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METHODS

Incidental left MCA aneurysm post minor head injury

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Middle cerebral artery (MCA) aneurysms account for approximately 21% of cerebral aneurysms. The most frequent location for MCA aneurysms is the M1–M2 bifurcation, while less commonly, they may arise near the lenticulostriate arteries or anterior temporal branch origin. In cases of bilateral MCA aneurysms, determining the ruptured aneurysm can be challenging. This study highlights factors influencing rupture, including the ratio of perpendicular height to neck diameter, flow angle, and the angular relationship between M1 and M2 segments. Due to their relatively superficial position in the Sylvian fissure, MCA aneurysms are more accessible than other aneurysms, although their neck-to-dome ratio complicates treatment. Given that MCA branches may arise from the sac or neck, surgical clipping is often preferred over coil embolization. This report underscores the need for neurosurgeons to engage in comprehensive research on the unique characteristics, treatment approaches, and intraoperative considerations for managing MCA aneurysms.

Keywords: Aneurysm, Middle Cerebral Artery, Clipping, Coiling, Rupture

Introduction

Among the cerebral aneurysms, one of the most prevailing aneurysms is the middle cerebral artery (MCA) aneurysm. These MCA aneurysms, when ruptured, are listed as the third most commonest, as their prevalence is approximately 21%. With an incidence of approximately 40%, anterior communicating artery (AComA) tops the list, followed by the internal carotid aneurysm, which accounts for approximately 30% (1). Among the MCA aneurysms, the most commonly observed location is the M1-M2 bifurcation, which accounts for an incidence of about 8–85%. Following this, the occasional occurrence sites of MCA aneurysms include at the commencement of the lenticulostriate arteries or the anterior temporal branch origin.

Nevertheless, diminutive aneurysms that emerge in the distal territories of the MCA are conventionally categorized as mycotic in origin. Aneurysms of the MCA may manifest bilaterally, and in circumstances where patients demonstrate symmetrical aneurysms, it poses substantial difficulties in determining which aneurysm has experienced rupture (2).

From the results discussed in this study regarding the anatomical relations of both ruptured and unruptured MCA aneurysms, it appears that the only factors that influenced rupture, as the multivariate analysis helps explain, were first that of the ratio of perpendicular height to neck diameter, followed by the flow angle, and then lastly by the angular relationship between the two M1 and M2 segments. The MCA aneurysm is relatively superficially positioned in the Sylvian fissure; hence, it is relatively more accessible compared to other types of aneurysms. On the other hand, the neck-to-dome ratio of the MCA aneurysm occurs at a higher level than that of other forms of aneurysms. Moreover, the MCA branches can arise from the sac or neck of the MCA aneurysms, which makes their treatment approach difficult. Surgical clipping is hence considered the treatment of choice rather than coil embolization for the management of MCA aneurysms. Hence, neurosurgeons should conduct extensive research on the types, peculiarities, simulation techniques, intraoperative monitoring, and surgical procedures regarding MCA aneurysms (3).

Steps in MCA aneurysm clipping

Position

The shoulder is raised on the operative side, and the head is rotated 90 degrees toward the contralateral side. The head is fixed with a Mayfield head clamp with a three-pin fixation technique. One must ensure that the cranium is kept elevated above the plane of the cardiac structure with patent bilateral jugular veins. The inguinal region is prepared to allow for the possibility of endovascular access. The anesthesiologist approaches from the lower extremities and the left lateral side of the body. The surgeon is located at the vertex.

Pterional craniotomy

A curvilinear incision is made 1 cm anterior to the tragus and extended posteriorly in continuity with the hairline to the midline of the scalp. The pericranial flap is developed by Yasargil's principles of interfascial dissection and turned down in an anteroinferior direction. The temporal muscle is dissected with a periosteal elevator from bony sutures beginning in the orbito-zygomatic suture and the pterion. Cutting monopolar cautery is applied to cut the superior insertion.

This avoids damaging the periosteum. Thus, it helps reduce the atrophy of the temporal muscle and therefore improves the aesthetic result. The muscle is retracted in a posteroinferior direction from there.

