The Calculation Algorythm of Cerebral Arteriovenous Malformations Residual Volume After Endovascular Embolization

G. S. Sergeev[1], V. P. Kurbatov[2], K. Yu. Orlov[2], V. A. Panarin[2], L. E. Kalneus[3], E. G. Tarancev[4], A. L. Krivoshapkin[2]

[1] Novosibirsk State Medical University, Ministry of Healthcare of Russia
[2] Academician E. N. Meshalkin Novosibirsk Research Institute of Circulation Pathology, Ministry of Healthcare of Russia
[3] Novosibirsk State University
[4] Institution of the Russian Academy of Sciences. Institute of Automation and Electrometry, Novosibirsk

Abstract

The treatment strategy of arteriovenous malformations (AVMs) of the brain is the actual problem of modern neurosurgery. Stage care AVM embolization is most often used in endovascular surgery for a safer turn it off. Therefore, it becomes actual to develop algorithms and objective criteria for assessing the degree of AVM turn off, in time as a visual assessment by angiograms and MR studies is subjective and has high deviation. We suggest an algorithm of a mathematical calculation of AVM devascularization percent after endovascular embolization with MRI. 13 patients with MRI of the brain (GE Signa Infinity, 1,5 T) were taken for analysis before and after partial embolization of AVM on angiography (Toshiba Infinix CS-s). During MRI was performed unenhanced and contrast angiography (TOF). Volume of Onyx-18 and AVM node with perinodulyar part of afferent and efferent vessels (before and after embolization) was calculated on the basis of mathematical and graphical analysis raster graphics exported from DICOM files MRI contrast angiography. Estimated volume Onyx® LES-eV3 on MRI compared to the amount specified in the surgical protocol. The analysis was performed independently by five specialists visually and with an original algorithm to determine the percentage of AVM devascularization after surgery. Average difference of values between specialists in visual assessment was 14,8 ± 1,6 % (range 40 %). Mean difference of values between experts with using the algorithm was 3,1 ± 0,34 % (range 5,8 %). Developed algorithm has shown its high independence from investigator in assessing the degree of AVM devascularization after embolization, which allows to receive standardized values.

Key words: Arteriovenous Malformation, Medical Software, Radicalism.

References

1. *Sergeyev G. S., Orlov K. Yu., Krivoshapkin A. L.* New software to standardize the assessment of embolization of cerebral arteriovenous malformations. Circulation Pathology and Cardiac Surgery. 2013. N. 1. P. 25–28 (in Russian).
2. *Chupakhin A. P., Cherevko A. A., Khe A. K.* Measurement and analysis of cerebral hemodynamic parameters in the presence of brain vascular anomalies. Ibid. 2012. N. 4. P. 27–31 (in Russian).
3. *Da Costa L., Wallace M. C., Ter Brugge K. G.* The natural history and predictive features of hemorrhage from brain arteriovenous malformations. Stroke. 2009. V. 40. N. 1. P. 100–105.

4. *Dubourg J., Messerer M.* State of the art in managing nontraumatic intracerebral hemorrhage. Neurosurg. Focus. 2011. V. 30. N. 6. P. 22.
5. *Fischbein N. J., Wijman C. A.* Nontraumatic intracranial hemorrhage Neuroimaging Clin. N. Am. 2010. V. 20. N. 4. P. 469–492.
6. *Gross B. A., Du R.* Natural history of cerebral arteriovenous malformations: a meta-analysis. J. Neurosurg. 2013. V. 118. N. 2. P. 437–443.
7. *Kim H., McCulloch C. E., Johnston S. C.* Comparison of 2 approaches for determining the natural history risk of brain arteriovenous malformation rupture. Am. J. Epidemiol. 2010. 15. V. 171. N. 12. P. 1317–1322.
8. *Laakso A., Hernesniemi J., Yonekawa Y.* Surgical Management of Cerebrovascular Disease. Springer. 2010. V. 15. P. 120.
9. *Sahlein D. H., Becske T., Nelson P. K.* Nidal embolization of brain arteriovenous malformations: rates of cure, partial embolization, and clinical outcome. J. of Neurosurg. 2012. V. 117. N. 1. P. 65–77.
10. *Soltanolkotabi M., Schoeneman S. E., Alden T. D.* Onyx embolization of intracranial arteriovenous malformations in pediatric patients. J. of Neurosurg.: Pediatr. 2013. V. 11. N. 4. P. 431–437.
11. *Sorensen G. A., Patel. S. K., Harmath C. B.* Comparison of Diameter and Perimeter Methods for Tumor Volume Calculation. JCO. 2001. V. 19. N. 2. P. 551–557.

