ORIGINAL ARTICLE

CONTENTS

Possibility of thromboaspiration method in treatment of embolic migration complication during arteriovenous malformation embolization of the head and neck localization

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ABSTRACT

Aim: To analyze the embolic migration complication during arteriovenous malformations (AVMs) embolization of the head and neck localization, and to demonstrate the possibility of tromboaspiration method in treatment of such complications in cerebrovascular region.

Materials and Methods: The endovascular intervention was performed in 116 patients with AVMs of the head and neck localization. We used a superselective catheterization of the external cerebral artery branches as a treatment method of AVMs embolization. During embolization of AVMs, the spherical and not spherical polyvinyl alcohol (PVA) emboli were implanted.

Results: The result of treatment was technically successful in 112 (96,6 %) patients with AVMs of the head and neck localization. There were 4 (3,5 %) cerebrovascular complications during AVMs embolization of the head and neck localization. In 2 cases a cerebrovascular complication arose during the AVMs embolization of head localizations. In those 2 cases the cerebrovascular complications were successfully treated conservatively. In other 2 cases cerebrovascular complications arose during the AVMs embolization of neck localizations. One patient died as result of a massive ischemic stroke in the vertebrobasilar zone. Another patient was successful treated by tromboaspiration method.

Conclusions: Any surgical intervention on the carotid arteries, including endovascular surgery, is associated with a risk to the health and life of the patient. A thorough angiographic diagnosis of the external and internal carotid and vertebral arteries is necessary before endovascular embolization. Modern endovascular technology, such as tromboaspiration, may be helpful to avoid embolic migration complication in cerebrovascular region.

KEY WORDS: arteriovenous malformation, cerebrovascular complication, tromboaspiration

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INTRODUCTION

Arteriovenous malformations (AVMs) are congenital vascular malformations as result of genetic glitch of embryonic angiogenesis [1]. The most difficult is the diagnostic and treatment of patients with AVMs localization in the head and neck area. This is due to the anatomical features of the structure of this region [2, 3]. Endovascular embolization of head and neck AVMs always carry the risk of embolism of functionally important cerebral vessels [4, 5]. We analyzed the embolic migration complication during AVMs embolization of the head and neck localization, and demonstrated the possibility of tromboaspiration method in treatment of such complications in cerebrovascular region. We also presented a clinical case of ischemic stroke in the vertebrobasilar zone in a patient with an AVM in the neck region, which developed as a result of the embolus migration from the occipital artery to the vertebral artery through an abnormal shunt located in the AVM region, with subsequent thromboaspiration of clots from the vertebral artery system.

AIM

The aim of the study was to analyze the embolic migration complications during AVMs embolization of the head and neck localization, and to demonstrate the possibility of tromboaspiration method in treatment of such complications in cerebrovascular region.

MATERIALS AND METHODS

The endovascular interventions were performed in 2014-2024 for 116 patients with AVMs of the head and neck localization. There were 56 men (48,3 %) and 60 women (51,7 %). The average age of the patients was (mean ± standard deviation) 31,6 ± 3,7 years. There were 87 patients (75,0 %) with AVMs of head localization and 29 (25,0 %) – of neck localization. We used a superselective catheterization of the external cerebral artery branches as a treatment method of AVMs embolization. During embolization of AVMs, the spherical and non-spherical polyvinyl alcohol (PVA) emboli were implanted.

Fig. 1. A view of the patient's neck at 16-year-old. AVM in the neck region with purple vascular spots on, the nape and neck.

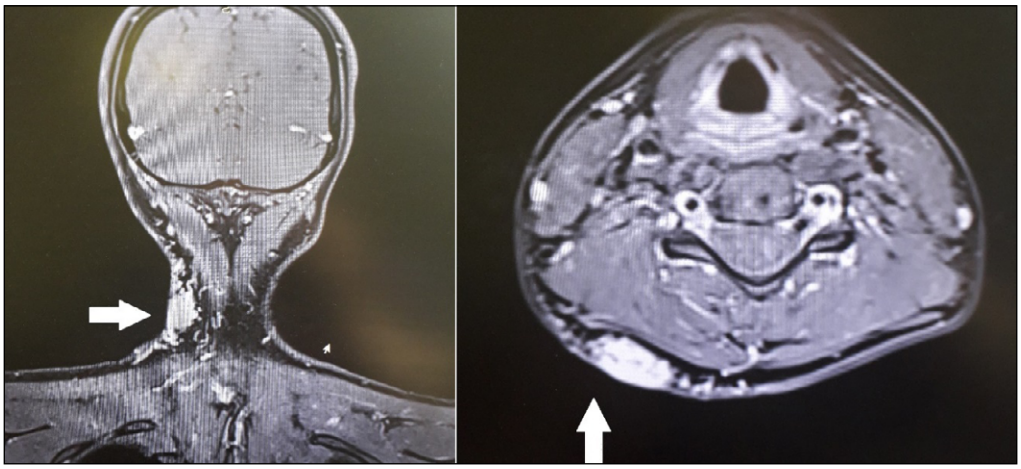

Fig. 2. MRI of the head and neck showed an AVM in the soft tissues in the occiput and neck region (white arrow).

