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A rare case of rupture of an aneurysm of the distal sections of the medial frontobasal artery

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Cerebral aneurysms are most often located on the proximal segments of the arteries of the circle of Willis, with some predisposition towards the anterior communicating artery. However, aneurysms can develop on any cerebral arteries including abnormal ones. In this clinical observation, a case of rupture of an aneurysm located in the distal segment of the hypertrophied medial frontobasal artery is presented. The case was complicated by the presence of an aneurysm on the middle cerebral artery, the rupture of which, according to the conclusion from the primary vascular center, caused subarachnoid hemorrhage, while an aneurysm of the frontobasal artery was not detected. It was only after the patient was transferred to a regional vascular center and a targeted review of angiograms during the preparation of the patient for surgery that a distal aneurysm of the frontobasal artery was detected, which, according to the intraoperative picture, was the cause of the hemorrhage.

Keywords: aneurysm, subarachnoid hemorrhage, anterior cerebral artery, medial frontobasal artery, orbitofrontal artery

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BACKGROUND

Subarachnoid hemorrhages (SAH) occur at a rate of 8–10 cases per 100,000 population per year. Statistically, the most common ruptured aneurysms are located in the anterior communicating artery (ACA), followed by aneurysms of the middle cerebral artery (MCA) and internal carotid artery (ICA), with approximately equal frequency. Ruptures of vertebrobasilar aneurysms account for approximately 10 % of cases [1–3].

However, rare aneurysm locations are occurred, which can pose diagnostic challenges. Aneurysms can be localized in atypical arterial sites or abnormal vessels. For example, diagnostic and tactical difficulties arise when aneurysms are localized in persistent primitive arteries, such as the primitive trigeminal or hypoglossal arteries [4–6].

It can be difficult to detect an atypically located ruptured aneurysm because of massive SAH, which requires careful preoperative analysis of angiograms.

We present a clinical case of aneurysm rupture, located at distal segment of the hypertrophied medial frontobasal artery (in some classifications – the orbitofrontal artery).

CLINICAL CASE

A 50-year-old male patient T., experienced a severe headache while at work (he works as a physician in the primary vascular department). An emergency brain computed tomography (CT) revealed massive SAH (Fig. 1).

Cerebral angiography revealed the left MCA aneurysm. The patient was urgently consulted by specialists of the regional vascular center and moved to regional vascular center (RVC) for the surgical intervention within two hours.

During admission the patient was conscious (Glasgow Coma Scale score 15) and complained of a severe headache (up to 9 according to Visual Analogue Scale). Neurological status was the following: pupils were equal (D = S), photoreactions are preserved, full range of eye movements, the Mann–Gurevich sign is positive.

The face was symmetrical; the tongue was in the midline. The pharyngeal reflex was preserved. Strength in all extremities was 5 points. Tendon reflexes were moderately brisk, without a clear difference between sides. No sensory disturbances were detected. The patient performed the finger-nose and knee-heel tests satisfactorily. Kernig's sign was 110°, and nuchal rigidity was 5 cm.

The CT-angiography data were reviewed with identification of 2 aneurysms – 5.6 mm M1 aneurysm of the left MCA (diameter 5.6 mm, neck width 3.2 mm) and additional previously undetected aneurysm of the distal part of the hypertrophied medial frontobasal artery measuring 3.9 mm with neck width 1.9 mm (Fig. 2).

According to CT-angiography data, it was impossible to reliably determine which aneurysm was ruptured; however, initially MCA aneurysm was supposed to be ruptured because of its larger size. The diagnosis was: "SAH due to rupture of a left MCA aneurysm, Fisher III, Hunt-Hess II. Aneurysm of the distal segments of the medial frontobasal artery".

A decision was made to perform an urgent operation in the following volume: osteoplastic craniotomy, microsurgical clipping of both aneurysms.

A left lateral supraorbital approach was performed with the following usage of transsylvian approach to access the left MCA aneurysm. The aneurysm was pale pink and has no signs of rupture. Clipping of this aneurysm was performed (Fig. 3).

