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Case Report

'Peacock tail' Clipping Technique for a Giant Middle Cerebral Artery Aneurysm: A Technical Note

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ABSTRACT

Background: Giant middle cerebral artery aneurysms are surgically challenging lesions. Because of the complexity and variability of these aneurysms, a customized surgical technique is often needed for each case. In this article, we present a modified clip reconstruction technique of a ruptured complex giant partially thrombosed middle cerebral artery aneurysm.

Case description: The aneurysm was exposed using the pterional approach. Following proximal control, the aneurysm sac was decompressed. Then, we applied permanent clips to reconstruct the aneurysm neck. The configuration of the aneurysm mandated a tailored clipping pattern to account for residual aneurysm sac sagging beyond the confinement of the single inflow and the two outflow channels. As a result, clipping in a fanning pattern was done to obliterate the lateral extensions while retaining a smooth curvature of the reconstructed neck. This final clipping pattern mirrored the arrangement of the peacock tail feathers. The 'peacock tail' clipping technique can be thought of as a variation of the traditional straight tandem clipping, also known as 'picket-fence,' applied to less complicated aneurysm configurations.

Conclusion: Giant MCA aneurysms may demand an adaptive clipping technique to account for the unique geometry of each aneurysm. In this paper, we described the 'peacock tail' clipping technique for clip reconstruction of a giant complex partially thrombosed M2 MCA aneurysm as a modification of the conventional tandem clipping technique.

Introduction

Giant middle cerebral artery (MCA) aneurysms account for 9.8 % of all MCA aneurysms and are responsible for 14 -19 % of all cases of aneurysmal subarachnoid hemorrhage (1). Apart from their size, these aneurysms have a range of undesirable characteristics, such as shape irregularity, lack of definable neck, intramural thrombus formation, calcification, and complex vascular relationships, rendering them unsuitable for direct clipping or coiling (2,3). Techniques such as clip reconstruction, aneurysm trapping with extra-cranial intracranial bypass, and hybrid endovascular-surgical approaches play a crucial role in the treatment of these formidable lesions (4,5). Due to the complexity and variability of these aneurysms, a customized surgical technique is often needed for each case. Hereunder, we present a modified clip reconstruction technique of a ruptured complex giant partially thrombosed middle cerebral artery aneurysm (figure 1). While bypass surgery is typically the first-line treatment option for complex giant MCA aneurysms, complex aneurysm neck reconstruction was deemed more appropriate in this scenario due to a number of case-specific factors, including the mass effect of the giant aneurysm, patient's age and the requirement for a double-barrel bypass for both M2 segments of the MCA.

Case description:

A 63-year-old female presented to the emergency department following a severe headache. On examination, she demonstrated signs of meningismus. Her initial computed tomography (CT) scan showed a mass at the insular part of the left Sylvian fissure; subsequent images with magnetic resonance imaging (MRI) and CT angiography showed a giant partially thrombosed aneurysm in the M2 segment of the MCA (Figure 1). The patient agreed to surgery. A left pterional craniotomy was performed and after we opened the dural the aneurysm was visualized filling the Sylvian fissure (Figure 2A). Arachnoid dissection was performed in a distal to proximal fashion to expose the aneurysm. We identified and dissected three relatively large cortical MCA branches that were adherent to the aneurysm dome. The dissection was continued aiming at finding the proximal M2 trunks; a step that proved difficult due to the large aneurysmal girth. As a result, a temporary clip was applied to the proximal M1 segment of the MCA to soften the aneurysm. Then, a bipolar cautery (low setting) was used to shrink the aneurysm dome, followed by incising the thrombosed portion, with partial evacuation of the mural thrombus (Figure 2B). Then, we applied two large straight clips across the aneurysm dome and the temporary clip was removed (6 minutes). Next, dissection was performed to free the aneurysm dome from the surrounding cortex and to identify the proximal segment of the M2 divisions as they leave the aneurysm.

