Endovascular treatment of a transverse–sigmoid sinus aneurysm presenting as pulsatile tinnitus

Case report

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The authors report on the case of a 38-year-old woman who had experienced incapacitating pulsatile tinnitus in the left ear for 6 months. Angiographic studies revealed a wide-necked venous aneurysm of the left transverse–sigmoid sinus. Solitary stent placement across the aneurysm neck resulted in a slight modification in the lesion’s characteristics. A second session, in which embolization with Guglielmi Detachable Coils was performed, resulted in a 100% occlusion of the aneurysm, with patency of the parent vessel and resolution of the tinnitus.

Key Words • tranverse–sigmoid sinus • venous aneurysm • tinnitus • endovascular therapy

Cerebral venous aneurysms are included in the group of venous malformations and are associated with AVMs, but single venous aneurysms are rare. Recently, Houdart, et al., reported on a sigmoid sinus aneurysm associated with pulsatile tinnitus; endovascular coil occlusion of the lesion was followed by resolution of the tinnitus. Occlusion of the IJV and TSS have been proposed to treat venous disease, but these procedures appear to be harmful because of the risk of increased intracranial pressure. We report on the case of a 38-year-old woman who presented with severe pulsatile tinnitus in the left ear that was associated with a left TSS aneurysm. Solitary stent placement across the aneurysm neck, followed by embolization with GDCs, resulted in occlusion of the aneurysm, patency of the parent vessel, and resolution of the tinnitus.

Case Report

History and Clinical Examination. During the previous 6 months this 38-year-old woman had experienced an intermittent pulsatile tinnitus that lasted several minutes and was related to head movement. Two months after the start of symptoms, tinnitus became continuous and severe in intensity. On admission, her vital signs and the results of neurological examination and otoscopy were normal. Compression of the left IJV decreased the intensity of the tinnitus, whereas compression of the right IJV increased it. These findings favored a venous origin.

Neuroimaging Examination. High-resolution bone window computerized tomography scans demonstrated a left petrous bone eroded at the TSS, with involvement of the mastoid cells. On DS angiography a venous aneurysm (8 × 6 mm; neck 6 mm wide) was revealed in the left TSS (Fig. 1). Considering the wide neck of the lesion and the dominance of the left transverse sinus, and the fact that stents with enough diameter and flexibility to navigate in a retrograde way through the jugular vein do not exist, we chose a solitary stent placement via a paratorcular approach to allow patency of the parent vessel.

First Operation. A burr hole positioned 3 cm to the right of the torcular herophili allowed the placement of a 0.035-in Terumo guidewire as far as the left jugular vein. A guiding catheter (Arrow No. 8 French ×25 cm) was introduced and located in the TSS proximal to the aneurysm; a 10 × 28 Wallstent was then expanded across the aneurysm neck. Clopidogrel (75 mg/day) and aspirin (325 mg/day) were initiated to avoid stent occlusion.

Postoperative Course. The patient was symptom free for 3 months, then pulsatile tinnitus reappeared intermittently with moderate intensity. A follow-up DS angiography study demonstrated patency of the TSS and a slight decrease in the size of the aneurysm (Fig. 2).

Second Operation and Outcome. As a result of these findings, embolization with GDCs was performed with the patient in a state of general anesthesia and heparinization was induced with 10,000 IU heparin. A No. 6 French Envoy guiding catheter (Arrow No. 8 French ×25 cm) was introduced and located in the TSS proximal to the aneurysm; a 10 × 28 Wallstent was then expanded across the aneurysm neck. Clopidogrel (75 mg/day) and aspirin (325 mg/day) were initiated to avoid stent occlusion.

Abbreviations used in this paper: AVM = arteriovenous malformation; DS = digital subtraction; GDC = Guglielmi Detachable Coil; IJV = internal jugular vein; TSS = transverse–sigmoid sinus.
day) and aspirin (325 mg/day). At her 6-month follow-up visit she was symptom free, and the control angiogram obtained at that time demonstrated an occlusion of the venous aneurysm as well as patency of the venous sinus (Fig. 4).

**Discussion**

Tinnitus is considered to be chronic when it has been present for more than 3 months. Spontaneous tinnitus, that is, tinnitus “usually lasting longer than 5 minutes” is present in 10% of adults, and in 0.5% of them the symptoms severely reduce the ability to lead a normal life. In a large-scale Swedish study somewhat higher figures were reported: 2.4% of adults said that “tinnitus plagues me all day.” Our patient had a chronic incapacitating pulsatile tinnitus that had lasted more than 6 months.