The next step included accessing the anterior communicating artery and determining the origin of the hypertrophied right medial frontobasal artery from the initial A2 segment of the anterior cerebral artery (ACA). The 3-cm dissection of the frontobasal artery was performed.

The purple-red aneurysm with signs of rupture was identified at the intersection of the artery and the right olfactory nerve. The aneurysm was clipped with two titanium clips after identifying its neck (Fig. 4).

The control intraoperative angiogram revealed no filling of the aneurysm and patency of the frontobasal artery.

The patient was extubated the following day after surgery, regaining consciousness and showing no neurological deficit. He was discharged on the 15th postoperative day in satisfactory condition.

DISCUSSION

The medial frontobasal artery, sometimes referred to as the orbitofrontal artery, is the first branch of the postcommunicating segment (A2 segment) of the ACA. It runs along the inferior surface of the medial frontal lobe and typically it is a small artery, not always clearly visible on angiography, unlike the larger next branch of the A2 segment of the ACA (frontopolar artery).

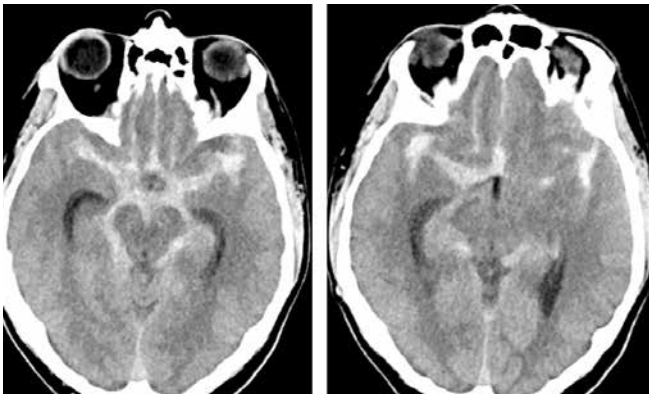

Fig. 1. Multislice computed tomography of the brain of patient T. Massive subarachnoid hemorrhage in the area of the basal cisterns is visualized

In this clinical case, an abnormal structure of the right frontobasal artery was noted, measuring 2 mm in diameter, with the ACA diameter at the origin of the artery measuring 2.5 mm, however the left frontobasal artery was not clearly visualized on angiograms.

There are papers, describing thw rupture of aneurysms of the second branch of the postcommunicating segment – the frontopolar artery, both at the site of its origin from the A2 segment of the ACA and in the distal parts [7–11]. S.K. Hong (1997) described a clinical case of ACA aneurysm rupture at the site of frontobasal artery origin (the artery is indicated as "frontoorbital") [12]. K. Aso et al. (2015) presented a case of aneurysm rupture in the area of the common trunk orifice, from which the frontobasal and frontopolar arteries arose [13]. However, no cases of distal aneurysms rupture of the frontobasal artery have been previously published.

Interestingly, that aneurysm was located not at the origin of the frontobasal artery from the A2 segment of the ACA, but 3 cm distal to its orifice, outside the bifurcation zone. It could be suggested as a bacterial aneurysm, however bacterial aneurysms are most often located in the distal segments of the MCA.

Furthermore, our patient had no systemic signs of inflammation or any history of infections. Apparently, the anatomical variation, with the presence of a large medial frontobasal artery, led to hemodynamic overload in this segment and resulted in aneurysm formation.

This case is not only of scientific interest, as it illustrates the influence of cerebral arteries anatomical variations on the aneurysm genesis, but also has important practical significance. V.V. Krylov et al. (2018) reported, that 82.4 % of the selected patients also had a pericallosal artery aneurysms associated with a MCA aneurysm, but the cause of SAH was the rupture of distal aneurysms [14].

In the presented case of massive SAH and M1 segment aneurysm of the MCA, our colleagues at the primary vascular center easily missed the distal aneurysm of the frontobasal artery, located at the base of the skull in the projection of the ethmoid bone. Although we were able to identify the frontobasal artery aneurysm upon review of the preoperative angiograms, we initially suspected the rupture of MCA aneurysm, due to its larger size.

This was a mistake, since the aneurysm that ruptured was the frontal basal artery aneurysm, which had to be excluded from the blood flow first, since there was a risk of intraoperative rupture with minimal traction of the frontal lobe.

