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Case Report

Treatment of complex intracranial aneurysm: Case report of the simultaneous use of endovascular and microsurgical techniques

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Abstract

Background: The surgical treatment of complex intracranial aneurysms (CIAs) represents a significant challenge to the skill and expertise of the neurosurgeon. The natural history of complex cerebrovascular lesions is especially unfavorable because of the pressure effect on adjacent areas, the risk of embolism in the presence of intraluminal thrombi, and the possibility of hemorrhage through leakage or rupture of the aneurysm. The surgical strategy must be customized for each case in order to maximize the treatment effectiveness and the safety of the patient.

Case Description: A 68-year-old woman presented with a 10-month history of atypical headaches but no other neurological symptoms. Computed tomography scan and digital subtraction angiography revealed an unruptured saccular aneurysm on the M1 segment of the right middle cerebral artery. The lesion was 21 mm in length in its largest diameter and with an undefined neck (extensive involvement of the walls of the afferent vessel). Craniotomy was performed in order to expose the lesion and allow microsurgical dissection of the neck of the aneurysm and its adjacent structures. A balloon catheter was navigated via the internal carotid artery to a position alongside the aneurysm neck. With the balloon fully inflated, the aneurysm was punctured and drained, and a guide clip was located at the neck of the aneurysm. Additional clips were applied using a similar procedure to ensure the exclusion of the aneurysm.

Conclusion: The patient recovered without complications and complete occlusion of the CIA was confirmed on follow-up angiography. A modified Rankin score of 0 was attributed to the patient 6 months after treatment. A multidisciplinary perspective is important in planning and executing the treatment of CIAs.

Key Words: Endovascular, giant intracranial aneurysm, interdisciplinary communication, neurosurgery

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INTRODUCTION

Among the various types of cerebrovascular lesions, giant or complex intracranial aneurysms (CIAs) are generally considered to present the greatest challenge to the neurosurgeon.[6] In the absence of a conventional definition of CIA, the criteria usually adopted to classify an aneurysm as complex are the presence of intraluminal thrombi, coarse calcification within the wall of the lesion, aneurysm neck with irregular morphology, and involvement of the vascular wall of the adjacent blood vessel.[2,6]

Despite the lack of a standardized definition, it is accepted that the prognosis for CIA is almost invariably poor owing to the unfavorable natural history and high risk of the treatment applied.[2] The inauspicious natural history is related to the pressure effect of the aneurysm on the adjacent cranial nerve and brain tissue, the risk of embolism caused by the presence of intraluminal thrombi, and the greater risk of hemorrhage through leakage or rupture of the aneurysm in comparison with other lesions.[6]

Regarding surgical treatment, morbidity and mortality associated with this type of surgery remain high despite advances in microsurgical technologies, devices, and modalities.[2]

In this case study, we describe the combined and simultaneous use of endovascular and microsurgical techniques for the management of a patient with an unruptured CIA on the middle cerebral artery (MCA). This report describes the use of intraluminal balloon remodeling in order to prepare the neck of a complex MCA aneurysm for subsequent application of surgical clips.

CASE DESCRIPTION

Case report

A 68-year-old woman presented with a 10-month history of atypical headaches but no other neurological symptoms. Computed tomography (CT) scan and magnetic resonance imaging (MRI) of the brain showed a cerebral aneurysm located at the sphenoid segment of the right lateral fissure [Figure 1]. Digital subtraction angiography (DSA) together with CT angiography revealed a saccular aneurysm with 21 mm in length in its largest diameter and an undefined neck (extensive involvement of the walls of the afferent vessel) on the M1 segment of the MCA [Figure 2].

The patient presented no associated comorbidities and physical evaluation showed no clinical signs of neurological alterations. She received and fully understood a detailed explanation of the proposed novel procedure and subsequently signed the document of informed consent. Surgery was performed 20 days after the diagnosis. The proposal for the use of associated techniques had been previously approved by the hospital Ethics Committee.

