Ruptured Carotid Artery Pseudoaneurysm in the Middle Ear

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ABSTRACT

Objectives:

1. To describe our experience managing a pseudoaneurysm of the petrous internal carotid artery that was violated during middle ear surgery.
2. To discuss a review of the literature relating to petrous internal carotid artery pseudoaneurysm.

Methods:

The following is a case report describing our experience managing a 3 centimeter pseudoaneurysm of the petrous portion of the internal carotid artery that was encountered in January 2007 during a tympanoplasty and revision mastoidectomy in a 47-year-old female undergoing a tympanoplasty and revision mastoidectomy at a tertiary care university medical center. A brief review of the literature relating to petrous carotid artery pseudoaneurysms follows.

Results:

The patient was taken to the interventional neuroradiology suite and underwent transarterial occlusion of the affected internal carotid artery. The patient was then escorted to the operating room for a postauricular infratemporal trans-petrosal approach to the pseudoaneurysm and definitive over-sewing of the external ear canal.

Conclusions:

Iatrogenic pseudoaneurysms resulting from violation of an aberrant carotid artery during middle ear surgery are rare occurrences that have been documented in the otolaryngology literature. Pre-existing pseudoaneurysms are also an important phenomenon to consider when preparing a patient for a middle ear procedure. Although injury to a pre-existing pseudoaneurysm is a serious event, the situation can be successfully managed using a multidisciplinary approach involving interventional radiology techniques coupled with definitive otologic repair in the operating room.

CASE REPORT

A 47-year-old female who was lost to follow-up after a left sided canal wall up mastoidectomy for chronic secretory otitis media in 1999 presented to our outpatient otology clinic in 2006 with a left sided deep retraction of the posterior pars tensa into the sinus tympani. A bulging tympanic membrane in the anterior superior quadrant and middle ear fluid were also noted on exam. The patient underwent computed tomography (CT) of the temporal bones which revealed a left sided soft tissue mass most compatible with a blue dome cyst (cholesterol granuloma) filling the entire middle ear and mastoid cavities (Figure 1). An audiogram demonstrated a left mild to moderately severe conductive hearing loss with excellent word recognition and normal hearing on the contralateral side.

The patient was taken to the operating room for a left revision canal wall up mastoidectomy and perichondrial tympanoplasty with pressure equalization tube placement. Tymanomeatal, vertical, and postauricular incisions were made in the standard fashion. After a fascial graft was harvested, the expected soft tissue disease was dissected from the mastoid cavity and a blue dome cyst was removed from the antrum. The dissection continued under the operating microscope, and the tympanomeatal flap was elevated revealing the posterosuperior tympanic membrane retraction onto the incudostapedial joint. The membrane was carefully removed from the joint with a Rosen needle. Upon anterior dissection, bright, vigorous, arterial bleeding rapidly filled the middle ear space.

Routine packing proved insufficient to achieve hemostasis. The middle ear was quickly and aggressively packed with sterile gelatin resorbable sponges (Gelfoam), and the external ear canal was occluded with oxidized cellulose absorbable gauze (Surgicel). Next, the mastoid cavity was packed with Gelfoam and Surgicel. The wound was closed, and a pressure dressing was placed on the surgical site.

The anesthesia team quickly established an arterial monitoring line and pharmacologically paralyzed the patient. The patient's systolic blood pressure was maintained between 90 and 100 mm Hg, and the patient was urgently transported to the interventional neuroradiology suite.

A cerebral angiogram was performed which demonstrated a large (3 cm) pseudoaneurysm of the left petrous internal carotid artery (ICA) extending into the middle ear cavity (Figures 2 & 3). The patient's relative hypotension was maintained at a mean arterial pressure (MAP) of approximately 103 mm Hg, and the left ICA was temporarily occluded. An exuberant circle of Willis was appreciated with adequate blood supply to the entire left anterior cerebral circulation via an intact anterior communicating artery and to the entire left posterior circulation via an intact posterior communicating artery and convexity collaterals. Hypertension was induced to maintain a systolic blood pressure between 140 and 150mm Hg, and a central venous catheter was placed to assist with hypervolemia. At that time, the petrous and cervical ICAs were successfully permanently occluded with stainless steel thrombogenic coils.

Right ICA (Figure 4) and left vertebral artery (Figure 5) post-occlusion angiography confirmed complete left ICA occlusion and maintenance of left sided cerebral blood supply from the anterior and posterior arterial systems. Additionally, a patent left external carotid artery with evidence of collaterals to the left ophthalmic artery was demonstrated with left common carotid angiography (Figure 6). There was no evidence of non-vascularized areas.

