

What Is the Best Imaging Modality in Evaluating Patients With Unilateral Pulsatile Tinnitus?

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BACKGROUND

Pulsatile tinnitus (PT) is a relatively rare cause of tinnitus. It makes up about 4% of patients with tinnitus, which in turn affects up to 10% of the population.¹ PT can be described as objective or subjective, as well as venous, arterial, or nonvascular. About 20% of PT patients will have objective tinnitus. Incidence of abnormal, often treatable, structural findings in patients with PT has been noted to be high, ranging from 44% to 91%.¹ PT can be a result of vascular as well as neoplastic causes, and if left undiagnosed, it can lead to significant morbidity and mortality. Overlooking an aneurysm or a tumor maybe catastrophic for the patient; therefore, further investigation is highly recommended. In this Best Practice review, we aim to evaluate the various imaging modalities and determine which may be the best initial test in patients presenting with unilateral PT.

LITERATURE REVIEW

PT is often due to the transmission of vibrations from turbulent blood flow to the cochlea. Objective PT is audible to the examining physician. Vascular abnormalities are the most common radiological findings in these patients. The diagnosis is made through a complete neurological examination, including otoscopy and auscultation of the external ear canal, the periauricular area, and the neck.^{2,3} In the elderly, the most common causes of PT are arteriosclerotic plaques and stenosis of vessels in the head and neck.⁴ If the initial evaluation reveals a mass in the middle ear, a CT scan of the temporal bone with contrast is the most helpful initial test. The three most common entities in this situation are high-riding jugular bulb, aberrant internal carotid artery (ICA), or a

paraganglioma.¹ Other rare causes include endolymphatic sac tumors, vascular metastasis, extension of intracranial meningioma, and facial nerve hemangiomas.

If the patient has an audible bruit around the periauricular region, a CT angiogram may be the best first test to perform. If that is normal and there is a high index of suspicion, a four-vessel angiogram is appropriate to assess for aneurysm, dissection, or arteriovenous malformations.^{4,5}

However, the dilemma occurs when a patient presents with unilateral PT without a middle ear mass or audible bruit. It is important to compartmentalize the evaluation in terms of venous, arterial, and nonvascular PT. Venous PT is determined by the finding that the tinnitus subsides by gentle pressure over the neck vessels on the side of the symptom. In older patients without an audible bruit but with a history of transient ischemic attack, cerebrovascular accident, hypertension, diabetes, hyperlipidemia, or smoking, a suspicion for atherosclerotic carotid artery disease should be maintained.^{1,4} These patients are best evaluated by duplex carotid ultrasound and echocardiogram. In obese females with associated headaches, hearing loss, and blurred vision, magnetic resonance imaging/magnetic resonance venogram (MRI/MRV) should be the initial test to evaluate for idiopathic intracranial hypertension (IIH). Radiographic findings of venous sinus stenosis, empty sella, flattening of the posterior globes, and distension of the perioptic arachnoid spaces have been described in such cases.¹ If indicated, a definitive diagnosis of IIH can be made by measuring the opening pressure at lumbar puncture. Other causes of venous PT are atypical formation of the jugular bulb (high-riding bulb; diverticulum) and sigmoid sinus diverticulum or dehiscence (SSDD). In addition, nonvascular causes of PT are superior semicircular canal dehiscence and otosclerosis.^{3,4} These entities are best visualized with a CT scan. Therefore, an initial test for most patients with venous PT not suspicious for IIH is with a computed tomography angiogram/computed tomography venogram (CTA/CTV), which will evaluate both the bony structure surrounding the ear as well as the vasculature with less risks than would the definitive four-vessel angiogram.⁴

CTA/CTV appears to be a promising initial imaging in most cases of PT. Narvid et al. evaluated the benefits of CTA/CTV in patient with PT.⁵ The authors compared seven patients with angiographic-proven dural

