The average aneurysm height was 6.7 mm (SD  $\pm$  4.08, median 6.0), the average width of the aneurysm dome was 5.47 mm (SD  $\pm$  3.42, the median 4.0), the average width of the aneurysm neck was 4, 12 mm (SD  $\pm$  2.26, median 4.00). The risk factors were dominated by hypertension (86.2% of patients), followed by hypercholesterolemia (56%), smoking (53.2%), previous subarachnoid bleeding (11%), and alcoholism (5.5%). As 4 patients died within 30 days of admission to hospital, 105 patients

were eventually followed up for 12 months and all of them came for follow-up visits. Assessment of the patient's neurological status was performed on all discharged patients on the day of discharge from the ward, 30 days from the date of discharge, followed by 90 days, 180 days and 360 days. Clinical evaluation was based on a modified six-point Rankin scale. Modified Raymond-Roy classification (MRRC) was adopted for both embolised and enrolled patients as a criterion for the degree of arterial recanalization. Control angio MR, DSA and in some cases aneurysm clipping also Angio CT was performed 6 and 12 months after surgery. In addition, a neuropsychological examination was performed 12 to 24 months after the procedure, the purpose of which was to assess higher nervous functions such as speech disorders, visual memory, auditory memory, abstract thinking, and visual-spatial functions.

Statistical analysis was developed using the R 3.5.3 software and TIBCO Statistica 13.3. Basic descriptive statistics were analyzed together with Shapiro-Wilk tests, as well as Fisher frequency test, Mann-Whitney U test analysis, nonparametric analysis of variance using ANOVA-type statistic. The significance level was considered to be  $\alpha < 0.05$ .

Based on the results obtained, the following conclusions were drawn: the embolization technique and the clipping technique can be used interchangeably in the case of ruptured and unruptured MCA aneurysms, the effectiveness of both methods assessed on the basis of the degree of aneurysm closure on the MRRC scale is the same immediately after surgery, however, in long-term (12 months) follow-up, the embolization efficiency was significantly lower than for clipping. The main factors responsible for the occurrence of complications and poor clinical condition of the patient after treatment are the presence of subarachnoid hemorrhage and the severity of the clinical condition on admission. For embolized patients, the highest risk of failure was associated with hypercholesterolemia. In the case of operated patients, the greatest risk of surgery failure depended on the size of the aneurysm (D: N ratio). In cases with ruptured MCA aneurysms, embolization should be considered more than surgery because of the lower percentage of rupture and thromboembolic complications. The

use of endovascular techniques should be considered for the treatment of "residual" aneurysms after incomplete clipping. The costs of treatment with endovascular techniques significantly exceed the costs of microsurgical treatment.