The patient was returned to the operating room in stable condition, and she was prepped for definitive treatment of the pseudoaneurysm via a postauricular infratemporal trans-petrosal approach. The previous incision site was lengthened and the cartilaginous ear canal was oversewn with 3-0 Prolene and 3-0 Vicryl sutures. Upon removal of the Gelfoam and Surgicel from the middle ear and mastoid, there was some oozing of blood from the entire surgical bed with no brisk bleeding. Using the operating microscope, the bony external ear canal was removed down to the vertical segment of the facial nerve. The tympanic membrane was elevated, and the incus was removed (Figure 8). The pseudoaneurysm filled the anterior portion of the hypotympanum, the mesotympanum, and the epitympanum. When the malleus and entire tympanic membrane were dissected from the lateral surface of the thrombosed pseudoaneurysm, hemostasis was achieved. The temporoparietal flap was rotated into the surgical defect, and the postauricular wound was closed in layers over a suction drain. A pressure dressing was placed on the wound, and the patient was transferred to the neurosciences intensive care unit.

A postoperative CT scan of the brain was normal. The patient was treated with hypertensive and hypervolemic therapy to ensure adequate development of robust collateral circulation. On postoperative day one the patient was extubated and was neurologically intact. She was seen in the outpatient clinic one month after her discharge from the hospital and continued to be neurologically intact.

DISCUSSION

Pseudoaneurysms of the petrous internal carotid artery have rarely been reported in the literature. The etiologies of these pseudoaneurysms are varied. There have been reports of pseudoaneurysms arising spontaneously, congenitally, iatrogenically from surgery or radiation therapy, traumatically (i.e. gunshot wounds), and from tuberculosis or other bacterial and mycotic infections.[1,2,3,4,5,6] Pseudoaneurysms are false aneurysms with walls formed from reactive fibrous connective tissue usually after injury to the layers of the arterial wall.[3,5] The lumen of the pseudoaneurysm is shared with the vessel.

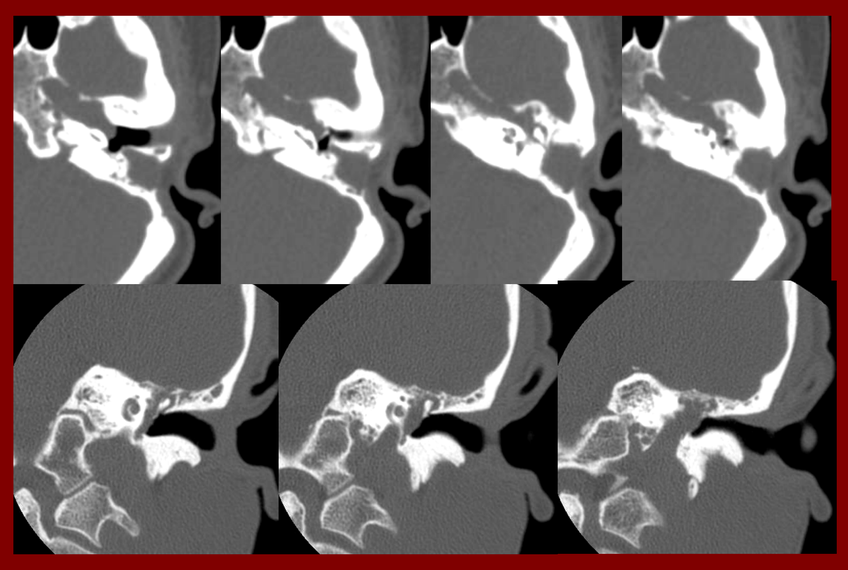
The rare nature of vascular lesions in this region of the ICA can be attributed the lack of vascular branches in the petrous portion, the protection offered by the carotid canal, and the uncommon incidence of petrous ICA atheromatous disease.[3] The cervical ICA is relatively mobile until it becomes fixed at the skull base in the carotid canal. As the mobile segment is stretched, the vessel wall is vulnerable to traumatic injury which can predispose the vessel to pseudoaneurysm formation.[3] This case demonstrates that, although rare, lesions of the petrous ICA do occur. Sometimes these occurrences present emergent situations which must be dealt with promptly. It is prudent for the otolaryngologist to understand the treatment choices available for such an emergency.

Symptoms and signs of a pseudoaneurysm of the petrous ICA are variable depending on the nature and location of the lesion. Epistaxis, sensorineural or conductive hearing loss, bloody otorrhea, headache, cranial nerve palsies, midface pressure, otalgia, and jaw pain can be presenting symptoms and signs of an ICA pseudoaneurysm.[2,3,5] Imaging with CT or magnetic resonance imaging (MRI) is often able to give indications as to the presence of a vascular lesion of the petrous ICA, but angiography remains the gold standard for diagnosis.[5]