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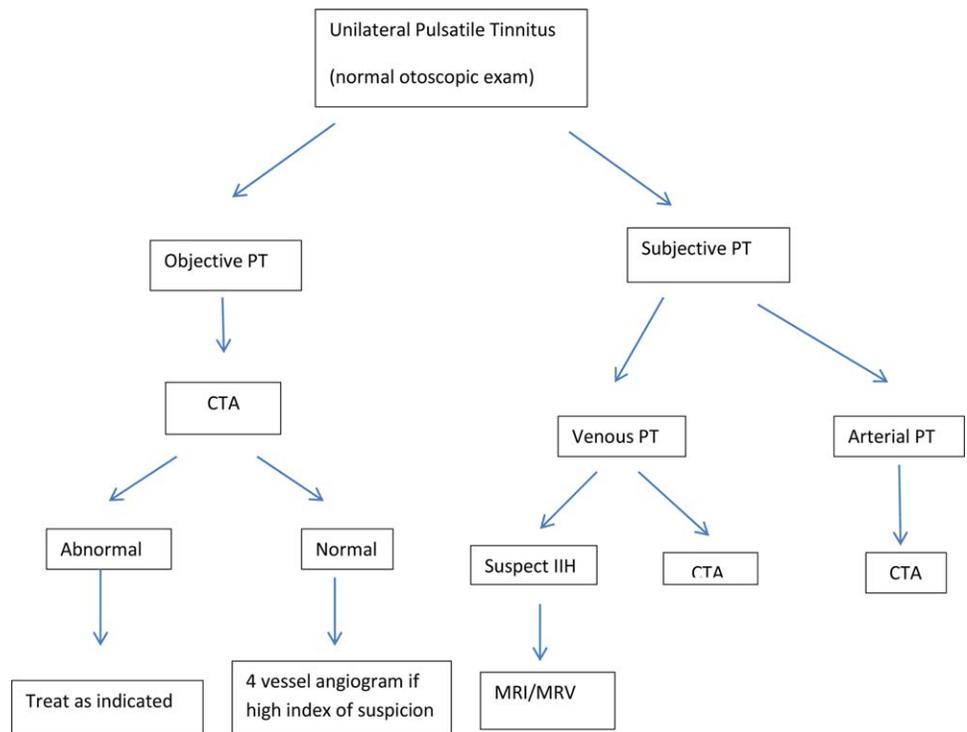


Fig. 1. Diagnostic algorithm for patients with unilateral pulsatile tinnitus. CTA = computed tomography angiogram; IIH = idiopathic intracranial hypertension; MRI = magnetic resonance imaging; MRV = magnetic resonance venogram; PT = pulsatile tinnitus. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

arterio-venous fistula (DAVF) with seven age-matched controls with PT but no DAVF. They proposed that the presence of asymmetrically visible and enlarged arterial feeding vessels, shaggy sinus/tentorium, and asymmetric jugular-venous attenuation had a sensitivity of 86% and a specificity of 100% in identifying DAVF.⁵ MRI/MRA evaluation have yielded a wide range of sensitivities for vascular pathology, ranging from 50% to 100%. Shweel et al. report that MRI/MRA scans diagnosed the cause of PT in nine of 27 patients.² Two patients were subsequently diagnosed with small ICA aneurysm via angiogram, which was missed in the initial MRI/MRA study. The authors report an overall sensitivity of 80% and a specificity of 88%, with an error rate of 15% in diagnosing the cause of PT.² However, it is also important to note that MRI cannot evaluate osseous pathology as well as CT-based imaging.⁵ Schoeff et al. also report a 23% incidence of SSDD in patients with PT compared to 1.2% among asymptomatic patients.³ This is best identified with a CT or CTA.

In evaluating arterial subjective PT, the most widely performed tests are MRI/MRA, CTA, or a four-vessel angiogram. Both MRI/MRA and CTA are useful in evaluating PT; however, MRI/MRA is limited by poor bony resolution, flow, and artifacts related to air-fat interface. It is felt that the initial test in these cases should begin with a CTA. Due to cost and risks of complications, a four-vessel angiogram should not be used in most cases.⁴

BEST PRACTICE

Deciding on the initial radiographic evaluation in patients with unilateral PT can be challenging due to the many causes as well as the questionable results of some of the imaging findings. Recent studies have shown

an increase in the cases of SSDD, which is best visualized on a CT scan. In addition, sensitivity and specificity analysis have shown that CTA may be the best initial test in patients with unilateral subjective PT. For patients with objective PT with no middle ear mass, a CTA is the best initial exam. For those others with subjective unilateral PT, it is important to distinguish between venous and arterial PT. For patients with signs and symptoms of IIH, MRI/MRV is the appropriate initial study. And for the remaining cases of venous and arterial PT, consider CTA as the best initial study due to safety and broad effectiveness (Fig. 1).

LEVEL OF EVIDENCE

All five of the articles in this review were level 4 (retrospective studies and nonsystematic reviews). There were no randomized control trials or systematic reviews looking at the role of imaging in evaluation patients with unilateral PT. There is a need for a prospective study comparing the sensitivity and specificity of the various imaging modalities.

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