

# Endovascular Embolization of High-Risk Arteriovenous Malformation

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**Abstract:** *Intracranial arteriovenous malformations (AVMs) are relatively rare cerebral lesions – 0.06 up to 1.1% of the general population. These lesion are of great importance, because they can result in significant morbidity and mortality among young people. The ultimate aim in the treatment of AVMs must consist in preventing the risk of future bleeding. This is achieved by single-step or gradual elimination of the pathological vasculature from the normal brain circulation - mainly by application of intravascular embolization agents. After developing the non-adhesive liquid embolic agent Onyx, the implementation of radical embolizations with much lower risk became possible.*

**Keywords:** endovascular, embolisation, arterio-venous malformation, onyx , high-risk

## 1. Introduction

Intracranial arteriovenous malformations (AVMs) are relatively rare cerebral lesions – 0.06 up to 1.1% of the general population (1); (9). These lesion are of great importance, because they can result in significant morbidity and mortality among young people.

Currently, this type of pathology requires a multidisciplinary approach to its treatment. Cerebral AVMs are treated by main methods – classical surgery, radiosurgery, endovascular embolization, and a combination of these methods. However, recent technical and material achievements in medicine require endovascular embolization of intracranial AVMs as a primary and the first modern method in the treatment of these lesions, with the lowest risk and highest success rate.(2)

The ultimate aim in the treatment of AVMs must consist in preventing the risk of future bleeding (3). This is achieved by single-step or gradual elimination of the pathological vasculature from the normal brain circulation - mainly by application of intravascular embolization agents. After developing the non-adhesive liquid embolic agent Onyx, the implementation of radical embolizations with much lower risk became possible.

Onyx is a ready-to-use liquid embolic agent, consisting of ethyl-vinyl alcohol copolymer (EVON) combined with tantalum powder. The latter provides radiopaque visualization. The embolic agent is used via dimethyl sulfoxide (DMSO) placed in the microcatheters before its intravascular application (4). It is introduced lava-like, without fragmentation, allowing its good control without increased risk of transition into “undesirable” vascular structures. Should the embolic agent come into contact with blood or physiological saline – the latter precipitates into a

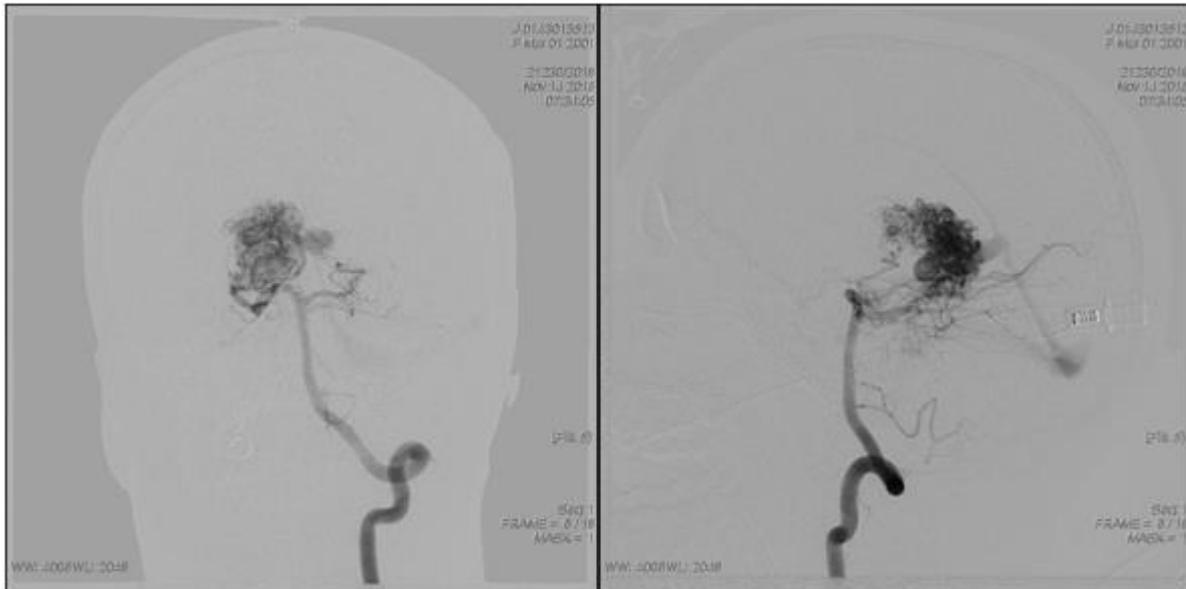
soft, gradual hardening mass.

