Balloon-Assisted Clipping of a Large Paraclinoidal Aneurysm: A Salvage Procedure

OBJECTIVE: Surgical clipping and parent vessel reconstruction of wide-neck paraclinoidal aneurysms can be very challenging. We report a case of a ruptured paraclinoid aneurysm which failed standard clipping techniques. We were able to reconstruct this aneurysm while providing proximal and distal control using an adjuvant endovascular balloon.

CLINICAL PRESENTATION: We report the case of a 45-year-old woman presenting with a ruptured large paraclinoidal aneurysm, which involved a significant portion of the internal carotid artery wall.

INTERVENTION: Repeated attempts at fenestrated clip placement resulted in slipping of the clip and occlusion of the parent artery. Ultimately, the aneurysm ruptured at the neck, and, despite trapping and direct aneurysmal suction decompression, significant bleeding was encountered. The bleeding point was packed, and, subsequently, endovascular access was obtained. A balloon was navigated and then inflated across the neck of the aneurysm using C-arm fluoroscopic guidance. The aneurysm was successfully clipped, and intraoperative angiography demonstrated no parent vessel stenosis.

CONCLUSION: This case demonstrates a salvage procedure in the event of intraoperative rupture and inadequate interruption of local blood flow. Balloon inflation resulted in adequate hemostasis and provided intraluminal support for optimal clip placement while preserving the parent artery.

KEY WORDS: Balloon-assisted clipping, Intraoperative rupture, Paraclinoidal aneurysm

Surgical clipping of paraclinoid region aneurysms can be challenging and often requires temporary interruption of local blood flow to decompress the aneurysm and to facilitate clip placement. This has traditionally been accomplished by trapping of the aneurysm and suction decompression. Endovascular balloon inflation across the aneurysm neck has also been used to achieve both proximal and distal control during aneurysm surgery, eliminating the need for temporary clipping. We report the use of a similar technique as a salvage procedure in the setting of intraoperative rupture without adequate proximal control. Although endovascular access was not planned preoperatively, navigation of a balloon was feasible and proved to be extremely helpful in interruption of local blood flow. Furthermore, the balloon provided intraluminal support and prevented parent artery compromise during clipping.

CASE REPORT

A 45-year-old woman presented with a sudden onset of severe headache. On physical examination, she had severe meningismus and no focal neurological deficits. Computed tomography revealed Fisher 3 subarachnoid hemorrhage, and digital subtraction angiography demonstrated a 2-cm left paraclinoidal aneurysm (Fig. 1). In the setting of an acute rupture, it was thought that the aneurysm would be best treated through surgical clipping, as endovascular therapy would require an antiplatelet regimen for stent-assisted coiling. A preoperative balloon test occlusion, which we frequently perform at our institution for complex unruptured paraclinoid aneurysms, was not performed, as the option of vessel sacrifice was not favored in the setting of subarachnoid hemorrhage with the potential of future vasospasm.
Operative Procedure

The patient underwent a modified left orbitozygomatic craniotomy with exposure of the cervical internal carotid artery (ICA). The aneurysm was identified after partial sylvian fissure dissection and opening of the opticocarotid cistern. It originated from the inferomedial aspect of the superior hypophyseal segment of the ICA and involved a significant portion of the carotid wall. The anterior clinoid process was then removed, and the distal dural ring was opened so that the ophthalmic artery and the clinoidal portion of the ICA could be better visualized.

