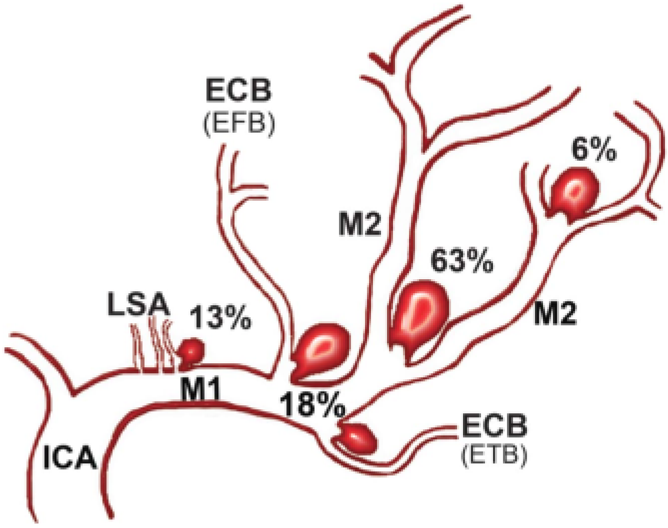
Middle cerebral artery M1 segment aneurysm



A low percentage of middle cerebral artery aneurysm are proximal, that is, at the M1 segment of the middle cerebral artery, which starts from the origin of the middle cerebral artery up to its bifurcation

The aneurysms of the proximal segment of the middle cerebral artery (M1) are linked at their origin to the so-called 'early branches' of the artery. The predominating arteries are the anterior temporal artery and the small perforating arteries that irrigate the basal ganglia region.

It is very important to know their relations and their origin according to their topography and direction, in order to know to which artery they are linked, which must be sought and respected during the dissection and clipping or the endovascular occlusion, and so to avoid neurological sequelae, many of them invalidating.

Early frontal branch aneurysms were more common than typical M1 segment bifurcation aneurysms. M1 segment aneurysms arising from early frontal and early temporal branches have distinct anatomic features that impact surgical management and outcome [1)].

Subtype

M1-Sup aneurysm [2)].

Treatment

Proximal middle cerebral artery (M1 segment) aneurysms have various configurations and are distinct from middle cerebral artery bifurcation aneurysms.

Proximal MCA aneurysms are often wide-necked and intimately connected to an M1 branch at its origin on M1, features that favor exosurgery rather than endosurgery. The direction and course of the parent and branching arteries and the orientation of the fundus are the most important factors affecting the efficacy and safety of clipping [3].

Coil embolization in M1 aneurysms seems to be safe and efficacious, although it may require various technical strategies due to distinct anatomic configurations [4].

EVT for proximal MCA aneurysm is feasible and safe. However, more adequate follow-up is required to evaluate its long-term results.

With the constant advances in endovascular therapy and with the help of the placement of stents or other devices at the origin of the aneurysm may, in a probably not so distant future, tip the scales in favor of the endovascular therapy over surgery for these aneurysms [5]

The main arteries (early temporal, orbitofrontal) usually have a caliber that makes them easily identifiable under the magnified vision of the microscope An aneurysm originating in one of these arteries must always be dissected for the artery not to remain included in the clip.

It is worth emphasizing that, unlike other locations, in most of the cases found by the authors these arteries arise at the neck of the aneurysm itself, hence the dissection must be distal to them and, on placing the clip, it is necessary not only to respect them but also avoid their compression, which can lead to a later thrombosis. Even more difficult is the case where an aneurysm arises from a perforating branch, which usually irrigates the ganglio-basal region. These arteries are very small although in relation to the aneurysm and they have a thicker caliber than usual. Since they are small, if surgery is not performed under the microscope with high magnification they may not be identified and thus may get included in the clip, with the consequent infarction of an area in the basal ganglia region, which may or may not lead to deficits and poor clinical results.

In addition to this, in the small series of the authors, approximately 70% of the aneurysms had a broad neck (neck/fundus ratio), which is important at the time of placing a clip. It is a well-known fact that a broad-necked aneurysm can determine a compromise in the parent artery or of the branch where it originates at the moment of placing a clip.

This risk is higher if the related artery is of smaller caliber.

Therefore, a good knowledge of the anatomy is indispensable, as well as a careful study of the imaging is required, which must be of good quality in order to identify the branch in which the aneurysm originates and the other branches present at the proximal sector, in order not to damage them during the dissection of the sylvian cistern and to always identify the branch that gives origin to the aneurysm. This branch must be dissected and separated from the neck of the malformation so that it ‘does not suffer’ at the moment of placing the clip.

On occasions, as it happens in aneurysms of the middle cerebral artery bifurcation, it is necessary to perform transient or temporary proximal clippings in order to facilitate the dissection. Other times it may be necessary to puncture and empty the aneurysm, so as to complete the separation of the efferent branches and to facilitate, through the loss of tension in the aneurysm, the definitive clip placement, with no damage or tightening of the vessels. Therefore, it is necessary that any surgery for cerebral aneurysms and even more those of middle cerebral arteries, includes a neuro-anesthesiologist trained in cerebral protection as well as neuro-physiological monitoring for the control of the cerebral function, both during the temporary clipping and after the placement of a definitive clip. In such way, the surgeon works comfortably and offers the patient better outcomes.

