



## HYBRID VASCULAR NEUROSURGERY – NEXT STEP IN THE MANAGEMENT OF INTRACRANIAL ANEURYSMS

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### ABSTRACT

After the implementation of endovascular neurosurgery there has been a strong debate between neurosurgeons and neuroradiologists about the best treatment option for aneurysms. The question is relatively straightforward in aneurysms treatable with both methods, where endovascular treatment has advantage due to its better outcome. However, with the development of new endovascular technologies an increasing number of aneurysms subjected to clipping are treated by endovascular way, but many aneurisms that can be easily treated by endovascular way are still treated surgically.

Although the majority of aneurisms are treated both by open and endovascular way, the optimal treatment method is selected individually. The main obstacle to this is single directional training of involved specialists. The specialists of hybrid vascular neurosurgery area have high qualification both in open and endovascular operations and are able to make a decision on the basis of the best treatment tactics, and not individually by own experience.

As a result of interpretation of scientific data it was concluded, that implication of hybrid approach to the management of aneurysms in subarachnoid hemorrhage may decrease mortality and improve outcome. Prospective randomized trials are required for statistical significance.

**KEYWORDS:** subarachnoid hemorrhage, clipping, endovascular coiling, hybrid neurosurgery.

### INTRODUCTION

After the implementation of endovascular neurosurgery there has been a strong debate between neurosurgeons and neuroradiologists about the best treatment option for aneurysms. The question is more or less straightforward in case of aneurysms, which are amenable for both endovascular coiling and clipping. In this case the preference is given to endovascular technique, which has better clinical outcomes. However, with the development of new endovascular technologies an increasing number of aneurysms subjected to clipping are treated by endovascular way, but many aneurisms that can be easily treated by endovascular way are still treated surgically.

Although the majority of aneurisms are treated both by open and endovascular way, the optimal treatment method is selected individually. The

main obstacle in choosing the appropriate treatment route is single directional specialization of the physician, involved in the treatment of patient. The specialists of the hybrid vascular neurosurgery area have high qualification both in open and endovascular operations and are able to make a decision on the basis of the best treatment tactics, and not individually, solving the problem by that.

The aim of the study is to evaluate the benefit of hybrid training of aneurysm specialists during the treatment of intracranial aneurism.

### MATERIALS AND METHODS

A retrospective analysis was performed on patients admitted to the University Stroke Center of Armenia over the period from June 2010 to March 2013. All patients were evaluated by a neurosurgeon using Hunt & Hess scale, assessing the neurological status. Similarly, all patients underwent non-contrast CT of the head, which was assessed by a radiologist and graded by Fisher's scale. Di-

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agnostic Cerebral Angiography was performed after the initial stabilization of patient's condition.

If an aneurysm was present, the decision of its further securing was made by a qualified neurosurgeon who was capable to perform both clipping and endovascular coiling.

Intra-arterial infusion of ultrahigh-dose (1x100mg/hour) "Verapamil" or transluminal balloon angioplasty was performed in case of symptomatic cerebral vasospasm development. The outcome was assessed using Modified Rankin's Scale at discharge, within 3 months and 1 year follow-up.

## RESULTS

A total of 105 patients were included in the study, among them 61 males and 44 females. The mean age of patients was 49 (18-79 years old) and the mean Hunt & Hess score was 3.2 (1-5) during the admission. In 81 (77.2%) patients it was decided to perform endovascular coiling whereas in the remaining 24 (22.8%) – clipping.

During the treatment 51 (48.6%) of patients developed cerebral vasospasm, however only 33 (31.4%) of them became symptomatic. All symptomatic patients underwent selective intra-arterial infusion of ultrahigh-dose "Verapamil" infusion and balloon angioplasty were utilized as an adjunctive therapy in 5 patients.

Satisfactory results (MRS  $\leq 2$ ) were registered in 48 (45.7%) of patients at discharge, 60 (57.1%) at 3 months and 68 (64.8%) at one-year follow-up. Overall mortality rate attributable to subarachnoid hemorrhage was 14.2% (15 patients) in one-year follow up.

## DISCUSSION

An extensive research of modern literature was performed in order to reveal current information regarding to hybrid management of intracranial aneurysms. While hybrid management of thoracoabdominal and other extracranial arteries are widely used [Clavijo L et al., 2004; Wu W et al., 2011; Chung C et al., 2014; Gouaillier-Vulcain F et al., 2014; Komooka M et al., 2015], there are only a few number of articles describing hybrid techniques in intracranial vascular neurosurgery [Qiu H et al., 2014]. Hybrid vascular surgery has been even implemented for the treatment of jugular venous pathologies [Chua W et al., 2012].

Only one group of scientists estimated the ad-

vantage of hybrid neurosurgical approach; however the number of patients was limited by individuals who had passed craniotomy with the removal of hematoma, which was developed as a complication of endovascular treatment [Yamakawa K et al., 2012]. Only 5 patients were included in the study.

All other scientific publications are consistent with case reports [Alozie A et al., 2011; Arko L et al., 2015] and research [Owasirikul W et al., 2013].

Taking into account the scant information in literature about hybrid neurosurgical approaches, the main comparison was performed with the articles describing the overall outcome of ruptured intracranial aneurysms' treatment [Hoh B et al., 2004; Frazer D et al., 2007; Pereira A et al., 2007; Taki W et al., 2011; Alaraj A et al., 2010; Gu D et al., 2012; Preiss M et al., 2012; Wadd I et al., 2015].

In our study the favorable outcome, which was consistent with MRS  $\leq 2$  was achieved in 48 (45.7%) of patients at discharge, 60 (57.1%) at 3 months and 68 (64.8%) at one-year follow-up. This is somewhat higher than 50% favorable outcome reported in literature.

Overall mortality rate attributable to subarachnoid hemorrhage in the study group at one-year follow up was 14.2% (15 patients) compared to 32% reported in literature.

## CONCLUSION

The implication of hybrid approach to the management of subarachnoid hemorrhage decreases mortality and improves outcome. Prospective randomized clinical trials are required for statistical significance.

- Possible scenarios of hybrid vascular neurosurgery's implementation include:
- Endovascular coiling of an aneurysm in acute phase of subarachnoid hemorrhage followed by clipping in case of continuous growth of the aneurysm;
- Primary clipping of the aneurysm followed by intra-arterial treatment in case of symptomatic vasospasm;
- Simultaneous endovascular coiling and clipping of different aneurysms in the same patient.
- Endovascular coiling of one aneurysm in acute period of subarachnoid hemorrhage followed by clipping of a different aneurysm at a later date;
- Intraoperative angiography during the clipping;
- Immediate endovascular coiling after failed clipping (and vice versa).

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