Case Report

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Post-Operative Identification of Middle Meningeal Artery-Sphenoparietal Sinus Arteriovenous Fistula Following Pterional Craniotomy and Aneurysm Clipping

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Abstract

Introduction: The authors present a case report on the formation and treatment of an intradural arteriovenous fistula (AVF) between the middle meningeal artery (MMA) and the sphenoparietal sinus (SPS) following pterional craniotomy and middle cerebral artery (MCA) aneurysm clipping. The fistula arose due to an anatomical variant, in which the MMA originated from the ophthalmic artery instead of the maxillary artery.

Case presentation: 33-year-old female presented to the emergency department of Louisiana State University Health Sciences Center, Shreveport, USA with an episode of acute onset headache with subsequent seizure and loss of consciousness. Digital subtraction angiogram (DSA) showed a bilobed MCA aneurysm, measuring 9×4 millimeters with an aneurysmal neck size of 3 millimeters. Based on imaging and clinical scenario, it was determined that craniotomy, clipping of an aneurysm and evacuation of the hematoma would be the best surgical treatment option for this patient. A right pterional [frontotemporal] craniotomy was performed. The greater sphenoid wing was then drilled until frontal and middle fossa was flush. The patient tolerated the clipping procedure well and was in stable condition in the neurosurgical intensive care unit. However, on post-operative day 1, the patient developed right oculomotor nerve palsy, including dilated pupil and extraocular muscle palsy. DSA demonstrated right middle meningeal artery to sphenoparietal sinus (MMA-SPS) fistula. CNIII palsy was thought to be secondary to increased pressure within the cavernous sinus, the direct draining reservoir of the SPS. Endovascular embolization was planned once the patient recovers from surgery if her CNIII palsy would not resolve.

Conclusion: MMA-SPS fistula is a potential operative complication of frontotemporal craniotomy. The possible complications can range from mild to severe including death and the methods of treatment are still not standardized. Understanding the patient’s vascular anatomy prior to craniotomy may help reduce the risk of these complications. Treatment should be based on the new-onset neurologic deficit, as some fistulas may resolve spontaneously.

Keywords: Sphenoparietal sinus; Fistula; Middle meningeal artery; Craniotomy; Pterional

Introduction

The pterional [frontotemporal] craniotomy is a well-described surgical corridor for accessing the middle cerebral artery (MCA) and its branches to clip MCA aneurysms. During this process, the greater wing of the sphenoid bone must be removed and the middle meningeal artery [MMA] is often sacrificed. The authors present a case report on the formation of an arteriovenous fistula [AVF] between MMA and sphenoparietal sinus [SPS] after pterional craniotomy and MCA aneurysm clipping. The fistula arose due to an anatomical variant, in which the MMA originated from the ophthalmic artery instead of the maxillary artery.

Case Presentation

A 33-year-old African-American lady with past medical history significant for poorly controlled hypertension presented to the emergency department of Louisiana State University Health Sciences Center, Shreveport, USA with an episode of acute onset headache with subsequent seizure and loss of consciousness. On arrival at our institution, the patient was neurologically intact, complaining primarily of a headache and nausea. CT scan of the brain revealed an acute intraparenchymal hematoma of size 2.2 × 3.6 centimeters in the right temporal lobe with adjacent edema and Fischer Grade 4 subarachnoid hemorrhage. CT angiography revealed a right MCA bifurcation aneurysm (Figure 1 A,B,C). Subsequent digital subtraction angiography (DSA) showed a bilobed aneurysm, measuring 9×4 millimeters with the aneurysmal neck size of 3 millimeters. (Figure 1 D,E). Based on the clinical and radiological findings, it was determined that clipping of the aneurysm and evacuation of the hematoma would be the best surgical treatment option for this patient.

