


# Our Experience in Pulsatile Tinnitus and a Normal Tympanic Membrane in 66 Patients

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## Abstract

**Introduction** Pulsatile tinnitus (PT) can harbor potentially life-threatening conditions (LTCs), whereby a delay in diagnosis could be disastrous.

**Objective** The purpose of this study was to ascertain whether associated signs and symptoms at presentation could help identify a subgroup of high-risk patients.

**Materials and Methods** A total of 66 patients with PT were retrospectively assessed. The diagnoses were classified as group I with an LTC or not in group II.

**Results** There were 4 patients (6%) with a final diagnosis of LTC (group I) and 62 patients (94%) without a final diagnosis of LTC or no diagnosis (group II). The results were not quite statistically significant regarding the trauma and were strongly statistically significant regarding headache and the cranial nerve paralysis.

**Conclusion** The combination of PT with any of the three features of occipital headache, cranial nerve palsy, and recent trauma should alert the clinician to potentially serious causes.

## Keywords

- ▶ cranial nerve
- ▶ otology
- ▶ pulsatile tinnitus

## Introduction

Tinnitus is classified as either pulsatile or nonpulsatile based on the noted sound. Pulsatile tinnitus (PT) is an audible perception of heartbeat synchronicity, which usually has a vascular etiology.<sup>1</sup> It is caused by turbulent blood flow generated by increased flow volume or vessel stenosis and may be of arterial or venous origin.<sup>2</sup> PT occurs in less than 10% of tinnitus patients<sup>3</sup> and is usually unilateral.<sup>4</sup> PT is therefore a relatively common otologic symptom and both expert consensus and general guidelines recommend that all patients with PT should be investigated.<sup>2,3</sup> However, despite intensive assessment, no cause is found in up to 30% of cases and patients often end up on routine waiting lists for relevant imaging.<sup>5</sup> Life-threatening conditions (LTCs) can present with PT and these may have disastrous consequences, if not managed promptly. Generally, there is a lack of emphasis in the literature on the associated signs and symptoms in patients with PT. The aim of this study was to ascertain whether associated (red flag) features at presentation could help to identify a subgroup of high-risk patients allowing clinicians to request appropriate investigations more expeditiously.

## Materials and Methods

Discretionary ethical approval from the Chairman of the local Ethics committee at the University Hospital Limerick was obtained. A retrospective assessment of a consecutive series of data collected prospectively on all adult patients 18 years or more (66 patients) with PT, who presented to the routine outpatients service of the senior author during a 4-year period (between 2013 and 2017), was performed.

The study was conducted in an academic tertiary care medical center. The investigation was to find different presentation and investigation to elucidate the cause and site for red flag criteria for fast tracking. We divided the patients into the following two groups: Group I, patients with final diagnosis of potentially acute or chronic LTCs; and group II, patients without a final diagnosis of non-LTC. We excluded PT patients with obvious vascular tympanic cavity lesions.

## Results

The study involved 66 patients, 20 males and 45 females (mean age  $\pm$  standard deviation [SD] at diagnosis 48.6  $\pm$

13.1 years and range: 23–86 years). There were 41 females (69.5%) and 18 males (30.5%). There were no sex differences with regard to the symptomatic presentation ( $p = 0.640$ ), as shown in ►Table 1. PT was right-sided in 46 cases and left-sided in 20. It was unilateral in 60 cases and bilateral in 6 cases. From the total 66 cases, 4 patients (6%) were considered to have a final diagnosis of the LTC (group I) and 62 patients (94%) without a final diagnosis of a LTC or no diagnosis (group II).

## Discussion

The PT can be due to various causes including idiopathic intracranial hypertension (IIH), neoplasm, or vascular disorders, such as hypertension, hyperthyroidism, vascular stenosis, aneurysms, and coronary artery disease.<sup>4</sup> PT may be the initial manifestation of atherosclerotic carotid artery disease (ACAD) and, therefore, the otolaryngologist may be the first to be consulted for this symptom.<sup>6,7</sup> Although in our study we have omitted patients with tympanic cavity vascular abnormalities, otoscopy is still the most important examination in PT as it may reveal a retrotympanic lesion such as a high or exposed jugular bulb, aberrant carotid artery, glomus tumor.<sup>3</sup> PT with a normal tympanic membrane is very common and on reviewing the published data and excluding vascular middle ear masses, the incidence ranges from 75 to 90%.<sup>5,7-11</sup>

### Synopsis of the Findings

In our cohort of PT with a normal tympanic membrane, 24% of patients were deemed to be idiopathic. We found LTC in 6% of patients which was consistent with reports in our discipline with venous anomalies in 1.5% of patients and traumatic vascular dissection in 1.5% of patients, followed by multiple sclerosis (MS) in 3% of patients. The non-LCT etiology involving hypertension, IIH, and vascular stenosis was noted in 69% of our patients. Our data confirmed that patients presenting with PT, headache, cranial nerve palsy (CNP), and history of trauma possibly harbored a serious condition. We were unable to clarify the speed of inception of PT in the LTC group but the onset of tinnitus in traumatic arteriovenous fistulae (AVF) and carotid artery dissections was usually sudden.

