CASE REPORTS

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CEREBRAL ARTERIOVENOUS MALFORMATION RADIOSURGERY AFTER INTRACRANIAL HEMORRHAGE – A CASE REPORT AND LITERATURE REVIEW

Bosnian and Herzegovinian language text

Summary

Introduction. Treatment of cerebral arteriovenous malformations is very challenging and controversial in spite of current recommendations. Surgery is recommended in patients with hemorrhagic stroke, but in patients with good neurological status, when symptoms improve rapidly, the risk of surgical morbidity may be much higher than the risk of rebleeding. Case report. We report a case of a patient with an intracranial hemorrhage due to a ruptured arteriovenous malformation located in the right temporal region of the brain. Because of angiographic and anatomical features of the arteriovenous malformation (deep location and deep venous drainage, but also small arteriovenous malformation nidus size), radiosurgery was the preferred treatment modality. The patient was treated conservatively in the acute stage, and the arteriovenous malformation was subsequently completely eradicated with gamma knife radiosurgery. During the 3-year imaging follow-up, no signs of rebleeding were found. Also, angiography demonstrated that the arteriovenous malformation was completely excluded from the cerebral circulation. The patient was in a good condition and presented without neurological deficits or seizures during the follow-up period. Conclusion. All treatment modalities carry a risk of neurological compromise, but gamma knife radiosurgery may be a good option, even in cases with hemorrhagic presentation. It needs to be mentioned that complete obliteration takes approximately 1 to 3 years after the treatment, and in some cases it cannot be obtained.

Key words: Radiosurgery; Arteriovenous Malformations; Stroke; Cerebral Hemorrhage; Treatment Outcome; Risk Factors; Embolization, Therapeutic; Diagnosis

Introduction

Brain arteriovenous malformations (AVMs) are abnormal, congenital connections between arteries and veins leading to arteriovenous shunting without intervening capillary network of vessels [1]. The vascular conglomerate, the so called nidus of AVM, has no capillary bed and the feeding arteries drain directly to the draining veins. Nidus is the weak spot, due to abrupt transition from arterial to the venous

Sažetak


Ključne reči: radiohiruršta; arteriovenske malformacije; cerebralno krvarenje; ishod lečenja; faktori rizika; terapijska embolizacija; dijagnoza
system, from high to low pressure vessels, and may result in hemorrhage, perifocal edema and/or subsequent irritation of the surrounding brain tissue [2, 3]. Therefore, brain AVMs usually manifest with headache, seizures, focal neurological deficits, and in case of rupture, AVMs manifest with intracranial hemorrhage [4–6]. Seizures and neurological deficits are due to mass effect or steal phenomenon [4].

Brain AVMs are responsible for 3% of strokes and 9% of subarachnoid hemorrhages [7, 8], affecting about 0.1% of population. The risk of hemorrhage is 2 – 4% per year, and the average annual mortality from untreated AVMs is 1.0% [9, 10]. The annual rupture rate is at least 0.9%, but in patients with risk factors such as deep AVM location and/or deep venous drainage it is much higher [9]. Also, the risk of subsequent hemorrhage is increased when the brain AVM presents with hemorrhage, and it may be from 4.5% to as high as 34% [10]. The main diagnostic tool is angiography, but magnetic resonance imaging (MRI) is also mandatory, because precise location of AVM and its relationship with the surrounding brain tissue is a key factor in further treatment planning [11]. Depending on the size, location and angioarchitecture of AVM, surgery and radiosurgery are the primary treatment options. Endovascular embolization can be considered as an individual treatment, or as an additional option before surgical resection [12]. Using the original 5-tier Spetzler–Martin (SM) classification and the 3-tier modification, we can estimate the surgical risk, risk of complications, and the outcome [13, 14].

In this case report, we present a patient with a deep seated AVM in the right temporal region of the brain with a hemorrhage; it was treated conservatively in the acute stage, and subsequently completely eradicated with gamma knife radiosurgery.

**Case Report**

A 31-year-old right handed female, with no major comorbidities, presented with sudden onset of headache accompanied by nausea and vomiting. On admission, the results of physical and neurological examinations were normal. The laboratory blood test results were within normal limits. The computerized tomography (CT) scans of the head revealed a right temporal subarachnoid hemorrhage (SAH) and CT angiography demonstrated a deep seated AVM in the temporal lobe of the brain (Figures 1 and 2). She was initially managed at the neurocritical care unit with supportive treatment and blood pressure control. Subsequent MRI and digital subtraction angiography showed a right temporal AVM with the nidus dimension approximately 2 cm and branches supplied mainly from the right middle cerebral artery, some smaller branches from the right posterior communicating artery, and drainage through the basal vein of Rosenthal into the sinus rectus (modified Spetzler-Martin AVM grade 2) (Figures 3 and 4). The available treatment options were discussed with the patient. The symptoms subsided after several days of conservative treatment, and the patient was discharged after 10 days. One month after the hemorrhage, she underwent gamma knife radiosurgery with a prescription dose of 24 Gy with a 40% isodose line and treatment volume of 1.2 mL. During the 3-year follow-up, several MRI exams were performed, showing progressive reduction in flow voids and noticeably reduced enhancement (Figure 5). A cerebral angiogram was performed 3 years after the treatment showing no residual AVM (Figure 6). The patient is in a good condition, without neurological deficits or seizures during the follow-up period.

**Discussion**

The treatment of brain AVM must be carefully planned, especially in patients with previous hemorrhage. Surgical treatment is recommended for Spetzler-
Martin AVMs grade A, multimodal treatment must be considered for grade B, and observation with some reservations is suggested for grade C [14]. It is hard to estimate the risk of neurological injury, and risks of potential rehemorrhage in a patient who is in excellent condition. Microsurgical interventions seem to have a low risk of complications in small malformations in non-eloquent areas, and result in immediate cure [15]. Stereotactic radiosurgery (SRS) can be effective in small brain AVMs and it is a minimally invasive procedure, but complete obliteration of circulation requires approximately 1 to 3 years after treatment [16]. The two most important factors for complete obliteration of the AVM with radiosurgery are the diameter of the lesion, and maximum without deficit dose of radiation. Hemorrhage in the latency period and radiation edema or necrosis may occur as late complications [16–18].

In our case, it was a small, but deep seated AVM, with deep venous drainage, so the treatment options included surgical resection or radiosurgery. Together with...
the patient, we decided to perform radiosurgery, due to her good neurological condition, small amount of subarachnoid hemorrhage (Fischer scale grade 2) and quick resolution of symptoms. The previously mentioned disadvantage of radiosurgery is the risk of hemorrhage, until the AVM is completely obliterated, while surgical resection is not associated with such a possibility. Therefore, follow-up neuroradiological imaging was conducted even one year after the radiosurgery. Reduction of flow voids and reduced contrast enhancement on head MRI showed a successful treatment. Also, there is strong evidence in a large series of patients, showing reduced risk of hemorrhage during the follow up period [8].

Some case series reported that AVMs that are 3 cm in size or smaller, show high response rate to radiation [19–21]. A large series from the Karolinska Institute, including 1.319 patients showed an 80% overall obliteration rate [22]. Other authors reported results showing complications of radiosurgery mostly depending on two factors: lesion location and the total volume of treatment [23].

**Conclusion**

A great number of factors must be considered when choosing the optimal treatment for individual patients, and all of them carry risk of neurological compromise. However, gamma knife radiosurgery may be a good option, even in cases with hemorrhagic presentation. It needs to be mentioned that complete obliteration takes approximately 1 to 3 years after treatment, and in some cases it cannot be obtained.

**References**


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