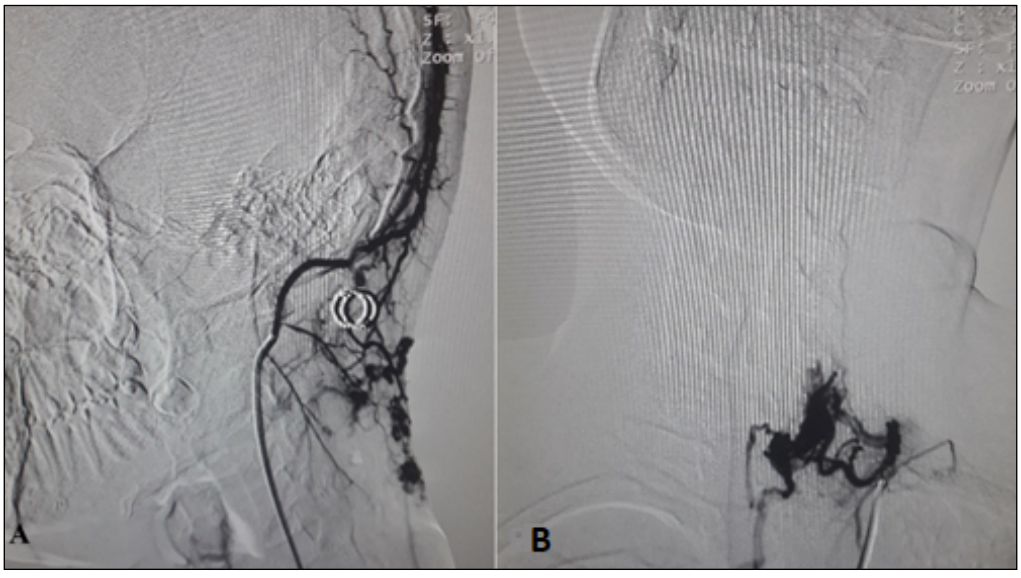

Fig. 3. The selective angiography of 16-year-old patient. The AVM of the soft tissues in the occiput and neck region: (A) – AVM filling from the left occipital artery; (B) – AVM filling from the left thyrocervical trunk.

Fig. 4. The selective angiography of 16-year-old patient. The AVM of the soft tissues in the occiput and neck region: (A) – the left vertebral artery; (B) – the right vertebral artery. Normal angiographic picture

Fig. 5. The selective angiography of 16-year-old patient. The AVM embolization from the left occipital artery: (A) – angiography before embolization; (B) – control angiogram. The beginning of shunting from the occipital artery into another arterial vessel (an arrow) was detected.