A burr hole is placed superiorly to the delicate temporal bone, and in an anterior–superior direction, the dura mater is carefully dissected. An oval-shaped craniotomy is performed, with particular attention to orient the axes of the bigger diameter parallel to the Sylvian fissure. The size of the usual craniotomy is generally about 5 cm by 4 cm.

The anterior segment of the craniotomy is then drilled to ensure that it aligns flush with the lateral side of the orbit. Once the bone flap has been elevated, removal of the sphenoid ridge is done using a Luer Rongeur that will later be drilled in order to carry the procedure toward the lateral wall of the orbit.

The meningo-orbital band becomes the reference point for the excised piece of bone. The bone flap is then kept moist in a normal saline solution so that it may be reinserted when the operation is to be concluded. Before the intradural phase begins, the optimal state of hemostasis is achieved.

Large Sylvian fissure opening

Incise the dura mater in a "U" configuration along the orbital wall and then reflect it forward. Make a small hole in the arachnoid membrane at the Sylvian fissure, about 4 cm posterior to where the sphenoid ridge was removed. Instill normal saline with gentle pressure until distal reflux is observed.

The aperture is further enlarged, and the Sylvian fissure is slowly retracted by sharp dissection along the course of the limen insula. If a patient comes in with an intraparenchymal hematoma, in most, if not all, of the hematoma is evacuated to decompress and simultaneously lower the chance of rebleeding.

Identification of the parent vessel and exposure of the aneurysm

The inferior trunk of M2 is drawn, and the dissection followed superio-anteriorly in an anterosuperior direction to the bifurcation. Commonly for proximal control, the M1 artery is located since it curves rostro-medially at the limen insula, below the striate perforators. The arachnoidal aperture on the Sylvian fissure surface is carefully expanded step-by-step as the dissection goes more lateral and deeper into the operative field. The Sylvian fissure is accessed from the bottom of a sequence, oriented to the superficial layers.

Next, in the course of this procedure, the surgeon finds the above-described M2 trunk and exposes the aneurysm neck. The surgeon pays extra heed so that all his instruments are kept sufficiently hydrated. All arachnoid membranes are sharply excised using microsurgical dissectors and microscissors from both the vascular structure and aneurysm wall. The maneuvers are done tangentially related to the vascular entities. After exposing all M2 branches, the M1 trunk, and the aneurysm neck, the clipping strategy is assessed and an appropriate clip is selected. The absence of intraoperative high-resolution angiographic imaging requires flow or blood velocity measurements in the M1 trunk, and all M2 branches must be visualized immediately distal to the aneurysm. That is to understand if there is any vascular compromise occurring with clipping. Depending upon the size of the aneurysm or intraoperative rupture, a temporary clip is placed proximally to deflate the dome or to control the hemorrhage adequately.

Clip application

The proximal clip is removed following the placement of the aneurysm clip on the neck region, thereby allowing complete access to the aneurysm dome. The integrity of the clipping apparatus is usually assessed by puncturing the dome of the aneurysm with a 25-gauge needle. It is projected that the aneurysm will exhibit deflation, after which the neck is thoroughly inspected on both lateral sides to confirm the absence of any residuals or the occlusion of nearby minute perforators.

VIDEO 1 | Microsurgical MCA aneurysm Clipping.
https://youtu.be/EH_Wbs0nUJA

ICG video angiography and Doppler confirmation of flow

Indocyanine green (ICG) angiography, harnessing the power of fluorescence imaging, is conducted to evaluate the openness of all vascular pathways. In instances where ICG is not accessible, the verification of patency is carried out through micro-Doppler ultrasonography. A 40 mg dose of papaverine is mixed in 10 mL of normal saline, which is carefully injected into the Sylvian fissure. To safeguard the surgical area, a moist compression is applied, and the patient's head is nestled beneath a clear drape. The interventional neuroradiologist executes a classic angiogram in tandem with a three-dimensional rotational angiogram. The resulting images are compared with preoperative images to ensure that every branch and perforator exhibits patency.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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