Surgical procedure

The patient was positioned on an operating table appropriate for fluoroscopy-guided surgical procedures, and general anesthesia was induced by intravenous administration of atracurium (0.5 mg/kg), remifentanil (1 μg/kg), and propofol (2 mg/kg). Subsequently, the head was held in a radiotranslucent carbon fiber cranial support (HeadFix®; Micromar Brasil, Diadema, SP, Brazil).

Exposure of the aneurysm was achieved by classic pterional craniotomy and microsurgical dissection of the cisterns associated with the ipsilateral portions of the internal carotid artery (ICA) and MCA. After dissection of the MCA (proximal and distal to the aneurysm), exposure of the lesion and dissection of the aneurysm neck and its adjacent structures, craniotomy was covered with a surgical swab moistened with 0.9% saline solution.

A 5 × 15 mm Copernic® balloon catheter (Balt Extrusion, Montmorency, France) was subsequently navigated under fluoroscope control through a right femoral puncture and, with the help of a 6F guiding catheter, placed on the right MCA and positioned alongside the aneurysm neck [Figure 3a]. The balloon catheter was briefly inflated to verify its position and DSA was performed to confirm the absence of blood flow in the occluded segment [Figure 3b]. In order to diminish the risk of embolism without increasing hemorrhaging unduly, a 0.9% saline solution containing heparin (5000 U/L) was delivered at a continuous flow of 30 mL/h through the guiding catheter.

The surgical microscope was repositioned to allow the balloon catheter be inflated under microscopic and fluoroscopic visualization. Then, the aneurysm was

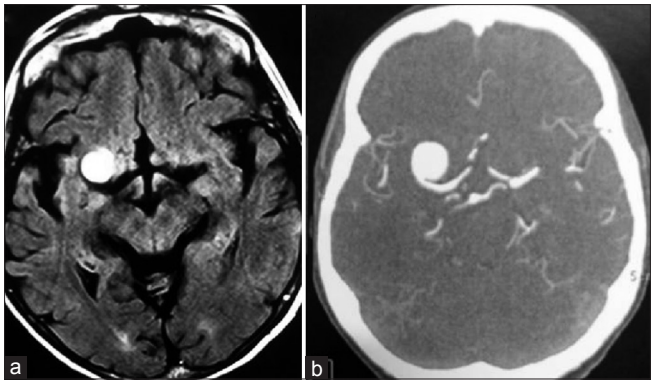

Figure 1: (a) Axial MRI (FLAIR sequence) showing the lesion's hypersignal located at the sphenoidal segment of the right sylvian fissure. (b) Contrast CT scan demonstrating a homogeneous lesion in the proximal segment of the sylvian fissure

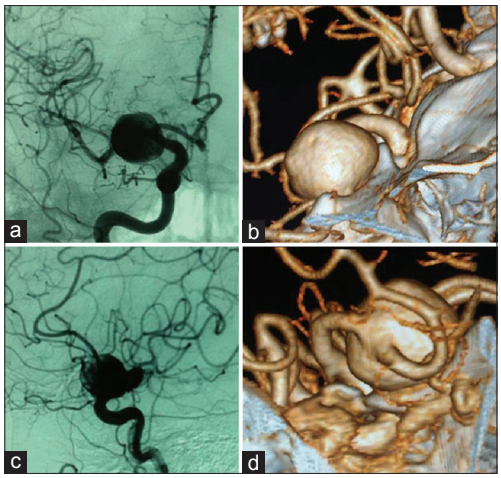

Figure 2: DSA at the anteroposterior (a) and lateral (b) positions showing a saccular aneurysm that is difficult to differentiate from the parent vessel. Three-dimensional CT angiography at the anterior-oblique (c) and posterior-oblique (d) positions confirming the diagnosis of an aneurysm with an undefined neck on the right MCA