Then we placed temporary clips on the proximal M2 divisions and a complete evacuation of the mural thrombus was achieved, allowing the resection of part of the aneurysm sac. At this stage, we applied permanent clips to reconstruct the aneurysm neck. The configuration of the aneurysm mandated a tailored clipping pattern to account for residual aneurysm sac sagging beyond the confinement of the single inflow and the two outflow channels (Figure 3). As a result, clipping in a fanning pattern was done to obliterate the lateral extensions while retaining a smooth curvature of the reconstructed neck. This final clipping pattern mirrored the arrangement of the peacock tail feathers (Figures 2C & 3).

Finally, the preservation of the inflow and outflow channels was verified by intraoperative doppler ultrasound. Also, intraoperative neurophysiological monitoring in the form of somatosensory and motor-evoked potentials was used and remained stable throughout the operation. The surgery went uneventfully, and the patient recovered well. Postoperative computed tomographic angiography (CTA) showed complete obliteration of the aneurysm with intact distal circulation.

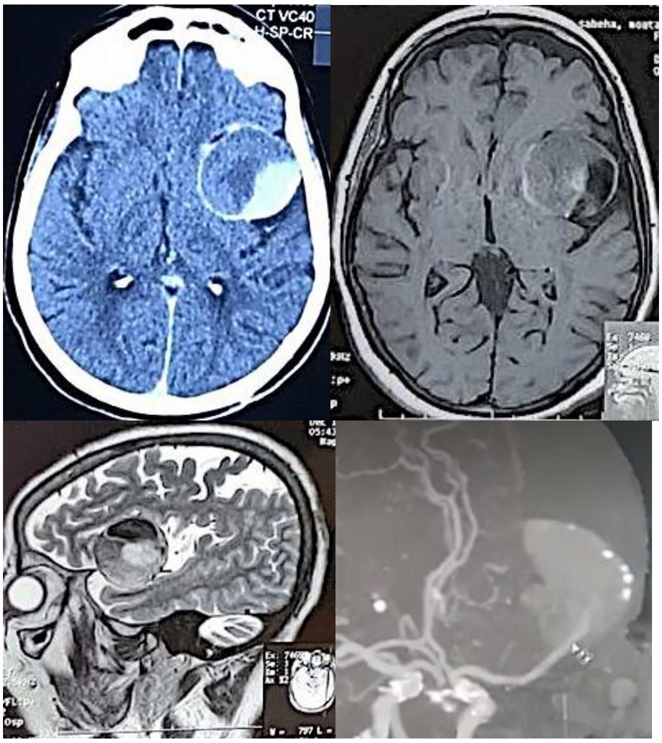

Figure 1: Giant, partially thrombosed M2 branch of the MCA aneurysm located at the insular part of the left Sylvian fissure is being shown. A: Non-contrast CT scan, (axial section), B: Non-contrast, T1-weighted MRI image (axial section). C: T2-weighted MRI (sagittal section), D: CT angiography (anterior view)

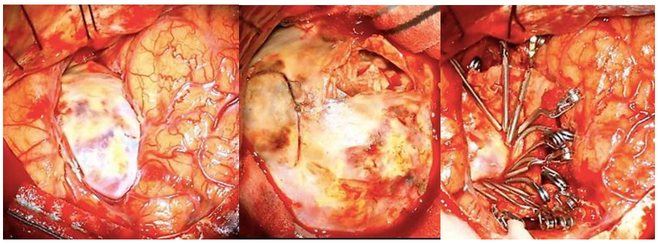

Figure 2: Intra-operative views showing: (A): the giant aneurysm dome filling the Sylvian fissure at initial exposure, (B) incision of the thrombosed part of the aneurysm and commencement of internal debulking, (C) Final configuration of the reconstructed neck with 13 clips assuming the shape of a peacock tail

Figure 3: Illustrated depictions showing the location of the aneurysm at the Sylvian fissure (A), (B) A zoom-in view showing the exact configuration of the aneurysm showing the limits of the resected part of the dome (dotted line) and the 13 clips assuming the pattern of a peacock-tail, (C): The arrangement of the peacock-tail feathers

Discussion

Microsurgical aneurysmal clipping is usually the first line of treatment for large and giant saccular MCA aneurysms (1). However, due to complex anatomy, atherosclerosis, calcification, or branch adhesion, conventional clipping is frequently impractical. Thus, these aneurysms are frequently treated using bypass/trapping or tandem clipping techniques. Tandem clipping employs multiple clips to reconstruct the aneurysm neck to facilitate clipping of these aneurysms (6,7). In this paper, we present a modification of the tandem clipping technique of the giant MCA aneurysm.