Causes of tinnitus can be divided into vascular and non-vascular. Pulsatile tinnitus is believed to be a consequence of sound created by turbulent blood flow being transmitted through the petrous bone to the cochlea and it is caused by benign intracranial hypertension, glomus tumors, atherosclerotic carotid artery disease, dural AVM, carotid–cavernous fistula, AVM of the head and neck, vascular tumors of the temporal lobe, and by aneurysms of the dural sigmoid sinus, as recently proposed by Houdart, et al. To our knowledge this is the only second report of pulsatile tinnitus produced by a TSS aneurysm. Other auditory symptoms have been associated with aneurysms; Khalil, et al., reported on one case of a patient with a middle cerebral artery aneurysm presenting as isolated hyperacusis, in whom embolization of the lesion with detachable coils produced complete resolution of symptoms.

Cerebral venous aneurysms are included in the group of venous angiomas and are associated with AVMs, but few cases of single venous aneurysms are reported in the literature. These lesions may be incidental or they may be associated with subarachnoid hemorrhage and seizures. It is difficult to propose a harmless intervention in patients with a sinus aneurysm because of lack of evidence. Occlusion of the IJV has been described previously, but it carries a risk of increasing the intracranial pressure and definitively suppresses one of the two brain-draining veins, with very little evidence of clinical benefit. In our patient the left TSS was dominant, so this treatment was not considered. We did not consider other surgical procedures like aneurysmorrhaphy because of the risk of injury to a dominant sinus, and because a combination of minimally invasive techniques (burr hole and endovascular approach) was deemed to be safer and more suitable for the radical treatment of the aneurysm.

Successful resolution of pulsatile tinnitus has been obtained with endovascular therapy for dural AVMs in the TSS. Shownkeen, et al., reported on three cases of pulsatile tinnitus caused by a dural AVM in the TSS that were treated with occlusion of the sinus with a detachable balloon and GDCs after embolization of the feeding artery with Histoacryl. The problem is that this procedure carries the same risk of occlusion of the IJV. Houdart, et al., reported successful resolution of pulsatile tinnitus after embolization of the aneurysm sac with detachable coils, which preserved the TSS.

In our case of a wide-necked aneurysm, embolization of the lesion with detachable coils was considered technically difficult because of the possibility of coil herniation into the lumen of the parent vessel and consequent regrowth/reganialization of the aneurysm. The management of these aneurysms is technically challenging. There are reports in which balloon-assisted or neck-remodeling techniques are used as adjunctive methods devised to aid the endovascular coil embolization of aneurysms characterized by a wide neck or unfavorable geometric features; these adjunctive methods provide a safe means of improving the efficacy of...
endovascular treatment. Recently Phatouros, et al. and Sekhon, et al. reported good outcomes with the stent-supported coil embolization technique. Based on the results of some experimental studies in which solitary stent placement was used, we have adopted this technique as a protocol in cases of wide-necked, giant incidental arterial aneurysms and aneurysms of the basilar artery, with good outcomes and prospective follow up; these cases will be detailed in another article.

Because of the experience in our center with wide-necked arterial aneurysms, and because stents that can navigate up to the jugular vein do not exist as of this writing, we decided on solitary stent placement via the paratantal approach, resulting in improvement of the patient’s symptoms. Nevertheless, a few months after initial treatment the symptoms worsened again, and follow-up angiography demonstrated a slight modification in the aneurysm characteristics. We used a long stent because there is no evidence that the amount of metal placed in a vein favors thrombosis, and we think that occlusion is related more to the venous architecture itself. Finally, we decided to perform embolization with GDCs as an adjunctive therapy and this treatment resulted in 100% occlusion of the aneurysm and preservation of the dominant TSS. The patient was asymptomatic at her 6-month follow-up visit.

Conclusions

A TSS aneurysm should be a differential diagnosis in pulsatile tinnitus workups. Embolization with detachable coils is a successful procedure to treat a well-circumscribed, venous aneurysm. A stent-supported coil embolization technique could be helpful in wide-necked venous aneurysms to allow occlusion of the lesion and to avoid complications related to the occlusion of the dominant sinus. Nevertheless, we need more evidence to support solitary stent placement or stent-supported coil embolization for the treatment of wide-necked venous aneurysms.

References


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