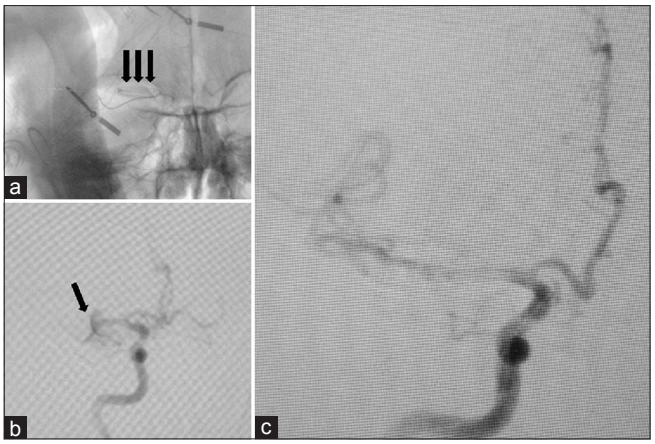

Figure 3: Intraoperative DSA. (a) The position of the balloon catheter together with guiding catheter coiled within the aneurysm (arrows). (b) Control DSA with absence of blood flow (arrow) in the aneurysm and distally. (c) Control DSA after aneurysm clipping

punctured and its contents drained in order to allow free viewing of the entire neck of the aneurysm.

The first clip was applied in the normal manner with accurate positioning of the clip blades being facilitated by the presence of the inflated balloon, which provided tactile feedback to the surgeon. Following this application and verification of the clip position, the balloon was deflated to reveal refilling of the aneurysm caused by minor bleeding from the puncture site. A new expansion of the balloon allowed repositioning of the guide clip and application of additional clips, one of which was a fenestrated aneurysm clip with higher closing pressure. Deflation of the balloon revealed that the aneurysm was no longer filling with blood. All endovascular balloon inflation maneuvers were timed, and the accumulated inflation period was less than 7 minutes.

At the end of microsurgery, an intraoperative cerebral DSA was performed demonstrating the complete exclusion of the aneurysm and preservation of the parent blood vessel without signs of stenosis [Figure 3c]. The deflated balloon and guide catheter were then removed, and hemostasis was performed by direct compression of the femoral artery. Concomitant with this femoral hemostasis, the dural, cranial, and scalp closures were performed according to standard techniques.

Postoperative course

Immediately after recovering from general anesthesia, the patient presented no neurological signs or symptoms. She was discharged from the intensive care unit on the first postoperative day and was discharged from the hospital on the third day.

On the second week after surgery, the patient complained of headaches, but improved after medication with oral analgesics. On the fourth week after surgery, she was totally asymptomatic and the surgical wound had healed satisfactorily.

A modified Rankin score of 0 was attributed to the patient 6 months after treatment and control CT angiography showed complete occlusion of the aneurysm without any signs of recurrence. Late control angiography (performed one year after surgery) shows the preservation of the sphenoid segment of the middle cerebral artery (without stenosis) and complete exclusion of the aneurysm [Figure 4].

DISCUSSION

The successful management of a CIA requires considerable expertise on the part of the neurosurgeon together with the use of state-of-the-art techniques and equipment.[2]

The morphology of the neck of the aneurysm is the most important feature of a CIA in terms of achieving the complete exclusion of the lesion without damaging brain blood flow.[2,5-8,10,12,13] Sometimes the presence of a wide and/or undefined neck, linked to the impaired circumference of the parent artery or efferent artery arising from the aneurysm, requires the use of techniques that are more complicated than simple endovascular coiling or surgical aneurysm clipping. In addition, since each case demands a particular solution employing patient-specific instrumentation and techniques, it is important to maintain a multidisciplinary perspective in order to maximize the effectiveness of the treatment and the safety of the patient.