Moreover, in addition to the larger size of the MCA aneurysm, it was necessary to consider the other morphological risk factors for aneurysm rupture. The aspect ratio for the MCA aneurysm was 1.7, while for the frontobasal artery aneurysm it was 2. Aneurysms with an aspect ratio greater than 1.8 are known to have a higher risk of rupture. The size ratio for the MCA aneurysm was 1.6, while the size ratio for the frontobasal artery was 1.95.

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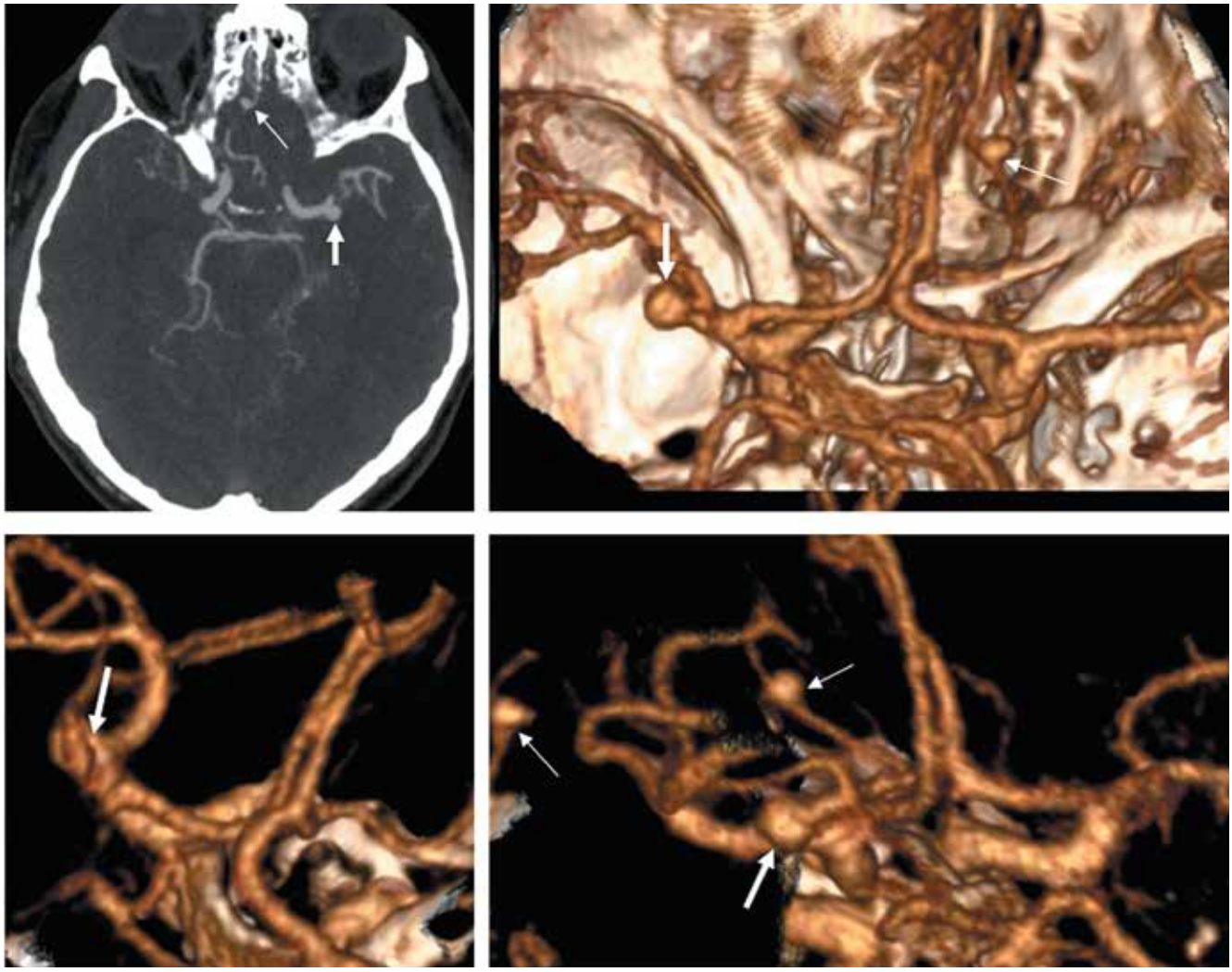