The realm of vascular neurosurgery, with its multifaceted challenges presented by large and giant aneurysms, has been met with the evolution of diverse techniques. Among these, tandem clipping strategies such as the 'picket-fence', 'reverse picket-fence', and 'mass reduction' methods have emerged. Each employs the application of multiple clips, catering to the management of aneurysms characterized by intricate structures or locations that defy the effectiveness of a singular clip. These techniques bring forth a tailored approach, adapting to the specific dimensions, configurations, and site of the aneurysm (8,9,10).

The 'picket-fence' technique, named for its resemblance to a row of upright fence slats, involves the application of multiple clips in a straight line, usually in a vertical orientation relative to the aneurysm's neck. The clips work together to approximate a flat, straight neck, thus isolating the aneurysm sac from the circulation. Its counterpart, the 'reverse picket-fenc technique, applies the clips in a similar manner but in the opposite orientation. In this case, the clips are stacked horizontally across the aneurysm neck, offering an alternate approach to reconstructing the neck for aneurysms of unconventional shape or location. Lastly, the 'mass reduction' technique is typically employed for large or giant aneurysms, often those partially filled with thrombus. This approach involves the application of a clip or multiple clips to compact or reduce the mass of the aneurysm. The clip induces thrombosis within the aneurysm, reducing its size and allowing for safer dissection from the surrounding brain tissue. After mass reduction, additional techniques such as clip reconstruction or bypass may be employed to completely isolate the aneurysm from the circulation. Nonetheless, when confronted with aneurysms exhibiting lateral extensions such us our case, often characteristic of substantial MCA aneurysms, the standard tandem clipping techniques may fall short. Such scenarios call for a refined strategy. The 'peacock tail' clipping technique represents a modification of the previously described straight tandem clipping technique, also known as the 'picket-fence,' in which parallel straight clips are vertically stacked across the dome, with the tips reconstructing the neck (8). The merit of the 'peacock tail' technique is that the clips are applied in a fanning pattern, which accommodates the aneurysm neck's lateral extensions that would sag out of the confinement of the picket-fence clip alignment. In such consistent with all neurosurgical procedures, the crux lies in personalized planning, taking into account the specific features and geometry of the aneurysm, to secure the best possible outcomes (8,9).

The intricate arena of vascular neurosurgery offers diverse operative strategies, among which bypass surgery and endovascular procedures are paramount. Often selected as the primary therapeutic approach for substantial, intricate MCA aneurysms, bypass surgery provides an effectual alternative by diverting the blood flow away from the aneurysm. The choice between bypass surgery and clip reconstruction is typically dictated by a range of factors specific to the case, such as the impact of the aneurysm's mass, the age of the patient, and the necessity for a double-barrel bypass for both M2 segments of the MCA which was technically challenging in this patient (6,7).

Endovascular procedures present a less invasive option in the treatment of aneurysms, utilizing techniques such as coiling or stent-assisted coiling. These methods can be particularly beneficial in managing aneurysms located in areas that are challenging or carry high surgical risk. However, the practical application of these endovascular treatments can vary extensively depending on the region, with economic and infrastructural barriers often limiting access to these services. For example, in regions like Iraq, endovascular intervention is predominantly offered within the private sector, leading to extensive and unaffordable costs for many patients. Therefore, it is essential to modify treatment plans to the unique context and resources at hand, guaranteeing the highest possible level of care for every patient within these limitations. Additionally, the lesion's size, being partially thrombosed, and the M2 are originating from the aneurysmal sac make the endovascular option less favourable.

The 'peacock tail' clipping technique demonstrates how an individualized neck reconstruction tailored to each aneurysm's unique geometry can safely and effectively isolate the aneurysm from the circulation while preserving distal flow.

Conclusion

Giant MCA aneurysms may demand an adaptive clipping technique to account for the unique geometry of each aneurysm. In this paper, we described the 'peacock tail' clipping technique for clip reconstruction of a giant complex partially thrombosed M2 MCA aneurysm as a modification of the conventional tandem clipping technique.

Conflict of interest

The authors have no conflict of interest.

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