Another fact to take into consideration in aneurysms of the proximal segment of the middle cerebral artery is that, in a nondespicable percentage of the cases, the aneurysm is embedded in the cerebral parenchyma. This is more frequent in the aneurysms which originate in relation to perforating arteries. More than never in these cases the dissection must be always cisternal and without the use of retractors. The separation from the parenchyma can lead to premature rupture of the aneurysm, even before visualizing it or having dominated the neck.

It is recommended to start the cisternal dissection distal from the aneurysm (for example, at an opercular level), to seek the middle cerebral artery or its efferent branches and to continue along the cistern in proximal direction up to the aneurysm. Even, as it is reached, it is necessary to continue proximally, in order to dominate the artery proximally in case a transitory clipping is necessary. If the dissection is always kept cisternal and without the use of retractors, accidents like bleedings of the malformation can be a rare occurrence. It can be argued that in cases of acute surgery with bleedings, the dissection and vision are not easy. In these cases, a slow and careful dissection is recommended, always following the artery and with continuous irrigation in order to wash away the blood from the cistern and to clear its visualization.

In the aneurysms that originate from the proximal branches of larger caliber, and mainly in the big aneurysms that relate to the anterior temporal or the orbitofrontal arteries, it may be suspected that the bottom of the aneurysm could be in contact with the dura mater or, as happened in one of the cases operated by the authors, be firmly adhered to it. In other three cases of the series there was contact with the dura mater, but the adherence was not firm and it was possible to separate it with dissectors without incidents. In cases like this, the dissection must be very carefully performed right from the opening of the dura mater, which should never be sharply separated from the arachnoid, since this maneuver may cause the aneurysmal rupture, with profuse bleedings, even before starting the cisternal dissection. [6)].

Outcome

In patients with M1 aneurysms, clinical status on admission and the presence of ICH were significant factors for surgical outcome. Surgical morbidity seems to be related to the direction of the aneurysm. It is critical to save the lenticulostriate artery and their branches in patients with superior-wall type aneurysms. Thorough preoperative angiographic evaluation, careful brain retraction, and meticulous inspection for hidden small branches are crucial to successful outcomes [7)].

Case series

20 consecutive patients with 21 saccular aneurysms of the proximal (M1) segment of the middle cerebral artery. The incidence of M1 aneurysms was 3.0% among 660 patients with intracranial aneurysms and 12.9% among 155 patients with middle cerebral artery aneurysms in our center. Of the 20 patients, 2 were men and 18 were women. The aneurysms were classified into two types: the superior wall type (9 cases), arising at the origin of the lenticulostriate or fronto-orbital artery, and the inferior wall type (12 cases), arising at the origin of the early temporal branches. Twelve (60%) patients had ruptured M1 aneurysms. The incidence of multiple aneurysms was high (nine patients, 45%), and M1 aneurysms were responsible for subarachnoid hemorrhage in four patients. Of 14 M1 aneurysms greater than 5 mm in diameter, 11 (78.6%) ruptured. In contrast, only one (14.3%) of seven small (< or = 5 mm) aneurysms ruptured. In 12 patients with ruptured M1 aneurysms, intracerebral hematomas were recognized in 6 (50%). Intracerebral hematomas by the superior wall M1 aneurysms were located in the frontal lobe, and those by the inferior wall M1 aneurysms were in the temporal lobe. Fifteen patients (75%) made a useful recovery 6 months after surgery. Four

patients (20%), who were in poor grade condition preoperatively, remained severely disabled. One patient died of sepsis 2 months after she recovered well from the operation. Special attention to the lenticulostriate arteries to avoid injury is critical for successful surgical treatment [8].

Case reports

A 36-yr-old male with a previously coiled aneurysm arising from the proximal M1 segment of the middle cerebral artery (MCA) just beyond the internal carotid artery (ICA) bifurcation who presented to our institution with subjective left hemiparesis, headache, and vomiting. Physical exam revealed a left facial droop, but neurological exam was otherwise normal, including full motor strength. Neuroimaging showed a large partially thrombosed aneurysm recurrence, measuring 5.2 cm, with obstructive hydrocephalus. Cerebral angiogram showed filling within a small portion of the aneurysm and marked stenosis of the MCA beyond the neck. A ventriculostomy was placed, and he underwent a pterional craniotomy for high-flow radial artery bypass from the common carotid artery to an M2 branch of the MCA and clip placement. This case demonstrates the creation of a blind sac by placing a clip on the MCA distal to the aneurysm and proximal to the lenticulostriate arteries for the treatment of a giant proximal M1 segment aneurysm. Postoperative digital subtraction angiography shows the MCA distribution, including the lenticulostriate arteries, filling through the radial artery bypass, and anterograde flow through the ICA, which perfuses up to and including the anterior choroidal artery. There is no residual filling of the aneurysm. The patient remained at his neurological baseline postoperatively and required ventriculoperitoneal shunt placement for hydrocephalus. At outpatient follow-up, computed tomography imaging showed decreased size of the thrombosed aneurysm, measuring 4.5 cm, and he had no neurological deficits. The patient gave informed consent for surgery and deidentified video recording of this case [9].

1)

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