Fig. 2. Multislice computed tomography angiography of patient T. A thick white arrow indicates an aneurysm of the M1-segment of the left middle cerebral artery. A thin white arrow indicates an aneurysm of the distal sections of the hypertrophied medial frontobasal artery

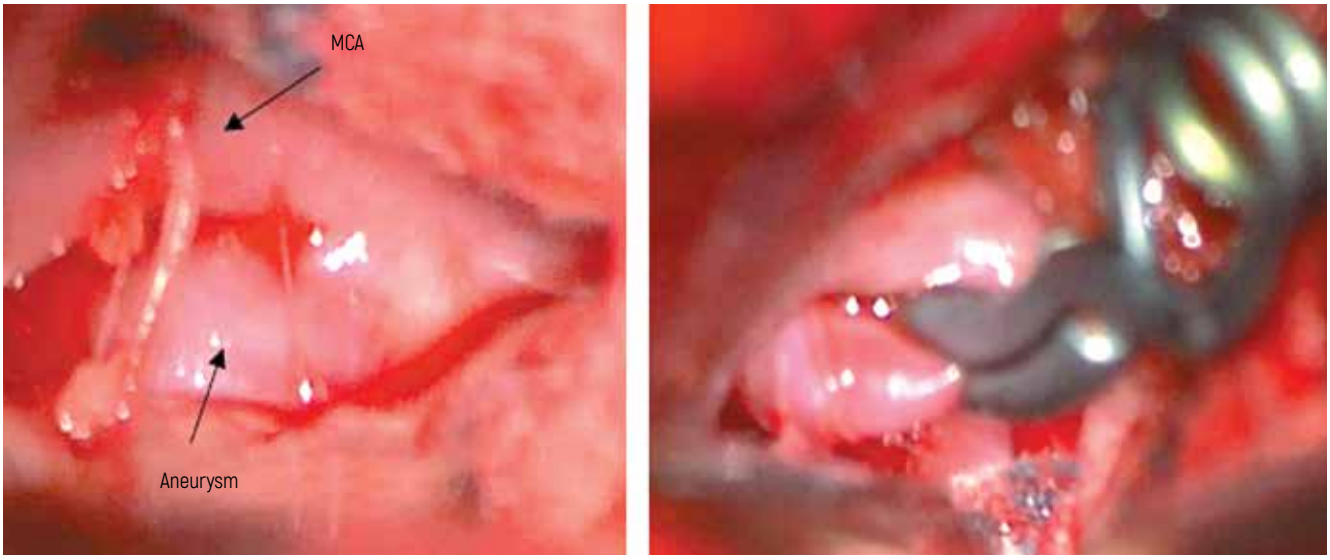

Fig. 3. Intraoperative photography (Kinevo 900 microscope). The middle cerebral artery (MCA) and aneurysm are indicated. On the right is the condition after clipping of the aneurysm neck on the middle cerebral artery