## 2. Case Report

M.M., a 15-year-old girl was admitted in the clinic due to a severe headache episode and repeated vomiting. After performing a CT scan and magnetic resonance imaging of the brain an intraventricular hemorrhage and arteriovenous malformation was visualized at the level of the right thalamus. The malformation was situated in capsula interna and partly in the right lateral ventricle. For the complete clarification of the malformations’ anatomical characteristics the patient undergone a digital subtraction angiography (DSA).

Due to the arteriovenous malformation’s location the classical neurosurgery is at highest risk of affecting and damaging the important brain structures. The visualized pathological nidus is not suitable for radiosurgery treatment, because of its size, as well as previous rupture data. At a multidisciplinary discussion of neurosurgeons and radiologists a decision for performing an endovascular embolization of the pathological nidus rupture was made, and thereby its volume will be reduced and the risk of rebleeding prevented. Subsequently, in the presence of residual arteriovenous malformation, the patient will be referred for treatment by radiosurgery.

After catheterization of the right femoral artery by the Seldinger technique, a digital preoperative cerebral panangiography was performed. At the right an AVM was visualized temporo-occipital, parasagittal. The pathological vascular nidus is filled with contrast media via branches of the right posterior cerebral artery (posterior medial and lateral posterior choroidal arteries) and drained towards the deep venous sinuses.



**Figure 1:** A pathological vascular nidus is visualized – filled with contrast media via branches of the right posterior cerebral artery

The patient was administered general anesthesia and a catheterization by Seldinger technique was performed. 6F introductory catheter was inserted through the right femoral artery until the right vertebral artery. During the procedure for better navigation a Roadmap was performed. Control injections of contrast media in the left vertebral artery and the ipsilateral internal carotid artery were made in order to check for retrograde filling of the pathological vascular nidus via pathological communications with the front brain

circulation. After initiating the procedure the patient was administered 2500 units of heparin to increase the activated partial thromboplastin time.

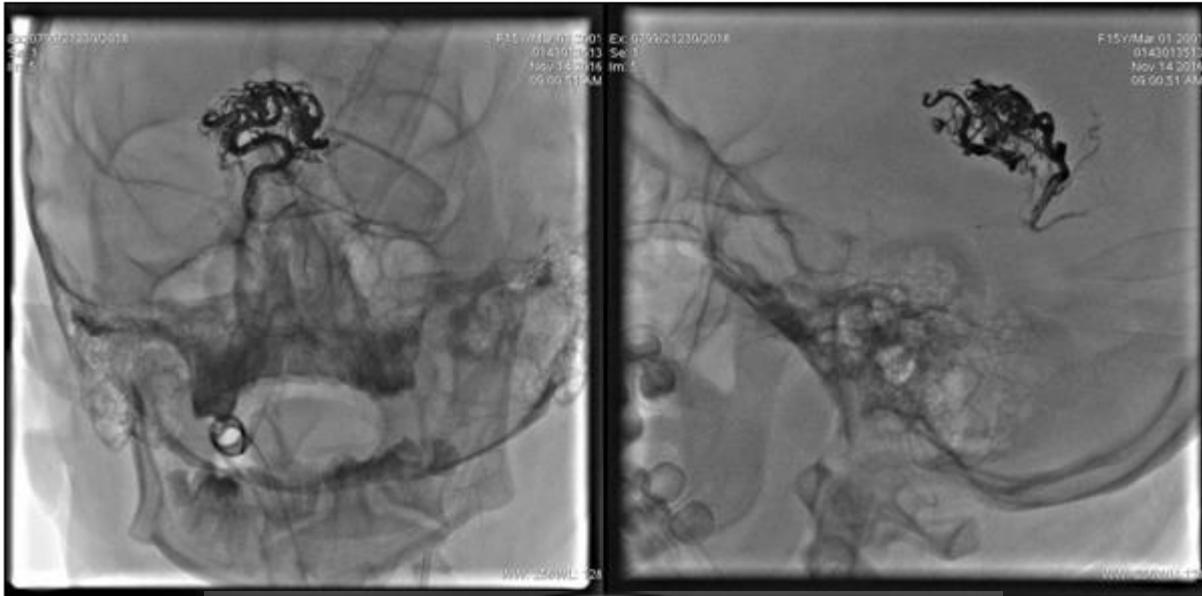
We proceeded to selective catheterization of the main feeding vessel by the microcatheter (Apollo) with 3 cm “detachable” tip and microintroducer Mirage 0'08.