In the present case, the surgical strategy was designed to achieve a custom-fit CIA resolution by using combined and simultaneous endovascular and microsurgical

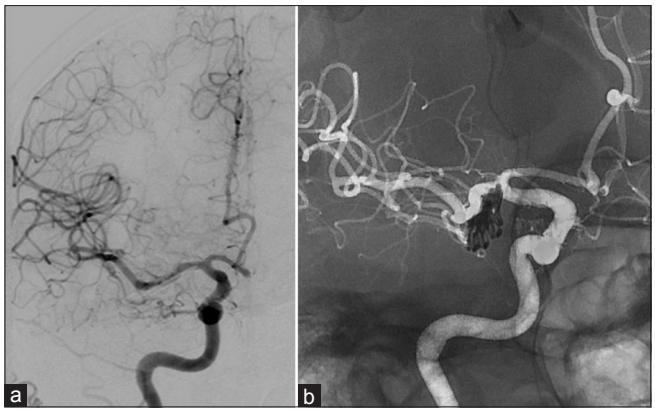

Figure 4: Late control angiography. (a) The preserved size throughout the course of the MCA and no residual aneurysm. (b) Several clips rebuilding the arterial anatomy of the patient

techniques with the aim of increasing the likelihood of a successful outcome.

Exclusive endovascular therapy was discarded because of the large size of the aneurysm (21 mm) and the unfavorable neck morphology. Endovascular aneurysm coiling would have required stent assistance, a factor that is associated with increased morbidity and mortality.[4,11] Moreover, the use of a flow-diverting stent was rejected because of the risk of damaging perforator arteries, especially the lenticulostriate branches,[3] and the high cost of such devices that renders them unavailable within the Brazilian public health service.

Similarly, the sole use of microsurgical techniques would have involved actions associated with elevated risk of morbidity and mortality,[1] such as revascularization of the area distal to the aneurysm to maintain brain blood flow, proximal and distal isolation of the lesion, draining the aneurysm sac, and direct clipping of the aneurysm neck in order to reconstruct the MCA while preserving the lenticulostriate branches.

Rather than employing these isolated approaches, our proposed strategy combined the use of intraluminal balloon remodeling and clipping of the neck of the aneurysm only after the lesion had been emptied [Figure 5]. At the outset, we believed that the risk of morbidity and mortality inherent to cerebral revascularization procedures (reportedly between 7 and 26.5%) could be reduced to a level close to that expected for unruptured MCA aneurysm clipping (2.1%).[9] This was the main reason that led us to join these two surgical techniques in the treatment of this patient.

At present, it is not possible to evaluate the real impact of recent advances in CIA therapeutic techniques because most publications describe different endovascular procedures carried out in specific centers or just compare embolization with microsurgical procedures. While

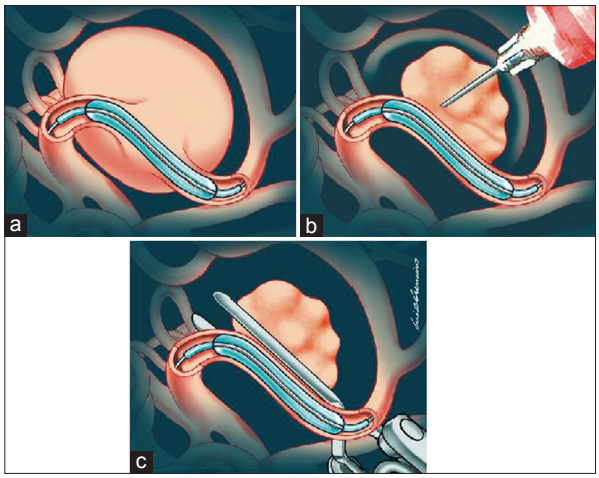

Figure 5: Schematic representation of the combined and simultaneous techniques reported (intraluminal balloon catheter and microsurgical clipping of the aneurysm). (a) Shows the position of the inflated balloon. (b) Demonstrates the puncture and drainage of the aneurismal using an adapted version of the Dallas maneuver. (c) The inflated balloon helps to prevent stenosis of the parent vessel and facilitates application of the guiding clip by providing tactile feedback to the neurosurgeon

comparison of the various techniques is certainly of value, we believe that the benefits of a multidisciplinary approach are more significant in terms of effectiveness and safety. In our opinion, the endovascular and microsurgical techniques are complementary rather than competing strategies for the treatment of complex neurovascular lesions.

