CASE REPORT

# A Case of Pulsatile Tinnitus Associated with Internal Jugular Vein Stenosis Diagnosed by Multidetector-computerized Tomography Angiography

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## *ABSTRACT*

*Tinnitus is a discomforting condition associated with a sound in one or both ears that occurs without an external stimulus and can be either pulsatile or continuous. Vascular and non-vascular factors are involved in the aetiology of pulsatile tinnitus (PT), requiring a careful physical examination and evaluation with proper and sophisticated imaging techniques to identify the cause(s). It is known that turning the neck towards the affected ear decreases PT, whereas turning the neck towards the unaffected side increases PT from venous hum, due to bending of the internal jugular vein over the transverse process of the atlas leading to increased blood flow. In this report, we present a rare PT case caused directly by jugular vein stenosis, in which clinical characteristics were in disagreement with the literature. In our case, PT markedly decreased, instead of being aggravated, when turning the neck to the unaffected side in a 35-year-old woman. There was axial maximal intensity above the left jugular bulb and about 85% stenosis in 3-D volume rendering images. We discuss the differential diagnosis by multidetector-computed tomography angiography with respect to its advantages over other imaging techniques such as CT, MR, MR angiography and conventional angiography.*


**Keywords:** Jugular vein stenosis, multidetector-computed tomography-angiography, pulsatile tinnitus.

## INTRODUCTION

Tinnitus is a discomforting condition associated with a sound in one or both ears such as ringing, whistling, clicking, or buzzing that occurs without an external stimulus and can be either pulsatile or continuous (1). Underlying factors causing pulsatile tinnitus (PT) can be considered in two groups: non-vascular and vascular causes. The cause of PT may be the turbulence of blood flow, which depends on increased flow volume or stenosis of vessel lumen (1). PT cases resulting from venous factors are reported to be mostly due to benign intracranial hypertension (BIH), followed by jugular bulb abnormality, and dural sinus stenosis (1), whereas those resulting from arterial factors are mostly linked to carotid atherosclerotic disease and glomus tumours (2).

Pulsatile tinnitus requires careful physical examination and evaluation with proper and sophisticated imaging techniques to identify the origin of the symptoms. The differentiation of venous PT and arterial PT can be provided by pressing on the internal jugular vein (IJV). In patients with PT caused by venous factors, this application ends up with a pause of PT (1). It is known that turning the neck towards the affected ear decreases tinnitus, whereas turning the neck towards the unaffected side increases tinnitus from venous hum, due to the bending of IJV over the transverse process of the atlas leading to increased blood flow (3).

External structures pressing on the jugular vein may lead to PT. However, to our knowledge, no report on PT caused directly by jugular vein stenosis has been documented. In this report, we present a unique PT case associated with jugular venous stenosis diagnosed by multidetector-computed tomography angiography

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(CTA) and discuss its clinical characteristics which are in disagreement with current literature.

## CASE REPORT

A 35-year-old female presented with a 3-year history of non-progressive PT in the left ear. There was no history of hearing loss, trauma of head or neck, ototoxicity, or cardiovascular disease. The physical examination, except for auscultation, was normal. The noise was abolished by occluding the left IJV. Pure tone audiometry and tympanometry were normal. Opposite to common experience, PT markedly decreased,, instead of being aggravated, when she turned her neck to the unaffected side. Tinnitus completely disappeared after digital pressure on the left side of her neck.

The patient was subjected to multidetector CTA (Aquillon, Toshiba Medical Systems, Tokyo, Japan). In addition to the traditional axial images, all the other available techniques (multiplanar reconstructions and 3D volume-rendering images) were used to assess the arterial and venous structures. There was axial maximal intensity above the left jugular bulb and about 85% stenosis in 3D volume rendering images (Figure).