Temporary clips were placed on the cervical ICA, ophthalmic artery, and distal ICA, including the posterior communicating artery. Despite these measures, the aneurysm remained tense and nonpliable. Direct suction decompression was performed by inserting a 25-gauge needle into the dome of the aneurysm. Although there was significant blood return, with application of a Frazier suction, the aneurysm became soft enough to allow dissection from the optic nerve. A right-angled fenestrated clip was used to close the entire length of the aneurysm neck, including the tear at the neck (Fig. 2B). Total occlusion was achieved. The balloon was then inflated, and a final roadmap guidance across the neck of the aneurysm. At this point, the common carotid artery (CA) was inserted through the guide catheter and navigated using a 10-mm HyperGlide balloon (ev3 Neurovascular, Inc., Irvine, CA) was inserted through the guide catheter and navigated using roadmap guidance across the neck of the aneurysm. At this point, the microscope was brought back into the operative field. The balloon was inflated under fluoroscopy, which was positioned around the patient’s head. The groin was sterilized, and femoral artery access was obtained. A bolus of 5000 U of heparin was given to prevent catheter- and balloon-associated thromboembolic complications. A 6-French guide catheter was then introduced and maneuvered into the left ICA. Subsequently, a 4 × 10-mm HyperGlide balloon was inserted through the guide catheter and navigated using roadmap guidance across the neck of the aneurysm. At this point, the microscope was brought back into the operative field. The balloon was inflated under fluoroscopy, and adequate hemostasis was achieved. The balloon was used to define the normal artery, and then a right-angled fenestrated clip was used to close the entire length of the aneurysm, including the rent at the neck (Fig. 2B). Total occlusion time was 20 minutes. The balloon was then deflated, and a final angiogram demonstrated brisk flow through the ICA with no filling of the aneurysm (Fig. 3, A and B).

Postoperative Course

Postoperatively, the patient developed a right-sided hemiparesis. A diagnostic cerebral angiogram revealed no major branch occlusion, vasospasm, or residual aneurysm (Fig. 3C). Magnetic resonance imaging demonstrated a stroke in the distribution of the inferior division of the left middle cerebral artery. Four days later, she developed vasospasm requiring intra-arterial nicardipine infusion. She was ultimately discharged to a rehabilitation facility with a significant improvement of her hemiparesis.

DISCUSSION

Approximately 5% to 10% of all cerebral aneurysms arise in the paraclinoidal region (6). Frequently, these aneurysms pose a challenge to both endovascular coiling and surgical clipping, owing to their large size, broad neck, and complex nature (9). Safe surgical clipping of paraclinoid region aneurysms often requires temporary interruption of local blood flow to decompress the aneurysm. Traditionally, this has been accomplished by placing temporary clips on the cervical ICA as well as the ICA distal to the aneurysm. Occasionally, despite these measures, the aneurysm remains tense owing to brisk retrograde flow through the ophthalmic artery and cavernous branches. Further decompression can be achieved directly by aneurysmal puncture and suction (5) or indirectly by retrograde suction of the cervical ICA via direct cannulation (2) or transfemoral
catheterization (1, 3, 4, 7). The use of endovascular balloons to achieve proximal control has avoided the need for cervical ICA exposure. Subsequent reports have described balloon inflation across the aneurysm neck with the added advantage of achieving both proximal and distal control, greater exposure of the aneurysm for permanent clipping owing to elimination of the need for temporary clips, improved accuracy of clip placement, and reduction of the risk of intramural aneurysm thrombus dislodgement (8, 9). These techniques, however, have been planned preoperatively.

We report the use of this technique as a salvage procedure in the setting of intraoperative rupture without adequate proximal control. We presume that trapping and suction decompression was insufficient owing to the presence of large cavernous branches. Although we were not prepared for endovascular access, navigation of a balloon under these circumstances was feasible and proved to be extremely helpful in interruption of local blood flow. Furthermore, the balloon provided intraluminal support and scaffolding and prevented parent artery compromise during clipping. Although our patient experienced a stroke, the use of this technique potentially avoided a more devastating complication. Preoperative placement of a transfemoral sheath would have saved critical access time and may be considered in the future for treatment of complex paraclinoid aneurysms. It is clearly understood that had the rupture at the neck been more devastating and not controllable by local tamponading, it would not have been possible, safe, or practical to simultaneously acquire transfemoral endovascular access during a period of profuse bleeding, and therefore this “salvage” technique cannot be expected to solve all cases of unstoppable intraoperative rupture. However, in selected cases, this technique may be a useful adjunct both for tamponade and for assistance with luminal reconstruction.

Disclosure

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

REFERENCES


COMMENTS

The authors present an interesting case of a large ruptured paraclinoid aneurysm that tore during clip application. A balloon was navigated endovascularly across the neck to achieve hemostasis and facilitate clipping.

