

Original Scientific Article

COMPARATIVE ANALYSIS OF SURGICAL AND ENDOVASCULAR TREATMENT OF INTRACRANIAL ANEURYSMS

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Abstract. *With a prevalence of about 2.3%, intracranial aneurysms represent the most common cause of spontaneous subarachnoid hemorrhage. Many studies compared currently most common therapeutic options-neurosurgical clipping and endovascular embolization, but so far no single solution in which therapeutic method should have an advantage has been found. The aim was to compare the outcome of treatment on discharge, among patients treated with clipping or embolization. The data of 62 patients treated at the Neurosurgery Clinic of the Clinical Center of Serbia, were obtained through discharge lists. The analysis included data on sex, age, Glasgow coma scale, aneurysm rupture, Hunt & Hess scale, localization, number of aneurysms, length of overall and postoperative stay as well as the existence of complications. The condition on discharge was assessed using the Glasgow outcome scale. In our study 37 subjects (59.7%) had a subarachnoid hemorrhage, while 25 (41.9%) patients were without bleeding. 30 patients underwent surgery, while 32 were treated by embolization. No significant relationship between the treatment modality and outcome on discharge was observed ($p=0.115$). Patients without bleeding had a significantly better outcome on discharge when treated by endovascular method ($p<0.001$), whereas in the group with a rupture no differences were found ($p=0.35$). Complications were significantly more common after surgery ($p=0.026$). No difference among the groups in the length of the total hospital stay was found ($p=0.246$), while a significantly longer postprocedural period was recorded following neurosurgical treatment ($p=0.029$). Groups treated with different modalities did not differ in the outcome on discharge. However, the percentage of complications was greater in the group of patients undergoing surgery, as well as the length of postoperative hospital stay. We believe that further detailed analyzes offering information on the condition of patients after a long period of follow-up are required.*

Key words: *aneurysms, clips, embolization.*

Introduction

Intracranial aneurysms are the most common cause of spontaneous subarachnoid hemorrhage. They can be of congenital, arteriosclerotic, traumatic, mycotic, embolic, and neoplastic origin. The prevalence of intracranial aneurysms is thought to be about 2.3%. Aneurysms that lead to spontaneous subarachnoid hemorrhage are most often not of congenital origin and are mostly localized in the anterior segment of the circle of Willis.

Currently, the most common therapeutic options in the treatment of intracranial aneurysms are neurosurgical clipping aneurysms and endovascular embolization. The goal in the treatment of aneurysms is to achieve immediate and permanent occlusion of the aneurysm lumen while preserving the parent blood vessel, surrounding blood vessels, as well as the brain parenchyma. Current recommendations indicate that unruptured symptomatic aneurysms should also be treated, given the possibility of rupture and the development of further complications [1].

Until the development of endovascular techniques, neurosurgery had primacy in the treatment of cerebral aneurysms. Since the beginning of the '80s of the last cen-

ture, great progress has been made in technology, imaging methods, development of new materials, which enabled rapid progress in the field of interventional radiological methods and led to a reorientation of many health systems to different therapy of these lesions. Since then, studies have been constantly conducted comparing these two treatments, but so far no unique solution has been found as to which method should be preferred [2].

The Goals

This study aimed to compare the treatment outcome on discharge of patients treated with neurosurgical clipping or endovascular embolization of intracranial aneurysms.

Materials and Methods

The study included 62 patients treated from 1.1.2017 to 31.10.2017. at the Clinic for Neurosurgery of the Clinical Center of Serbia. Data were obtained by reviewing discharge lists and included gender, age, Glasgow Coma Scale (GCS) at admission for all subjects, and aneurysm rupture data. The severity of subarachnoid hemorrhage in patients with a ruptured aneurysm was determined by grading patients on the Hunt and Hess (H&H) scale. The location and number of aneurysms, the method of treatment, the time when the intervention was performed were determined. Also, information was collected on the

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length of intrahospital stay and postoperative course and the existence of complications. The condition of patients on discharge was determined by the Glasgow Outcome Scale (GOS) - death outcome (1), persistent vegetative state (2), severe (3) or moderate disability (4), and good recovery - no symptoms or mild deficit (5).

The collected data were analyzed using standard statistical tests in the SPSS software package.

Results

The study included 62 patients, 45 females (72.6%), and 17 males (27.4%) (Fig. 1). The observed number of aneurysms was 70.

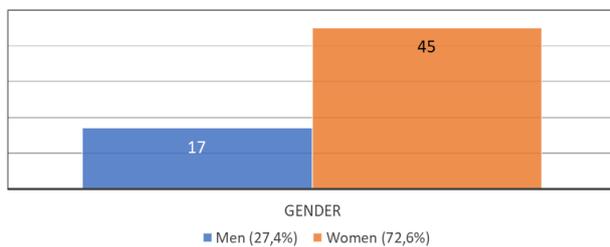


Fig. 1 Distribution of patients by gender.

The mean age was 53.47 years (SD = 11.94), the youngest respondent was 12 years old, and the oldest 78. No significant difference in mean age was observed between patients of different sexes ($t = -0.93$; $p = 0.920$) (Table 1).