## DISCUSSION

Pulsatile tinnitus is a common disorder and results from a variety of otologic and vascular lesions, including primary venous anomalies as well as conditions causing increased intracranial pressure and transmission of arterial pulsation to the dural venous sinuses (4). Pulsatile tinnitus may originate from vascular diseases and tumours. The most common tumoural causes are glomus jugulare and glomus tympanicum. In a review involving 107 patients with PT or vascular retrotympanic mass, it was reported that 25% had objective tinnitus and 25% had acquired vascular lesions and that a vascular tympanic membrane was present in 35%, whereas normal vascular variants were present in 21% (5).

Unilateral objective tinnitus caused by IJV is a mystery. Movement of the neck to the contrary side causes the IJV to bend over the transverse process of the atlas giving rise to turbulence in blood flow, with this maneuver; the effective lumen of the vein is being opened up because of the contraction of ipsilateral SKM, thereby increasing the venous return. Movement of the neck to the affected side has the contrary effect, resulting in decrease of the tinnitus (1). The neck movement rearranges turbulent flow in the IJV in association with BIH and/or external compression on the IJV because the IJV curves around the lateral process of the atlas (6).

Nehru *et al* reported a reduction in tinnitus when turning the neck to the affected ear and aggravation of tinnitus when turning neck to the unaffected ear in patients with venous hum, also known as idiopathic or essential PT when aetiology is unclear (3). Our patient has 85% stenosis in IJV, which was located above the transverse process of the atlas. In contrast with the literature, the PT significantly deceased when the neck was turned to the unaffected ear in our case. This reduction was probably related to blocking of blood flow further due to squeezing of IJV by the transverse process of the atlas at the time of turning neck to the unaffected ear. In addition to the involvement of IJV in the PT, this is the first case, to our knowledge, showing this phenomenon.

Various imaging modalities, including CT, MR imaging (MRI), and MR angiography (MRA), and conventional angiography, are used for the PT diagnosis. However, the selection of the most appropriate imaging method is essential for determining underlying causes. Krishnan *et al* evaluated PT using CT arteriography and venography (CTA/V) and reported their comprehensiveness and high reliability (7). The CT angiography was employed in the diagnosis of the PT cases caused by an aberrant internal carotid artery (8) and high-homolateral jugular bulb and aplasia of the contralateral transverse and sigmoid sinuses (9). Various diagnostic imaging methods have been suggested. In the absence of objective PT, use of MRI/MRA is recommended (5), whereas in the presence of PT, use of high-resolution CT (HRCT) followed by Doppler ultrasonography or HRCT followed by temporal MRI and carotid Doppler may be an appropriate initial diagnostic step (10). These suggest that imaging for the initial diagnostic step can be complicated and time consuming. However, the clinician may choose directly angiography to be certain about the involvement of vascular factors (11). CTA spatial resolution is higher than MRA and CTA image can be obtained while running CT without necessitating an extra investigation, especially in claustrophobic patients and patients with aneurysm clips and pacemakers. Despite digital subtraction angiography being a standard reference for the evaluation of aneurysms, stenosis, and vascular malformations, CTA is a new, cost-effective and minimally invasive alternative (12).

Using 3D-CTA for the entire head from the skull base to the vertex, Matsumoto *et al* showed that this modality provided information on detailed vasculature of tumours and cerebral haemodynamics (13). in the diagnosis and preoperative evaluation, 3D-CTA may replace conventional angiography' which is an invasive method with

less ability to demonstrate images of the lesion, arteries, veins and bony structures, and their relationships. In this case study, we were able to detect IJV stenosis and its location using multidetector CTA (Figure).

Figure: Appearance of the left jugular bulb and stenosis in multidetector-computed tomography angiography.

## CONCLUSION

A unique PT case resulting from IJV stenosis and clinically reduced by turning the neck to the unaffected side, in contrast with the literature, was presented. Employing CTA directly as a first initial diagnostic step allowed us not only to save time by eliminating multiple radiological examinations, but also to view middle and inner ear, arterial, and venous structures.

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