CONCLUSION

The novel combination of endovascular and microsurgical techniques to the treatment of an unruptured CIA on the MCA produced a successful outcome with complete occlusion of the CIA without any signs of recurrence. Based on our experience, we conclude that a multidisciplinary team approach is important in planning and executing the treatment of CIA. In this respect, our case study constitutes a valuable example on the application of a range of available resources to reach a solution for a complex situation.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Abdulrauf SI, Cantando JD, Mohan YS, Olivera R, Lebovitz JJ. EC-IC by-pass for giant ICA aneurysms. In: Abdulrauf SI, editor. Cerebral Revascularization. Techniques in Extracranial-to-Intracranial Bypass Surgery 1st ed. Philadelphia: Elsevier Saunders; 2011. p. 231-45.
2. Andaluz N, Zuccarello M. Treatment strategies for complex intracranial aneurysms: Review of 12-year experience at the University of Cincinnati. Skull Base 2011;21:233-42.
3. Brinjiki W, Murad MH, Lanzino G, Cloft HJ, Kallmes DF. Endovascular treatment of intracranial aneurysms with flow diverters. A meta-analysis. Stroke 2013;44:442-7.
4. Chalouhi N, Jabbour P, Singhal S, Drueding R, Starke RM, Dalyai RT, *et al*. Stent-assisted coiling of intracranial aneurysms: Predictors of complications, recanalization, and outcome in 508 cases. Stroke 2013;44:1348-53.
5. Day AL, Gaposchkin CG, Yu CJ, Rivet DJ, Dacey RG. Spontaneous fusiform middle cerebral artery aneurysms: Characteristics and a proposed mechanism of formation. J Neurosurg 2003;99:228-40.
6. Hanel RA, Spetzler RF. Surgical treatment of complex intracranial aneurysms. Neurosurgery 2008;62(Suppl 3):1289-97.
7. Lawton MT, Quinones-Hinojosa A, Sanai N, Malek JY, Dowd CF. Combined microsurgical and endovascular management of complex intracranial aneurysms. Neurosurgery 2008;62(Suppl 3):1503-15.
8. Peerless SJ, Wallace MD, Drake CG. Giant intracranial aneurysms. In: Youmans JR, editor. Youmans Neurological Surgery 3rd ed. Philadelphia: WB Saunders; 1990. p. 1742-63.
9. Smith TR, Cote DJ, Dasenbrock HH, Hamade YJ, Zammar SG, El Tecle NE, *et al*. Comparison of the efficacy and safety of endovascular coiling versus microsurgical clipping for unruptured middle cerebral artery aneurysms: A systematic review and meta-analysis. World Neurosurg 2015;84:942-53.
10. Thorell, W, Rasmussen, P, Perl J, Masarky T, Mayberg M. Balloon-assisted microvascular clipping of paraclinoid aneurysms. Technical Note. J Neurosurg 2004;100:713-6.
11. Wang K, Sun Y, Li AM. Peri-procedural morbidity and mortality associated with stent-assisted coiling for intracranial aneurysm. Interv Neuroradiol 2013;19:43-8.
12. Wiebers DO, Whisnant JP, Huston J 3rd, Meissner I, Brown RD Jr, Piepgras DG, *et al*. Unruptured intracranial aneurysms: Natural history, clinical outcome, and risks of surgical and endovascular treatment. Lancet 2003;362:103-10.
13. Zhu W, Tian YL, Zhou LF, Song DL, Xu B, Mao Y. Treatment strategies for complex internal carotid artery (ICA) aneurysms: Direct ICA sacrifice or combined with extracranial-to-intracranial by-pass. World Neurosurg 2011;75:476-84.