**Table 1** Gender distribution according to symptoms

| Presentation                | Male | Female | Total no. of patients |
|-----------------------------|------|--------|-----------------------|
| Age (>60 y)                 | 9    | 12     | 21                    |
| Headache/facial pain        | 2    | 2      | 4                     |
| Trauma                      | 1    | 0      | 1                     |
| Hearing loss                | 4    | 21     | 25                    |
| Vertigo                     | 2    | 4      | 6                     |
| Otalgia                     | 2    | 3      | 5                     |
| Bruit                       | 1    | 2      | 3                     |
| Cranial nerve paralysis     | 1    | 2      | 3                     |
| Focal neurological symptoms | 2    | 1      | 3                     |

The acute appearance of PT in association with headache, and/or focal neurological symptoms may therefore be an indicator of a potentially serious underlying condition and requires sooner than routine investigations to elicit or exclude the cause, as in ►Table 2. Patient age is also important as studies demonstrate that the age of PT with AVF is between the ages 30 and 40 years.

### Strengths of the Study

All patients attended to and followed-up by the senior author (J.E.F.).

### Comparisons with Other Studies

Idiopathic or essential PT is a term used interchangeably in the literature to describe patients with PT of unclear etiology<sup>8</sup> that varies greatly among published series from 9 to 55%.<sup>5,7,9-11</sup>

PT in patients with LTC also varies according to the surgical specialty as ear, nose, and throat (ENT) colleagues have estimated that 3 to 5.1% of their patients had potentially lethal etiology including AVF (2–3.8%) and dissecting aneurysm (DA) of the internal carotid or posterior communicating arteries (1–1.3%).<sup>5,7,9</sup> In two separate neurosurgical series, 28 to 34% of cases were reported with hazardous diagnoses involving AVF (26–27%) and DA of the internal carotid (2–7%).<sup>5,10</sup> The incidence of MS causing PT was 3.8% in one ENT series, which is similar to our findings.<sup>10</sup>

Non-LCT etiology of the PT in series studies conducted by ENT units with a range of 75 to 85%<sup>5,7,9</sup> but more frequent than those managed at neurosurgical departments at 45 to 65% of cases.<sup>10,11</sup> This published dichotomy between specialties may be due to the likelihood that several neurosurgical patients may have been referred by ENT specialists but it cannot be confirmed, as the referral pattern is not reported or deducible in these articles.

Thorough history taking and clinical examination are quite obviously the basis for fast tracking of patients with PT with a normal tympanic cavity for appropriate imaging. PT with headaches is the most common combination of clinical symptoms in dural AVF,<sup>12</sup> while the pain in cases of IIH is usually

**Table 2** Comparison between group I (patients with final diagnosis of cause) and group II (patients without final diagnosis of cause)

| Presentation                | No. of patients | Group I | Group II |
|-----------------------------|-----------------|---------|----------|
| Age (≥60 y)                 | 21              | 0       | 21       |
| Severe headache             | 4               | 3       | 1        |
| Trauma                      | 1               | 1       | 0        |
| Hearing loss                | 25              | 4       | 21       |
| Vertigo                     | 6               | 0       | 6        |
| Otalgia                     | 5               | 0       | 5        |
| Bruit                       | 3               | 0       | 3        |
| Cranial nerve paralysis     | 3               | 2       | 1        |
| Focal neurological symptoms | 3               | 3       | 1        |

retrobulbar and associated with diplopia in most instances.<sup>13</sup> Patients presenting with the combination of PT and occipital headache are most concerning for carotid artery dissection<sup>14-16</sup> or dural AVF.<sup>17,18</sup> CNP with or without other focal neurological signs in patients complaining of PT may be due to intracranial hemorrhage or progressive MS.<sup>19</sup> A history of trauma is important as tinnitus resulting from head or neck injuries tends to be more severe than that from other causes.<sup>12</sup> Moreover, fatal causes of posttraumatic dural AVF have been reported,<sup>20</sup> thus, injury-related PT can be a sign of potentially lethal conditions.<sup>21</sup> PT is experienced in 16 to 27% of carotid dissections at the side of the dissection after head trauma.<sup>22</sup> A traumatic carotid cavernous fistula is seen in 3.8% of traumatic skull base fractures.<sup>18</sup> Patient age is also important as studies demonstrate that the age of PT with AV fistula is common between the age of 30 and 45 years,<sup>23,24</sup> and DA of internal carotid artery has a peak incidence in the fourth decade.<sup>25</sup> Furthermore, the age of PT with arterial hypertension and vascular stenosis usually develops between the age 45 and 60 years, becoming more prevalent in older individuals.<sup>26</sup>

### Clinical Applicability of the Study

The authors suggest red flag criteria to fast-track investigations in patients with PT and normal tympanic membrane. The combination of PT with any of the three features among occipital headache, cranial nerve palsy, and recent trauma should alert the clinician to potentially serious causes. Speed of onset, young age, or focal neurological symptoms are also important associated features of possible worrisome hidden pathology. Pulsatile tinnitus in combination with vertigo, bruit, or age above 60 years is less likely to be due to priority conditions.

### Conclusion

- PT with a normal otoscopic examination is caused by an LTC inclusive of MS in 5 to 6% of patients.
- Associated features can help in fast-tracking investigations for patients with a potentially worrisome diagnosis.
- The combination of PT with any of the three features of occipital headache, cranial nerve palsy, and recent trauma should alert the clinician to potentially lethal causes.
- Speed of onset, young age, or focal neurological symptoms are also important associated features of possible serious pathology.

### Conflict of Interest

None declared.

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