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Optimization of endovascular treatment tactics of patients with large and giant cerebral arteriovascular malformations

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Urgency. Arteriovenous malformations (AVM) - are shown in 0.06 %-0.11 % of observations among brain vascular diseases. Diagnostic possibilities define frequency of diffusion of disease [1]. Large and giant AVM affect 16 to 35 % of all patients with this pathology. Their main clinical symptoms are intracranial bleedings (52-71 %), epileptic seizures (23-40 %), headaches and progressive neurological deficit (12%) [6, 7]. The lethality and rasping invalidism caused by large and giant ABM makes up 1 % and 1.5 % accordingly. The main objective of surgical treatment is excluding AVM from blood circulation, in connection with high risk of a repeated hemorrhage [3, 4, 5].

The majority of presented AVM classifications can be divided into 3 categories considering morphological characteristics, features of hemodynamic and parameters important for surgical treatment cerebral AVM. Medvedeva J.A., Matsko D.E. (1993) describe

angiomatous (cavernous, intermediate, racemose, admixed), non angiomatous (varices, fistulas and anastomoses, persistent embryonal vessels) and unclassifiable developmental anomalies.

In classification by Hassler (1986) reflects the characteristics of blood flow of resulting AVM vessels on which 4 groups are allocated: the main vessels, minor vessels, partial vessels, and also vessels with "normal" indicators of blood flow according to transcranial doplex scanning, without taking into account volume and localisation of AVM.

Classification by A. Pasqualin (1991) offered considers AVM volume and localisation, the type of feeding vessels, the character of a drainage vein and linear blood flow rate in resulting vessels on angio - and TCDS criteria, without the morphological data.

Localizations, volume and type of feeding define surgical tactics. One of classifications considering diameter, venous drainage, the relation to functionally significant zones is gradation published in 1986 R.F. Spetzler, N.A. Martin on which AVM is classified into 5 groups.

MR-angiography, selective angiography, PET allow to receive full understanding of malformations angioarchitecture and functional brain zones close to AVM. It is important for planning endovascular, a microsurgical intervention and/or radiosurgery [17, 18].

The basic methods of AVMs treatment are microsurgical excision, endovascular embolization by means of different embolic agents or their combinations and radiosurgery [10, 11, 12, 13, 14, 15, 16]. For today the question on interventions on ABM 1-3 stages on Spetzler-Martin in the world literature is covered completely enough and treatment tactics are conventional.

Most frequently the topic of giant and large malformations are located in functional zones and are fed from several arteries. Poor results of one stage extractions of those AVM promoted of new multistage treatments such AVMs: it contains preliminary embolizations for vast feeding and size with subsequent use of microsurgery for total removal [2, 16, 19].

The new conception of multistage treatment leads to decrease of risk of ischemic complications arising at step by step AVM obliterations [23]. For today superselective embolizations with an obligatory estimation of the functional importance of feeding arteries are considered to be the most adequate way of their obliterations [21].

By this time at endovascular treatment as an independent method, as well as for the purpose of preliminary embolization the most modern embolic agents are applied to extirpation – NBCA, ONYX, Glubran. There is only individual data about practice use of a single-step combination of two embolic agents; however results of application of such tactics in the literature are not covered completely.

The radiosurgery in relation to ABM IV and V gradation by Spetzler-Martin with application of equipment available now is not acceptable in cases of comprehensible in connection with the big area of an irradiation. In according to previous research, it can be used as a technique of treatment with preliminary endovascular embolization [15]. In Polenovs institute we operate on the patients who have transferred intracranial hemorrhage after one or several courses of proton therapy.

However there are also adherents of conservative treatment at patients with big and huge ABM who consider inexpedient interventions to the first manifestation of disease as intracranial hemorrhages and-or increase of generalized epileptic seizers to some times in a month/day [21, 22].

Thus, by this time definitive representation of the tactics of treatment of patients with large and giant AVM remains is subject to discuss. It can be explained by the absence of a uniform point of view on a problem among representatives of microneurosurgery, endovascular, radiosurgeries, conservative therapy. Today considerable quantities of new, improved embolic agents are applied in endovascular treatment of cerebral AVM, their quality being constantly improved. Thus accurately formulated intraoperations tactics of their application have not been found in the accessible literature to us. Rational use of this or that embolic agents depending on angioarchitecture AVM in a combination to application of a principle of step-by-step decrease of a blood flow in it still remains unknown. It also has served as the reason of carrying out of the present research.

Aim: The purpose of our research consisted in optimizing the tactics of endovascular treatment of patients with large and giant AVMs.