Authors

Krivoshapkin Alexei Leonidovich, M. D. Med. , Professor, Corresponding Member of RAMN Sciences, Chief of Angioneurology and Neurosurgery Center, Academician E. N. Meshalkin Novosibirsk Research Institute of Circulation Pathology, Ministry of Healthcare of Russia, Chairman of Neurosurgical Department, Novosibirsk State Medical University, Ministry of Healthcare of Russia.
Address: 630055, Russia, Novosibirsk, Rechkunovskaya St.,15.
Phone number: +7 (383) 347-60-06. E-mail: alkr01@yandex.ru

Orlov Kirill Yurevich, Ph. D. Med., Head of Neurosurgery Department, Chief of Endovascular Neurosurgery Research Group, Academician E. N. Meshalkin Novosibirsk Research Institute of Circulation Pathology, Ministry of Healthcare of Russia, Assistant Professor of Neurosurgical Department, Novosibirsk State Medical University, Ministry of Healthcare of Russia.
Address: 630055, Russia, Novosibirsk, Rechkunovskaya St., 15.
Phone number: +7 (913) 707-89-73. E-mail: orlov72@mail.ru

Panarin Vyacheslav Alexandrovich, Neurosurgeon, Department of Neurosurgery, Academician E. N. Meshalkin Novosibirsk Research Institute of Circulation Pathology, Ministry of Healthcare of Russia.
Address: 630055, Russia, Novosibirsk, Rechkunovskaya St., 15.
Phone number: +7 (913) 793-43-32. E-mail: p0203@mail.ru

Sergeev Gleb Sergeevich, Resident of Neurosurgical Department, Novosibirsk State Medical University, Ministry of Healthcare of Russia.
Address: 630091, Russia, Novosibirsk, Krasny Prospect, 52.
Phone number: +7 (923) 150-48-55. E-mail: dr.gssergeev@gmail.com

Kurbatov Vladislav Petrovich, Ph. D. Med., Senior Researcher, Head of Department of Radiological and Functional Diagnostics, Head of the X-ray Computed Tomography Department, Academician E. N. Meshalkin Novosibirsk Research Institute of Circulation Pathology, Ministry of Healthcare of Russia.
Address: 630055, Russia, Novosibirsk, Rechkunovskaya St., 15.
Phone number: +7 (383) 347-60-06. E-mail: vk73@mail.ru

Tarantsev Igor Gennadyevich, Senior Software Engineer Software Systems Laboratory Computer Graphics, Institution of the Russian Academy of Sciences. Institute of Automation and Electrometry, Assistant Professor of Physics and automation technology research, Department of Physics, Novosibirsk State University.
Address: 630090, Russia, Novosibirsk, Akademika Koptyuga St., 1.
Phone number: +7 (913) 918-21-86. E-mail: egor@sl.iae.nsk.su

Kalneus Leonid Eugenevich, Student, Department of Chemical Physics and Biophysics, Faculty of Physics Novosibirsk State University.
Address: 630090, Russia, Novosibirsk, Pirogov st., 2.
Phone number: +7 (953) 878-91-31. E-mail: l.kalneus@yandex.ru