**Figure 2:** Selective catheterization of pathological nidus.

Through the central pathological vessel feeding the malformation with Onyx embolic agent application was initiated. After pre-filling the microcatheter lumen (Apollo 3,5 cm) with physiological saline and application of 3 ml dimethyl sulfoxide (DMSO) the embolization was performed.

5 ampoules of the Onyx embolic agent were administered and a partial occlusion of the arteriovenous malformation was achieved, having inability to continue the embolization due to the high risk of near vital brain vessels blockage, supplying blood to the vital brain structures.

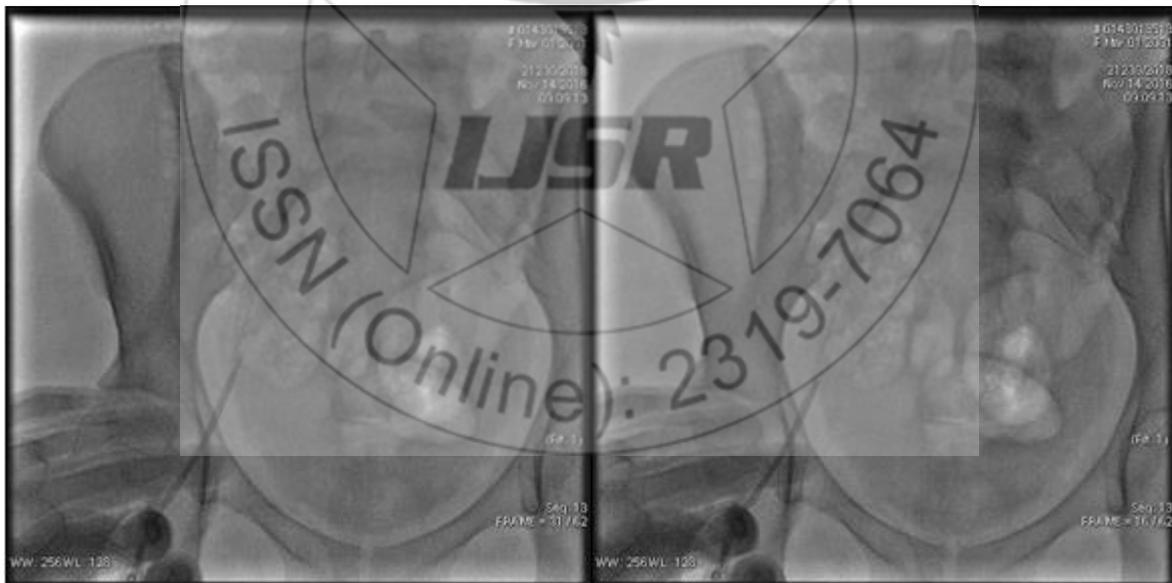


**Figure 3:** Post treatment amount of Onyx

Due to the pathological vascular malformation complex anatomy - its location in the right lateral ventricle area (the choroid plexus), the right thalamus, capsule interna on the right and the presence of deep high-debit venous drainage directing the deep venous sinuses - a high risk of bleeding was identified in the application of mechanical force to detach the microcatheter tip near the AVM. (5) (6) A decision was made to leave the microcatheter without trying

to apply tension stress and mechanical detachment of the intended tip in order to minimize the risk of pathological nidus rupture.

The microcatheter was transected at the level of the right femoral artery, and the cut end was left at the common iliac artery level.



**Figure 4:** The cut of microcatheter at the level of right femoral artery. intervention.

A control CT brain scan was performed and this did not reveal any intracranial hemorrhage evidence after the