Materials and methods.

From 2006 to 2010, 37 consecutive patients with intracranial IV V graduates AVM were treated with Onyx and hystoacryl embolization at Russian Polenovs Neurosurgical Institute. The mean age of these patients was 57 ± 12 years. There were 18 men and 19 women. Clinical presentation included ICH in 9 patients (24,3%), seizer in 17 patients (46%), hemorrhage and epilepsy was in 10 patients (27%), and sudden ischemic disturbances in 1 patient (2,7%). In 18 patients nidus of AVM was racemose, and in 19 patients was racemose-fistulous angiographies sings. On gradation Spetzler-Martin IV stage was at 32, V – at 5 patients. All patients underwent multistage intravascular interventions: in 13 patients - 2 stages, in 9 – 3 stages, in 8 – 4 stages, in 7 patients 5 and more stages of embolizations were executed. The general condition of patients was stable, compensated on vital functions.

All the patients were subject to a standard complex of neurosurgical diagnostic. For carrying out of the comparative analysis they are parted on two groups: the basic group included 13 patients who have been operated with application of principles of stage-by-stage AVM embolization taking into account its angioarchitectonics and uses of the most modern embolic agents. The control group included other 24 patients in whom AVM embolization was carried out with the account of only 1-2 principles.

Panangiography with the angiographies catheters was made by a standard technique of Seldinger; chose priority feeding artery, a microcatheter established in a nidus of malformations and embolized of a fistulous compartment by means of admixture NBCA with Lipiodolum in various parities depending on a blood flow rate. Onyx was used to embolization of racemose nidus of AVM. Volume of AVM calculated with Kandelja E.I.'s formula (1985г.).

Radicality of endovascular obliterations allocated like total – 95-100%, subtotal – 75-94%, partial – 50-74% and obliteration of compartments less than 50% of AVMs volume.

Long term results of treatments estimated on index of Bartel, OGS and volume of obliterations (table 1).

Table 1.

Estimated to endovascular embolisations

Excellent	- total obliteration not neurologist deficits - subtotal obliteration not neurologist deficits
Good	- total obliteration with moderately expressed neurologist symptoms - subtotal obliteration with moderately expressed neurologist symptoms - partial obliteration not neurologist deficits
satisfactory	- total obliteration neurologist ; - subtotal with rasping neurologic deficiency; - partial obliteration with moderately expressed neurologist symptoms; - obliteration less than 50% V of AVM not neurologist deficits
Bad	- partial obliterations with rasping neurologic deficiency; - obliteration less than 50% V of AVM with moderately expressed neurologist symptoms; - obliteration less than 50% V of AVM with rasping neurologic deficiency

Results: 37 operated patients with large and giant cerebral ABM are executed 122 embolizations (26 ONYX, 96 – admixture NBCA with Lipiodolum).

In tab. 2 degree of radicalism of AVM obliterations depending on number of the spent stages is given at use of this or that composition and their combination.

Table 2.

Number of stage radicality	2	3	4	5 and more	Total	
ONYX (n=4)						Control group
Total	2		1		3(75%)	
Subtotal	1				1(25%)	
NBCA (n=20)						
Total		1		1	2(10%)	
Subtotal	3	2			5(25%)	
Partial	1	2	2		5(25%)	
Less than 50%	3	2	2	1	8(40%)	
ONYX+ NBCA (n=13)						Basic group
Total	1	2		2	5(38.5%)	
Subtotal	2	2	3	1	8(61.5%)	
					37(100%)	

Apparently from the table, application of not adhesive composition ONYX allows to reach larger radicalism for smaller number of stages.

At carrying out of the analysis taking into account radicalism, a kind embolic agents and neurologic semiology in the postoperative period the following data has been obtained.

In 24 patients has been used one of embolic agent. In 4 patients are executed 10 embolizations by means of not adhesive composition ONYX. From them at 1 (25 %) the patient is received excellent, at 2 (50 %) – good, at 1 (25 %) – satisfactory result. In 20 patients are executed 65 embolizations by means of admixture NBCA with Lipiodolum. From them at 3 (15 %) patients results was excellent, at 12 (60 %) – good and at 5 (25 %) - satisfactory.

In 13 patients the combination of both embolic agents is used at 47 intravascular operations (31 by means of NBCA and 16 by means of ONYX). From them at 9 (69 %) patients it is received excellent, at 3 (23 %) – good and at 1 (8 %) – satisfactory results.

Thus, the best results have been received at use of combination of both embolic agents (excellent result in 69 % of cases) in some stages.