Treatment of these pseudoaneurysms depends on the urgency of the situation. A lesion that presents with midface pressure or is discovered incidentally by angiography for an unrelated problem is handled differently than a lesion causing life threatening arterial bleeding from the ear or nose. Oates, et al. have reported managing a small iatrogenic pseudoaneurysm (1.5mm) in a 4-year-old patient with packing of the external ear canal and inpatient observation with successful resolution of the lesion.[1] Direct operative management of the ICA is an option, but this approach has been considered by some authors to have significant morbidity. Catalano, et al. have described a saphenous vein bypass of the infratemporal and petrous ICA which isolates the area of disease.[7] An important consideration for permanent occlusion of the ICA is potential ipsilateral cerebral ischemia from such an action. In our case, our team tested the safety of permanent occlusion by temporarily occluding the ICA at a low MAP and showing adequate cerebral perfusion anatomically with angiography. Alternatively, the patient can temporarily be brought out of anesthesia to test neurologic function during temporary occlusion. We confirmed anatomic evidence of perfusion, and permanent sacrifice of the ICA was completed. Besides bypass grafting for patients with inadequate circulation during ICA occlusion, endovascular stenting is an option. Traditional stenting poses a difficult challenge because the pseudoaneurysm does not have a true wall, and there is often not adequate support for the conventional stent, especially in the presence of weak surrounding bone. A previous attempt by Auyeung, et al. led to delayed enlargement of the pseudoaneurysm after conventional stenting. The same group, however, has had success with covered stents (stent-grafts) which prevent blood flow through the stent walls.[2] In emergent situations with bleeding from an unknown source, angiographic occlusion and later definitive surgical closure provides rapid diagnostic information and appropriate therapeutic intervention.

Whichever method is chosen to control a hemorrhage from the petrous ICA, good communication between the members of a multi-disciplinary team is essential. Prompt diagnosis and decisive treatment during an unfortunate complication can avert a disastrous outcome.

FIGURE 1



Axial (top) and coronal (bottom) CT scans of the left temporal bone demonstrating a soft tissue density filling the middle ear and mastoid cavities.

FIGURE 2

A lateral view of the left ICA showing a large pseudoaneurysm of the petrous ICA extending laterally into the middle ear cavity.

FIGURE 3

An antero-posterior view of the left ICA showing a large pseudoaneurysm (arrow) of the petrous ICA extending laterally into the middle ear cavity.

FIGURE 4

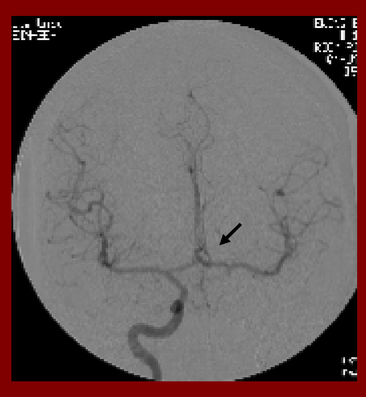
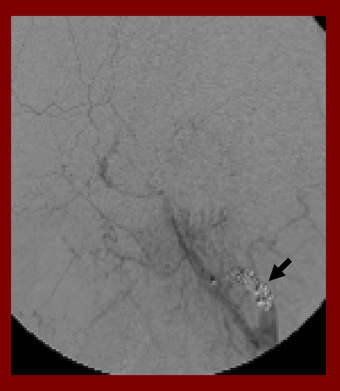


FIGURE 5

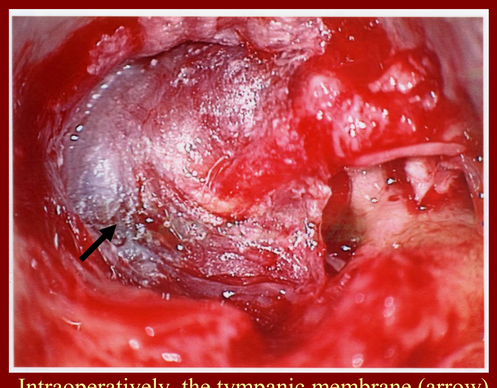
After left ICA occlusion, a right ICA angiogram (Figure 4) and left vertebral artery angiogram (Figure 5) show robust circle of Willis collaterals with anterior (arrow) and posterior (arrowhead) communicating arteries supplying the left hemisphere of the brain. The collaterals were also demonstrated prior to permanent sacrifice of the left ICA.

FIGURE 6



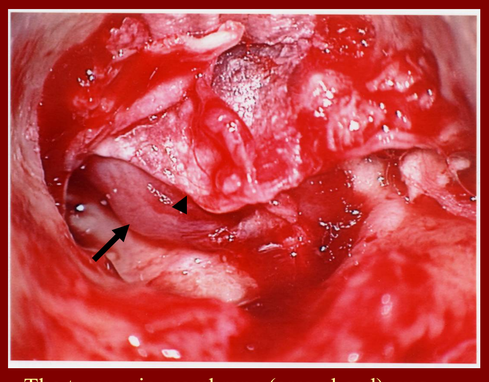
A left common carotid artery angiogram after left ICA occlusion with thrombogenic metallic coils (arrow) shows the external carotid artery.

FIGURE 7



Intraoperatively, the tympanic membrane (arrow) was visualized. The pseudoaneurysm was not seen in this view.

FIGURE 8



The tympanic membrane (arrowhead) was reflected to reveal the pseudoaneurysm (arrow) in the middle ear.

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