Giant intracranial aneurysm

Giant intracranial aneurysms (GIAs), are defined as intracranial aneurysms (IAs) with a diameter of ≥25 mm.

see also Complex intracranial aneurysm.

Classification

see Giant intracranial aneurysms of the anterior circulation.

see Giant intracranial aneurysms of the posterior circulation

Epidemiology

Giant intracranial aneurysms, are rare and heterogeneous lesions with complex vascular anatomy.

In 125 patients with 129 giant aneurysms (≥25 mm) who were treated between 1987 and 2007 at the Department of Neurosurgery of Helsinki University Central Hospital (HUCH). All the imaging studies and medical records were reviewed for relevant information.

The distribution of the giant aneurysms among regions was as follows: internal carotid artery (ICA) 39 %, middle cerebral artery (MCA) 32 %, vertebrobasilar and posterior cerebral artery (VB-PCA) region 25 %, and anterior cerebral artery (ACA) including the anterior communicating artery 5 %. The cavernous ICA segment (n = 21, 16 %) and the MCA bifurcation (n = 25, 19 %) were the most frequent specific locations. Half (n = 11) of all fusiform aneurysms were found in the VB-PCA region. As many as 41 % of the giant MCA aneurysms were ruptured. Major anatomic variations were found in three (2 %) and multiple giant aneurysms in three (2 %) patients. Wall calcification was noted in 24 % and intraluminal thrombosis in 33 % of ruptured giant aneurysms (n = 42).

The majority of giant aneurysms are located in the ICA and MCA regions, while the ACA region is an exceptional site. The MCA region is the most common site for ruptured giant aneurysms. Associated anatomic variations and the multiplicity of giant aneurysms are a rare finding [1)].

Quantification

Intracranial aneurysms (IA) are usually quantified according to their largest diameter. However, volumetry has recently been increasingly conducted as well, especially in giant intracranial aneurysms (GIAs). Since so far the true value of GIA volumetry is unknown

Magnetic resonance imaging of 69 unruptured GIAs in 66 patients was retrospectively evaluated. The largest diameter and volume were measured. Also, potential associations to the patients' clinical conditions were examined.

Comparing GIA sizes produced different results depending on whether GIA diameter or volume was measured. Measuring the diameter identified posterior circulation GIAs as the largest ones (39.2 mm, IQR 37.3-48.3), while measuring the volume found GIAs of the MCA to be the largest ones (12.3 cm(3), IQR 7.2-27.8). A correlation of GIA diameter and volume was only found in anterior circulation GIAs, which were predominantly saccular in shape, but not in those of the posterior circulation, of which most were fusiform. Neither GIA diameter nor GIA volume but only GIA location was associated with neurological deficits.

Diameter and volume measurements are not interchangeable modes of GIA quantification. This data suggest that the idea of distinguishing different sizes of GIA may be clinically less relevant than examining their location, shape or mass effect [2)].

Treatment

Giant intracranial aneurysm treatment

Outcome

Postoperative stroke was significantly associated with clinical outcome. Favorable outcomes can be achieved in most patients with GIAs after appropriate microsurgical modality. Recurrent aneurysm and size ≥ 3.5 cm are risk factors of postoperative stroke [3)].

Surgical strategies other that direct clipping for the treatment of anterior circulation GIA lead to a significant decrease in GIA volume over time. The resulting decrease in mass effect was more sensitively monitored by the measurement of changes in ipsilateral LVV than changes in MLS. CLINICAL TRIAL REGISTRATION-URL: http://www.clinicaltrials.gov . Unique identifier: NCT02066493 [4)].

Case series

Nine patients with GIA who underwent EC-IC surgery. Of them, three experienced dangerous postoperative hemorrhage, and one patient died. Among these three patients, two lacked the A1 segment of the anterior cerebral artery (ACA). The numerical simulation showed that after surgery, for the patient with an unruptured aneurysm and existence of ACA, the wall deformation, wall stress, pressure, and area of the oscillatory shear index (OSI) > 0.2 were decreased by 43%, 39%, 33%, and 13%, while the patient without A1 segment having postoperative hemorrhage showed 36%, 45%, 13%, and 55% increased, respectively. Thus, we postulated a dangerous “stump phenomenon” in such conditions and further demonstrated it from idealized models with different sizes of ACA. Finally, we found a larger anastomosis angle and smaller diameter of the graft can alleviate this effect.