We carry out the comparative analysis of radicalism depending on tactics of carrying out of embolization in two groups (picture 1).

In the basic group at 5 (38.5 %) patients total embolization is reached, at 8 (61.5 %) subtotal embolization is reached. In control group total embolization is reached at 5 (20.8 %) patients, subtotal embolization - at 6 (25 %), to 13 patients are executed partial and embolization less than 50 % from volume ABM (5 (20.8 %) and 8 (33.4 %) accordingly).

Results of application of offered tactics of embolization are presented in a picture 2.

In the basic group in 9 patients (69 %) the excellent result (a clinical example 1) is received, in 3 (23 %) patients the good result, in 1 (8 %) patient – satisfactory result is received. In control group only in 4 patients (17 %) the excellent result, in 14 (58 %) - good, and in 6 (25 %) – satisfactory (a clinical example 2) is received.

Discussion: On a wave of development of modern medical technologies, such as endovascular neurosurgery, microsurgery, and in radio surgeries, a choice of tactics of treatment large and giant AVMs remains need to discuss. After long years of discussions, the general opinion of the western school of neurosurgery is the multidisciplinary (combined) approach to treatment of the given pathology: preliminary embolization AVM, with the subsequent its microsurgical excision. However, despite application of new embolic agents (ONYX, Glubran), microsurgical toolkit and microscopes, the invalidism and a lethality remain impressing in comparison with results of treatment of patients with ABM I-III gradation on Spetzler-Martin. In connection with high risk of repeated hemorrhages, and also absence of the data about catamnesis of patients with AVM, received radial therapy (Gamma-knife, proton therapy), efficiency of the given technique remains disputable. The problem of our research consisted in search of the technique, allowing to improve efficiency of treatment of such patients, having raised radicalism, having lowered an invalidism and a lethality. Being based on morphological classification AVM offered by Medvedev and Matsko (1993), criterion of a choice of tactics was angioarchitectors nidus of AVM. For the purpose of decreasing the risk of the repeated hemorrhage, the first stage included the embolization of a fistulous portion AVM by means of an admixture histoacryl with lipiodolum depending on a blood flow rate.

In view of ability intranidal diffusions and easy controllability, for embolization of a racemose portion of AVM non-adhesive composition ONYX was used and promoted achievement of larger radicalism for smaller number of stages.

Considering small quantity of patients in investigated groups, to speak about statistical reliability of a technique it is not necessary, whereas there is an accurate tendency in improvement of efficiency of intravascular embolization of large and giant AVMs at the technique offered above.

Conclusions:

1. Application of a principle of step-by-step depression of a blood flow remains invariable at embolization AVM IV-V of gradation on Spetzler-Martin.
2. At embolization such AVM it is necessary to consider angioarchitecture with allocation fistulous, and racemose. Application histoacryl is the most convenient at embolization fistulous, and ONYX – a racemose compartments of AVM.
3. Application of offered tactics of embolizations has allowed to improve efficiency of intravascular embolization large and giant AVM: 1) to raise radicalism of operation from 37,5 % to 53,8 % with simultaneous reduction of number of stages with 4-5 to 2-3; 2) to enlarge number of excellent and good results from 75 % to 92 %, in control and basic groups accordingly.

Clinical example 1:

The patient S. 30 years, epileptic type of current AVM of the left temporal share, Spetzler-Martin V, a racemos-fistulose structure of malformations nidus, 1 stage – embolization of a fistulose portion by means of NBCA (fig. 3), 2 subsequent stages – embolization of a racemose portion by means of ONYX (fig. 4-5).

Outcome: subtotal embolization AVM, after operation became perceptible moderately expressed neurologic semiology which regressed completely within several days. In the remote period (through 12month) the neurologic semiology is presented moderated pyramid by insufficiency. An index of Bartela of 100 points. OGS – 5. Result excellent.

Clinical example 2.

The patient S. 56 years, with AVM areas of the central gyruses at the left, feeding from left MCA and ACA, with a drainage both in superficial, and in deep veins of a brain. Epileptic type of a current, Spetzler-Martin IV, a ratsemo-fistulose structure of a malformations nidus. The first

stage executes subtotal embolization by means of ONYX (fig. 6), the second stage reaches total obliteration AVM (fig. 7). In the remote period (in 12 months) the rasping neurologic semiology in the form of a hemiparesis is observed, a partial motor aphasia becomes perceptible, and epileptic attacks demand intensifying antiepileptic therapy. An outcome: the total embolization AVM, proof neurologic deficiency of ischemic character. The result is satisfactory.

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