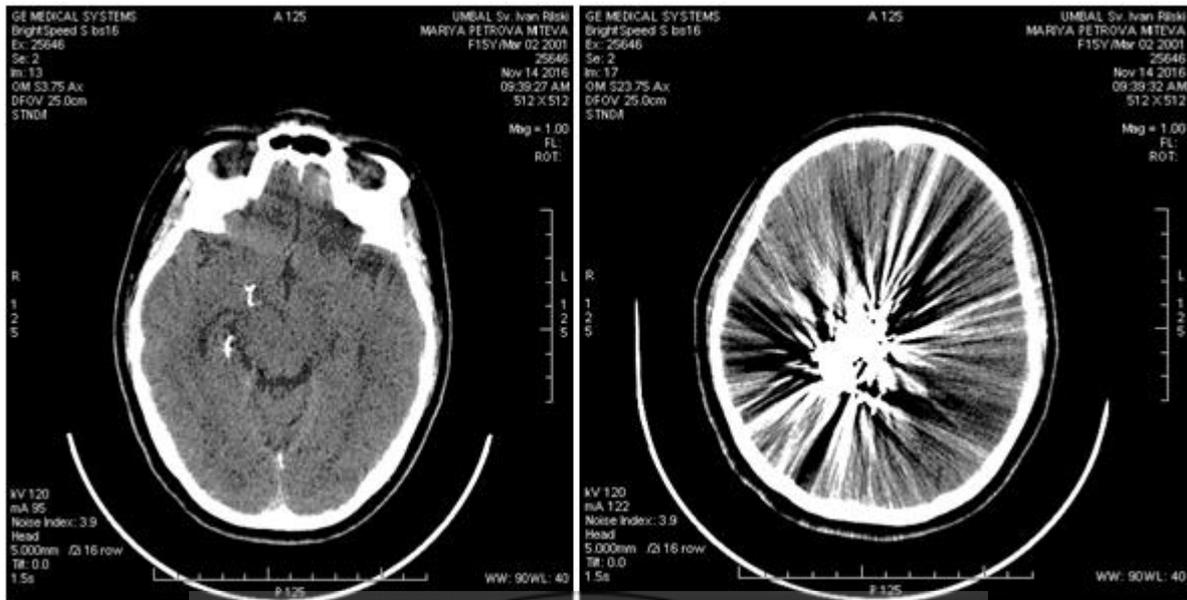
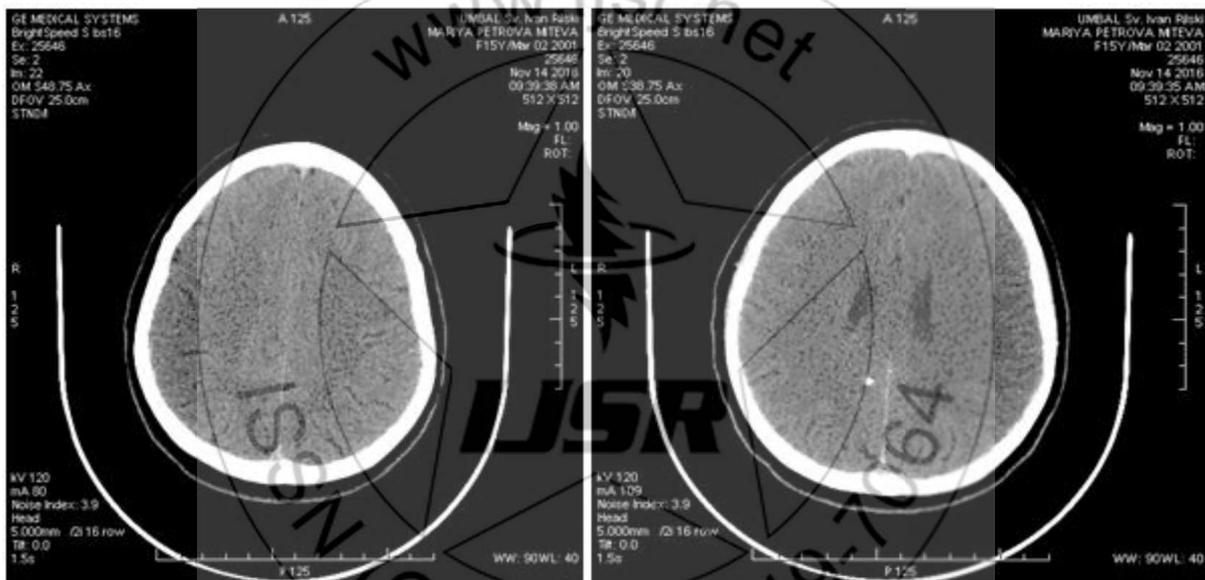


Figure 5: CT scan with no signs for haemorrhagic complications.



The patient had no complications during the postoperative period and no additional neurological symptomatology. After passing the intracranial hemorrhage acute period the patient was directed to radiosurgery of the residual arteriovenous malformation, which was held on Day 24 after the endovascular embolization.

### 3. Conclusion

The endovascular treatment of brain AVMs by the durable Onyx embolic agent remains a contemporary and essential treatment part of this type of pathology. Long-term studies in patients with “undetached” microcatheters left in the malformations are not conducted. However, a number of authors indicate no complications of the intravascular catheter placements in over 3-year follow-up, which significantly reduces the risk of rupture during the intervention. (6), (7),(8).

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