Surgical Technique

After informed consent was obtained, the patient was taken to the operating room. General endotracheal anesthesia was administered. The patient was given perioperative mannitol, steroids, and antibiotics. A lumbar drain was placed preoperatively to control CSF flow and brain relaxation. For fixation, the patient’s head was turned towards the left and extended such that the malar eminence was placed at the highest point of the operative field. Once this was completed, a right pterional (frontotemporal) scalp incision was marked, cleaned with alcohol, prepped and draped in a standard fashion. The skin incision was made. The underlying scalp and temporalis muscle were dissected anteroinferiorly. Using a high power drill, a right frontotemporal craniotomy was made and elevated off the duramater. The greater sphenoid wing was then drilled down until the frontal and middle fossa was flush. Once this was completed, epidural hemostasis was obtained using oxycel and gelfoam. The dura was opened in a U shape incision and elevated anteriorly exposing the sylvian fissure. An aneurysm was accessed, identified, and clipped successfully with good blood flow demonstrated by intraoperative indocyanine green [ICG] angiography. Meticulous hemostasis was achieved, and the dura mater was approximated using 4-0 Nurolon suture in a running fashion. Perioperative mannitol, steroids, and antibiotics. A lumbar drain was placed preoperatively to control CSF flow and brain relaxation. For fixation, the patient’s head was turned towards the left and extended such that the malar eminence was placed at the highest point of the operative field. Once this was completed, a right pterional (frontotemporal) scalp incision was marked, cleaned with alcohol, prepped and draped in a standard fashion. The skin incision was made. The underlying scalp and temporalis muscle were dissected anteroinferiorly. Using a high power drill, a right frontotemporal craniotomy was made and elevated off the duramater. The greater sphenoid wing was then drilled down until the frontal and middle fossa was flush. Once this was completed, epidural hemostasis was obtained using oxycel and gelfoam. The dura was opened in a U shape incision and elevated anteriorly exposing the sylvian fissure. An aneurysm was accessed, identified, and clipped successfully with good blood flow demonstrated by intraoperative indocyanine green [ICG] angiography. Meticulous hemostasis was achieved, and the dura mater was approximated using 4-0 Nurolon suture in a running fashion. Epidural hemostasis was achieved using oxycel, gelfoam and
gelfoam. A large, dried piece of gelfoam was placed in the epidural space. There was no significant blood loss during the surgical procedure. The bone flap was repositioned using titanium miniplates and screws (DePuy Synthes system). Wound hemostasis was obtained using bipolar coagulation. The muscle, galea, and skin were closed in standard fashion.

Postoperative course and identification of fistula

The patient tolerated the clipping procedure well and was in stable condition in the neurosurgical intensive care unit. However, on postoperative day 1, the patient developed right oculomotor nerve palsy, including dilated pupil and extraocular muscle palsy. The patient was taken for DSA, which demonstrated right middle meningeal artery to sphenoparietal sinus (MMA-SPS) fistula (Figure 1 F). Due to the patient’s new onset cranial nerve deficit, the patient was scheduled for endovascular embolization of this fistula. However, her CN III palsy resolved spontaneously over the course of the following two days and treatment was deferred as an outpatient basis so that she could recover from the aneurysm surgery. However, after discharge, the patient did not return to the clinic for follow up despite multiple attempts to contact her.

Discussion

The pterional craniotomy is a well-described and widely practiced approach for clipping middle cerebral artery aneurysms. Tsutsumi et al. in 1990 also reported a similar case in which a fistula developed between MMA and SPS after craniotomy for aneurysmal surgery using periproxial approach [1]. This fistula was treated conservatively since the patient never developed any neurologic deficit. The fistula did resolve spontaneously in that case. This is the only previously described instance of such fistulization, and most case reports of such fistulas describe the traumatic head injury as the etiology [2-5]. The possible complications of the fistula include arterialization of veins with consequent rupture of venous aneurysm, venous engorgement with compression of optic nerve, vision loss from injury to the ophthalmic artery and even death [3,4,6-8]. Isolated oculomotor nerve palsy due to MMA-SPS fistula following pterional craniotomy is not common. This is considered to be secondary to the increased pressure within the cavernous sinus, the direct draining reservoir of SPS [9]. Carotid-cavernous fistula can manifest with abrupt onset of proptosis, chemosis, visual loss, and ophthalmoplegia. The isolated ophthalmoplegia, in this case, is likely due to the lower output of MMA, but the exact mechanism remains unclear. Treatment of MMA-SPS fistulas such as open clipping, sinus ablation, and endovascular techniques have been described previously [4,6,10]. It is possible that the patient’s recovery from oculomotor nerve palsy could be from the spontaneous resolution of the fistula.

Conclusion

MMA-SPS fistula is a potential operative complication of frontotemporal craniotomy. The possible complications can range from mild to severe including death and the methods of treatment are still not standardized. Understanding the patient’s vascular anatomy prior to craniotomy may help reduce the risk of these complications. Treatment should be based on the new-onset neurologic deficit, as some fistulas may resolve spontaneously.
Conflict of Interest and Financial Support

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References