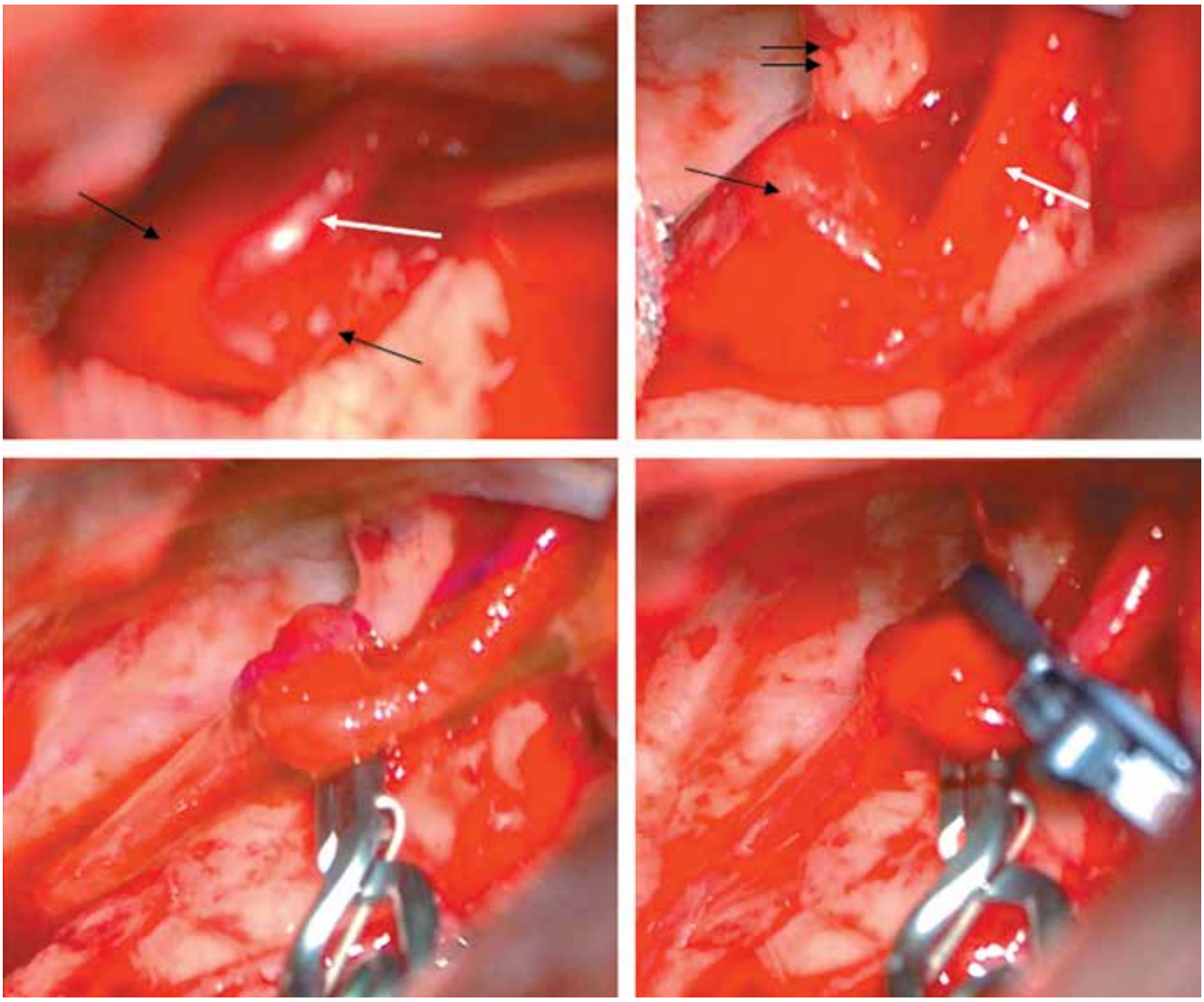

Fig. 4. Intraoperative photography (Kinevo 900 microscope). The black arrow indicates an aneurysm, and the white arrow indicates the hypertrophied frontobasal artery. The double black arrow indicates the right olfactory nerve

A higher size ratio is associated with a higher risk of rupture.

The presented clinical case once again emphasizes that surgical exclusion of aneurysms requires careful preoperative preparations, starting with a careful study of all branches of the carotid and vertebrobasilar arteries. The comprehensive assessment of the likelihood for rupture of each of multiple aneurysms should be done with the following planning of surgical intervention.

CONCLUSION

Cerebral aneurysms are in most cases localized on the proximal branches of the circle of Willis in the bifurcation area, but they can potentially form on any cerebral artery, whether it has a normal or abnormal structure or location.

Aneurysms of the medial frontobasal artery are extremely rare. In our clinical case, we observed an abnormally large right medial frontobasal artery, which likely contributed to the formation and rupture of the aneurysm.

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Authors' contributions
P.G. Shnyakin: collecting data for analysis, analysis of the obtained data, patient monitoring, article writing;
A.O. Gavrilova: analysis of publications on the topic of the article, article writing.

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