Table 1 The average age of the patient

Gender	Average age	
Men	Average	53.24
	St. Deviation	10.59
Women	Average	53.56
	St. deviation	12.60

At admission 40 subjects had GCS 15 (64.5), 16 subjects GCS 13 and 14 (25.8), respectively, and 4 GCS between 9 and 12 (6.5%). GCS could not be determined in two subjects at admission because they were sedated (Fig. 2).

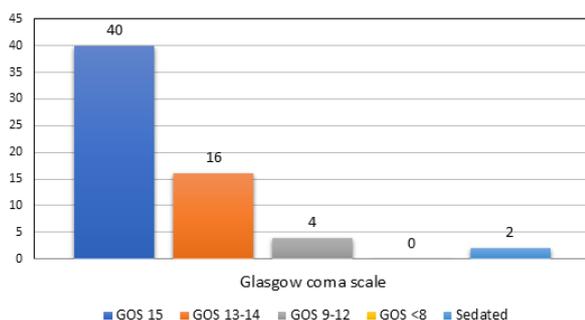


Fig. 2 Glasgow coma scale of patients on admission.

Subarachnoid hemorrhage was noted in 37 subjects (59.7%), while 25 (41.9%) were without bleeding.

Only one respondent (1.6%) had Hunt and Hess grade V, 9 respondents (14.5%) grade III, 24 (38.7%) grade II, 2 (3.2%) grade Ib, and 1 (1.6%) degree Ia. The majority of the patients in this study (25 respondents or 40.3%) were rated with 0 (Fig. 3).

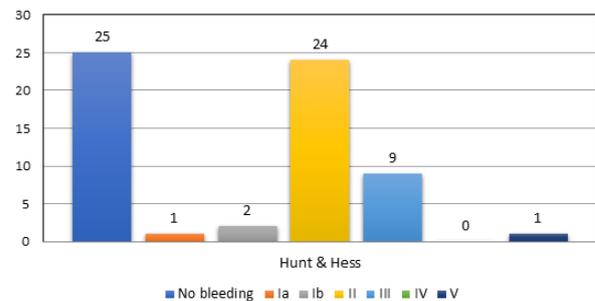


Fig. 3 Patient grades according to the Hunt & Hess scale.

The number of aneurysms ranged from 1 to 3 per subject. The largest number of subjects - 54 had 1 aneurysm (87.1%), 7 subjects (11.3%) had 2, and one subject (1.6%) 3 aneurysms.

Almost all of the aneurysms (95.8%) were localized in the anterior circulation and 3 (4.2%) in the posterior. Internal carotid artery aneurysms were the most common - 32 (45.7%), followed by middle cerebral artery aneurysms (ACM) - 19 (27.1%), followed by anterior communicating artery aneurysms (AcoAnt) - 11 (15.7%), aneurysms a. pericallosae were present in 4 cases (5.7%), a. superior cerebellum, a. anterior choroid, a. basilaris, and a. vertebralis 1 (1.4%) (Fig. 4).

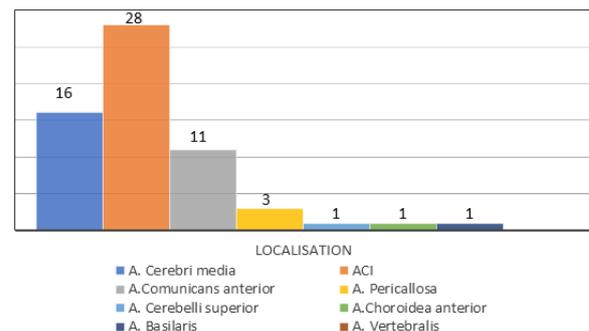


Fig. 4 Prevalence of aneurysms by localization.

Of the 62 patients presenting with subarachnoid haemorrhage included in the study, 30 patients underwent surgical treatment, while 32 were treated with the endovascular method. Statistical analysis did not show a significant association between therapy type and discharge outcomes (Mann-Whitney = 380.5; $p = 0.115$).

Looking only at the group of patients with subarachnoid hemorrhage due to aneurysm rupture, no significant difference was found in the outcome of discharge among patients treated with surgery or endovascular method (Mann-Whitney = 134.5; $p = 0.35$), while in the group of patients without

previous rupture, the outcome at discharge was significantly better after endovascular treatment (Man-Whitney = 15.5; $p < 0.001$) (Fig. 5).

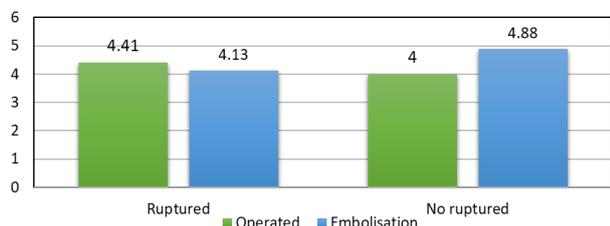


Fig. 5 Condition of patients at discharge expressed by the Glasgow outcome scale.