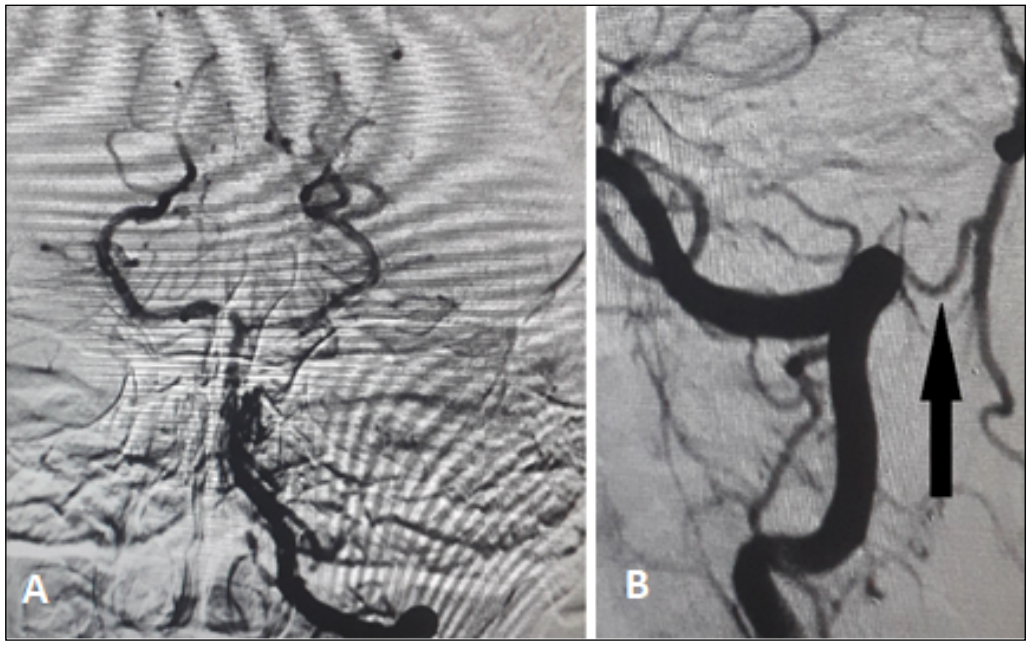

Fig. 6. The control vertebral artery angiography of 16-year-old patient: (A) – the angiogram revealed thrombosis of the basilar, superior cerebellar arteries on the right and left of the P1 segment and the posterior cerebral artery on the right and left; (B) – the thrombosis was due to the presence of a pathological arterial shunt between the left vertebral and left occipital arteries through the AVM area (an arrow).

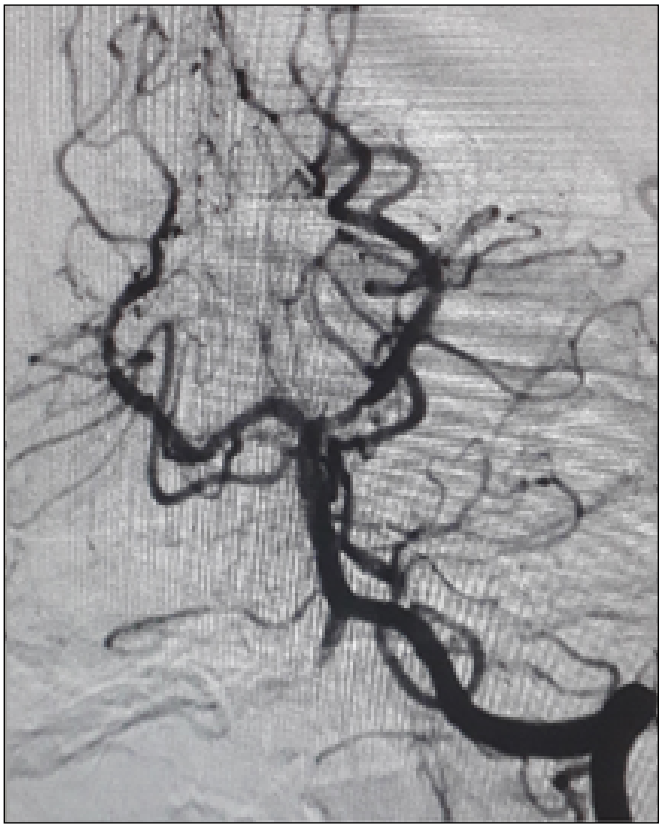

Fig. 7. The result of thromboaspiration performed in 16-year-old patients. The thromboaspiration favored the restoration of blood supply to the basilar, superior cerebellar arteries on the right and left and the posterior cerebral artery on the right and left.

Fig. 8. The 16-year-old patient. The result after rehabilitation.

This study was conducted in compliance with the principles of bioethics according to the Helsinki Declaration (1964) and the Universal Declaration on Bioethics and Human Rights (Paris, 2005). All patients signed informed consent to participate in the study.

RESULTS

The result of treatment was technically successful in 112 (96,6 %) patients with AVMs of the head and neck localization. There were 4 (3,5 %) cerebrovascular complications during AVMs embolization of the head and neck localization.

In 2 cases a cerebrovascular complication arose during the AVMs embolization of head localizations. They were conditioned by emboli migration from the external cerebral artery to the branches of internal cerebral artery. In those 2 cases the cerebrovascular complications were successful treated conservatively.

In other 2 cases cerebrovascular complications arose during the AVMs embolization of neck localizations. The analysis of complications showed, that ischemic stroke developed as result of the emboli migration through an abnormal arterial shunt between the occipital arteries and the vertebral artery, located in the AVM region. One patient died as result of a massive ischemic stroke in the vertebrobasilar zone. Another patient was successful treated by tromboaspiration method.

The following is a case of successful treatment of cerebrovascular complication after AVM embolization in 16-year-old girl. She was born with purple vascular spots on the nape and neck. The size of the spots has gradually been increasing (Fig. 1).