The technique of passing a balloon across the neck of a paraclinoid aneurysm is not new or unique, and the surgeons were fortunate to be able to accomplish this task considering the aneurysm had already torn at the neck. The technical aspects of this case however, bring up several important points. I have found that when the cervical internal carotid is temporarily occluded, placing a clip on the distal internal carotid artery (ICA) and posterior communicating artery (PCOM) actually makes a large paraclinoid aneurysm more tense than if these distal clips are left off. Although there is significant collateral flow to the aneurysm from cavernous and ophtalmic branches, proximal ICA occlusion alone greatly reduces the pressure in the aneurysm and usually allows for safe clipping.

The second issue has to do with the problem reported with the initial placement of the right angle fenestrated clip. I have found, as the authors experienced in this case, that the clip often is forced down onto the parent artery and narrows or occludes the lumen. In such cases, it is better to leave the stenosing clip in place and position another fenestrated clip more distally on the dome in the ideal location for lumen reconstruction. The initial offending clip can then be removed, usually with the second clip remaining in perfect position.

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FIGURE 3. A, intraoperative angiogram demonstrating the paracli- nodial aneurysm. B, final intraoperative angiogram revealed no filling of the aneurysm and brisk flow through the ICA. C, postoperative angiogram demonstrating complete obliteration of the aneurysm and no major branch occlusion or parent vessel stenosis.
Endovascular balloon inflation across an aneurysm neck is an effective method for gaining proximal and distal control of the aneurysm, eliminating temporary clips in the field, and providing a scaffold to reconstruct the parent artery. In this report, the technique salvaged a difficult intraoperative rupture of a large paraclinoidal carotid artery aneurysm that tore during clip application and could not be clipped without compromising the carotid artery. Bleeding was controlled with packing, the balloon catheter was navigated into position, and the aneurysm was clipped with 20 minutes of balloon inflation time. This case demonstrates another maneuver that might deal with intraoperative aneurysm rupture, and another trick to add to the contingency plan. It also demonstrates how endovascular techniques are working their way into the operating room to enhance our neurosurgical armamentarium.

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The authors relate a salvage procedure in which they were able to successfully clip a large paraclinoid aneurysm that had ruptured intraoperatively with balloon navigation across the neck of the aneurysm. The authors were able to control the bleeding and successfully address the lesion. Although the patient ultimately suffered a stroke, the potential outcome could have been far worse had the authors been unable to control the bleeding and successfully address the aneurysm. This report again underscores the need for both microsurgical and endovascular expertise in a team setting to address such complicated vascular lesions. The use of only one of these techniques in a vacuum leads to poor outcomes. The authors are to be commended for their quick thinking and ingenuity.

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Aziz-Sultan and his vascular colleagues in Miami present a case report where a combination of microsurgical and endovascular means were used to salvage the potentially fatal situation of an unanticipated intraoperative tear of a large paraclinoid aneurysm. After unsuccessful attempts to soften the large aneurysm via temporary clipping of the feeding vessels, direct suction decompression was utilized which softened the aneurysm. Clipping was unsuccessful at this point due to slippage and occlusion of the parent artery. Clip application also led to a tear in the neck of the aneurysm which eventually lead to the use of a Hyperglide endoluminal balloon placed over the aneurysmal neck, which suspended the hemorrhaging as well as served as a scaffold over which the clips could be placed. While this technique is by no means novel, as utilization of endovascular balloons for proximal control in paraclinoidal aneurysm repair has been widely reported, it does illustrate another potential use, i.e., as a salvage technique in cases of uncontrolled aneurysmal bleeding. Some institutions routinely place a preoperative femoral sheath in anticipation of either providing proximal control or in preparation for an intraoperative angiogram; however, as non-invasive imaging techniques, such as ICG videoangiography, become increasing more available, intraoperative transfemoral access becomes less. This case report illustrates indirectly the need to always follow first principles when considering cases of large paraclinoid aneurysms, i.e., proximal vascular control is necessary to establish from the beginning such that potentially fatal situations are avoided. Although every procedure has some associated risks, even placement of a transfemoral sheath, that risk may be small compared to the potential risk of not having proximal control when treating a large, complex aneurysm, such as the paraclinoid lesion described in this case.

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