The percentage of complications was significantly higher in the group of patients treated with microsurgical aneurysm clipping ($p = 0.026$) (Table 2).

Table 2 Prevalence of complications, length of intrahospital stay, and duration of the postoperative treatment period

	Type of the procedure	
	Clipping	Embolization
Complication	11 (36.7%)	4 (12.5%)
Length of total hospital treatment (in days)	15.07	12.41
Length of postoperative period (in days)	12.2	8.03

Of the complications, ischemia (6.5%) was noted in 4 patients, 2 patients each had septicemia (3.2%), cranial nerve paresis (3.2%), and edema (3.2%), while 1 observed bleeding (1.6%), transient diabetes insipidus (1.6%), meningitis (1.6%) and hydrocephalus (1.6%) and diarrhea (1.6%).

There was no difference in the length of the total intrahospital stay among groups of patients treated endovascularly or surgically endovascular and surgical ($t = 1,171$; $p = 0,246$), while the postoperative period was significantly longer in the group of patients undergoing neurosurgical treatment ($t = 2,223$; $p = 0,029$) (Table 2).

Statistical analysis did not show a significant correlation between the age of the respondents and the outcome at discharge (ANOVA = 1.753; $p = 0.182$).

No significant association was found between the time elapsed from admission to the procedure and the discharge outcome (Kruskal-Wallis test; $p = 0.975$).

In our study, the localization of the aneurysmal dilatation was not statistically significantly associated with the outcome at discharge (Kruskal-Wallis; $p = 0.288$), nor with the existence of treatment complications (Fisher = 4.188; $p = 0.758$).

Discussion

The development of medical science and technology in the second half of the 20th and the beginning of the 21st century enabled interventional radiological methods to

stand side by side with neurosurgery. Since the first major studies in the 1980s, numerous studies have been conducted on an ongoing basis to determine which treatment for brain aneurysms should be preferred. To date, no consensus has been reached on which method is more effective, and the opinion has been accepted that the decision on the therapy that will be implemented should be made by the teams for the treatment of cerebrovascular diseases, for each patient individually. Some of the proposed guidelines that can help make a decision take into account the location, morphology of the aneurysm, preoperative grade and age of the patient, the possibility of dissecting the aneurysm after previous operations, and the possibility of injury to perforating branches [3].

The largest study comparing surgery and endovascular embolization of ruptured aneurysms was the International Subarachnoid Bleeding Study (ISAT) [4]. ISAT results showed that ruptured aneurysms that could be treated in both ways had a better outcome when treated by endovascular approach, but with a higher degree of rebleeding. ISAT results after 5 years of follow-up showed a lower mortality rate in the group treated by the endovascular approach, but there was no difference in morbidity. Also, higher rate of rebleeding in the group of embolized patients was demonstrated [5]. Numerous studies have shown that the degree of recanalization of blood vessels after endovascular treatment is higher [6]. Other studies showed better results in the early postprocedural period following endovascular obliteration, but demonstrated no significant difference in morbidity and mortality over longer follow-up [7]. The results of our study showed that there was no difference in the outcome at discharge between the groups of patients treated with different methods, while the outcome in the immediate perioperative period was better in the group of embolized patients, while over time mortality and morbidity equalized [8]. Above all, we should not forget other advantages of open surgery, such as the evacuation of blood from the cistern, which contributes to the development of vasospasm and allows normal cerebrospinal fluid flow, for which endovascular methods are not possible. It should be kept in mind that when combining surgical clipping and endovascular coiling, or subsequent surgery after the endovascular intervention, hematoma evacuation carries the risk of hematoma enlargement due to the use of antiplatelet drugs. Also, the observed incidence of vasospasm does not differ between patients treated with clipping or embolization [9]. Various studies demonstrated no significant difference in morbidity depending on treatment method in unruptured aneurysms, but better occlusion if treated by microvascular clipping [10–13]. The results of this study show that patients undergoing endovascular treatment have a better outcome at discharge in the group of unruptured aneurysms. However, the observed higher rate of complications after surgical treatment is consistent with the opinion of most authors [4]. In contrast to other studies, subjects included in our study did not show an association between age and discharge outcomes [3]. Our findings support claims that the

length of postoperative stay in the hospital for longer in patients undergoing surgery [14].

Conclusion

Among the groups treated with neurosurgical clipping or endovascular embolization, cerebral artery aneurysms did not show a difference in the outcome of treatment on discharge, expressed by the Glasgow outcome scale. However, the percentage of complications is higher in the group of operated patients, as well as the length of postoperative intrahospital stay.

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Given the increasing prevalence of arterial hypertension, it is possible that non-traumatic subarachnoid hemorrhage, most often caused by rupture of the intracranial aneurysm, will be an even more common problem in the future with more cases, and thus a greater burden on neurosurgeons, interventional radiologists and the health system as a whole. We believe that the final judgment on the choice of therapeutic method to be given priority in treatment requires a further comprehensive analysis that will, in addition to information on the condition of patients on discharge, provide data on the condition of patients after a long follow-up period.