Neurosurgeon should cautiously evaluate the opportunity and risk for such patients who have aplasia of the A1 segment of ACA when making clinical decisions [5)]

Case reports

A patient with a ruptured intracranial giant intracranial aneurysm in which TCD was essential to monitor vasospasm and intracranial hypertension (IH). A 53-year-old male was admitted due to a sudden headache and impaired consciousness, left hemiparesis, and dysarthria. Cerebral CT scan and CT angiography at admission showed a right giant middle cerebral artery aneurysm with extensive and diffuse intraventricular SAH of Fisher grade IV and Hunt and Hess grade 4. Clipping, placement of an intracranial pressure sensor, and external ventricular drain (EVD) were performed on the same day, with difficulty in preserving the M2 branch and complicated by postoperative extensive right MCA ischemia. On day three of hospitalization, TCD revealed an increased pulsatility index (>1.5) with clinical deterioration leading to re-intervention for a decompressive craniectomy. On day six, a TCD follow-up was performed to monitor blood flow complications, particularly vasospasm, showing a severe increase in the middle blood flow velocity (MBFV) in the right MCA of 205 cm/s and Lindegaard Index > 6. Daily surveillance by TCD was maintained to guide clinical management since the attempt to withdraw the EVD led to clinical deterioration with subsequent worsening of vasospasm. Improvement occurred after surgery as ventriculoperitoneal shunt insertion was performed. TCD had a major role in the clinical orientation of SAH as well as in intracranial pressure management and was decided to establish long-term treatment [6].

An 11-year-old girl has a giant anterior circulation aneurysm. The ipsilateral internal carotid artery was entirely blocked and the aneurysm was supplied by posterior circulation. Following a high-flow bypass that connected the external carotid artery to the middle cerebral artery, the giant aneurysm thrombosed spontaneously [7].

Books

Giant Intracranial Aneurysm Yves Keravel

Videos

Left pterional craniotomy for thrombectomy and clipping of ruptured left MCA giant aneurysm

<html><iframe width="420" height="315" src="https://www.youtube.com/embed/8dimNdiIObE" frameborder="0" allowfullscreen></iframe></html>

References

1)

Nurminen V, Lehecka M, Chakrabarty A, Kivisaari R, Lehto H, Niemelä M, Hernesniemi J. Anatomy and morphology of giant aneurysms-angiographic study of 125 consecutive cases. Acta Neurochir (Wien). 2014 Jan;156(1):1-10. doi: 10.1007/s00701-013-1933-4. Epub 2013 Nov 19. PubMed PMID: 24249668.

2)

Dengler J, Maldaner N, Bijlenga P, Burkhardt JK, Graewe A, Guhl S, Nakamura M, Hohaus C, Kursumovic A, Schmidt NO, Schebesch KM, Wostrack M, Vajkoczy P, Mielke D; Giant Intracranial Aneurysm Study Group. Quantifying unruptured giant intracranial aneurysms by measuring diameter and volume-a comparative analysis of 69 cases. Acta Neurochir (Wien). 2015 Mar;157(3):361-8. doi: 10.1007/s00701-014-2292-5. Epub 2014 Dec 12. PubMed PMID: 25502806.

3)
Wang H, Lu J, Chen X, Hao Q. Risk factors and outcomes of postoperative stroke in surgical treatment for giant intracranial aneurysms. Chin Neurosurg J. 2022 Oct 3;8(1):31. doi: 10.1186/s41016-022-00297-x. PMID: 36184606.

4)
Maldaner N, Guhl S, Mielke D, Musahl C, Schmidt NO, Wostrack M, Rüfenacht DA, Vajkoczy P, Dengler J; Giant Intracranial Aneurysm Study Group. Changes in volume of giant intracranial aneurysms treated by surgical strategies other than direct clipping. Acta Neurochir (Wien). 2015 May 23. [Epub ahead of print] PubMed PMID: 26002711.

5)
Li S, Huang Z, Chen H, Chen F. Proximal Clipping and Distal High-Flow Bypass in the Treatment of Giant/Complex Intracranial Aneurysm: An Opportunity or a Risk from a Fluid-Structural Interaction Analysis. Cardiovasc Eng Technol. 2023 Dec 13. doi: 10.1007/s13239-023-00704-z. Epub ahead of print. PMID: 38093146.

6)
Lemos CI, Almeida V, Soares MF, Fonseca AC. Follow-Up by Transcranial Doppler After Rupture of a Giant Intracranial Aneurysm. Cureus. 2022 Nov 27;14(11):e31951. doi: 10.7759/cureus.31951. PMID: 36582551; PMCID: PMC9795273.

7)
Shah A, Vutha R, Doshi J, Trivedi N, Goel A. “Flow Reversal” and Cure in a Case of Giant Intracranial Aneurysm: A Case Report. J Neurol Surg A Cent Eur Neurosurg. 2021 Jun 2. doi: 10.1055/s-0041-1726106. Epub ahead of print. PMID: 34077980.