Patient was hospitalized in the endovascular neuroradiology clinic for angiographic examination, endovascular treatment with next surgical resection of AVM. The complex patient`s assessment included general clinical examination, electrocardiography, echocardiography, arterial Doppler ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI), contrast magnetic resonance imaging (MRI-angiography).

The MRI of the head and neck showed a vascular malformation in the soft tissues in the occiput and neck region with signs of arteriovenous shunting (Fig. 2).

At the next step we performed the selective angiography of subclavian, external and internal carotid, vertebral arteries. The AVMs filling from the left occipital artery and left thyrocervical trunk was detected (Fig. 3).

The signs of connection of AVM with brain vessels were not detected (Fig. 4).

The decision to perform AVM embolization from the left occipital artery was made. Before an embolization, the patient was generally anesthetized with propofol. The superselective catheterization of the occipital artery was performed, and embolization of AVM with «Embocure» emboli (Poland) 125-250 microns was started. During an embolization, the shunting from the occipital artery and AVMs vessels to another arterial vessel was appeared on the control angiograms (Fig. 5).

At the end of embolization, it was noticed that the patient did not regain consciousness and reacted slightly to irritation. Urgently, the patient was again taken for angiography. Angiography of vertebral and internal carotid arteries was performed. The angiogram revealed thrombosis of the basilar, superior cerebellar arteries on the right and left of the P1 segment and the posterior cerebral artery on the right and left. The thrombosis was due to the presence of a pathological arterial shunt between the left vertebral and left occipital arteries through the AVM area (Fig. 6).

The urgent thromboaspiration was performed, allowing us to restore a blood supply to the basilar, superior cerebellar arteries on the right and left and the posterior cerebral artery on the right and left (Fig. 7).

Following the intervention, the conservative treatment of ischemic stroke was applied. The patient`s condition improved from coma 1-2 to complete recovery of movement, consciousness and speech at 3-weeks follow-up. Moreover, the patient completely returned to normal life after two months of rehabilitation (Fig. 8).

DISCUSSION

Any surgical intervention on the carotid arteries, including endovascular surgery, is associated with a risk to the health and life of the patient. Neurological ischemic complications can be caused by migration of the embolic materials into the cerebral arteries or the vessel supplying the cranial nerves. This may lead to mortality or severe neurological deficit. To prevent this, meticulous attention should be paid to the angiographic findings demonstrating the neural arteries. However, the anastomotic channels between the target arteries and the branches coming off from the internal carotid, vertebrobasilar, or ophthalmic arteries are not always visualized on conventional angiography [6]. Existing vascular collaterals of the external and internal carotid artery systems should also be taken into account. The branches of the occipital artery supply blood to the skin and muscles of the back of the head, the auricle, the mastoid process, and the dura mater in the region of the posterior cranial fossa. The distal branches of the vertebral artery penetrate through the dura mater and go to the large occipital foramen. Extracranial segments of the vertebral artery also give rise to branches that supply blood to the deep muscles of the neck and meninges. The posterior meningeal branch originates from the vertebral artery above the level of C1 and supplies blood to the cerebellar tent and the medial parts of the dura mater of the occipital fossa. Therefore, there may be natural anastomoses between the vertebral and occipital arteries at the level of the distal small branches. In addition, the presence of a congenital vascular anomaly in the head and neck region increases the risk of large pathological arterial shunts and anastomoses between the internal and external carotid artery systems, including in the basin of the vertebral and occipital arteries. Therefore, it is important to have sufficient knowledge about the functional anatomy of the head and neck arteries having anastomotic channels with cerebral arteries, for which the injection of liquid embolic material or small-sized particles is contraindicated. Requiring experience and special training from the doctor. The use of interventional radiology in the treatment of AVM of the head and neck localization is still an understudied problem that constantly opens up new perspectives for research. Modern endovascular technology, such as tromboaspiration, may be helpful to avoid embolic migration complication in cerebrovascular region.

CONCLUSIONS

1. Any surgical intervention on the carotid arteries, including endovascular surgery, is associated with a risk to the health and life of the patient.
2. A thorough angiographic diagnosis of the external and internal carotid and vertebral arteries is necessary before endovascular embolization.
3. Modern endovascular technology, such as tromboaspiration, may be helpful to avoid embolic migration complication in cerebrovascular region.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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A – Work concept and design, B – Data collection and analysis, C – Responsibility for statistical analysis, D – Writing the article, E – Critical review, F – Final approval of the article

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