

# Resolution of Pulsatile Tinnitus Following an Upper Mediastinal Lymph Node Resection

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**Abstract:** External compression of extracranial/mediastinal vessels has not been reported as an etiology of pulsatile tinnitus. We present a case in which compression of extracranial vasculature led to long term pulsatile tinnitus which resolved completely with surgical resection of metastatic lymph nodes. This should be included in the list of differential diagnoses when dealing with any patient with a complaint of pulsatile tinnitus. Patients with advanced carcinoid cancer often present with distant metastases to their left superior mediastinum and supraclavicular lymph node chain. We believe a careful search for nodal metastases compressing vascular structures in such patients is warranted as debilitating pulsatile tinnitus may be cured by a simple surgical procedure.

**Key Words:** carcinoid, cytoreduction surgery, gamma probe detection, octreotide, pulsatile tinnitus

Unexplained tinnitus can be a long term debilitating problem for many patients. Tinnitus can be divided into objective (4% of cases) and subjective varieties, depending on if the tinnitus can be heard by the examiner, eg head and neck bruit on auscultation, or only by the patient. Tinnitus is further subdivided into pulsatile and nonpulsatile forms. In general pulsatile tinnitus cases are created when noise from turbulent, nonlaminar blood flow is transmitted into the hearing organs within the inner ear.<sup>1</sup> The etiology of pulsatile tinnitus is usually vascular, both arterial and venous in etiology. It may originate from decreased or increased blood flow: atherosclerotic carotid or subclavian disease as well as dissection, venous or arteriovenous malformations, vascular loops,

and fistulas.<sup>2-4</sup> Frequently, pulsatile tinnitus is associated with benign intracranial hypertension (pseudotumor cerebri).<sup>5</sup> Less frequently, pulsatile tinnitus may be the consequence of a solid neoplasm such as paraganglioma or glomus tumor.<sup>5,6</sup> We report, to our knowledge, the first case of metastatic carcinoid tumor with external compression of the left vertebral artery as a cause of seven year-long unilateral persistent pulsatile tinnitus.

## Case Report

A 56-year-old woman being treated for a metastatic mid-gut carcinoid tumor complained of a long history of pulsatile tinnitus. She claimed that she had been suffering from a left sided continuous pulsatile tinnitus for the last seven years, and stated that she had sought medical attention from multiple care providers over this time. She had undergone extensive workups for her tinnitus, including thorough physical exams, lumbar puncture with cerebrospinal fluid (CSF) pressure measurements, high resolution temporal bone computed tomography, ultrasound duplex scanning, magnetic resonance angiography (MRA) of her extracranial vessels, and MRI of her brain. These tests revealed no evidence for pseudotumor cerebri, mass, vascular stenosis or other abnormalities as a cause for her persistent tinnitus. She eventually gave up pursuing medical evaluation for her tinnitus. She underwent

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## Key Points

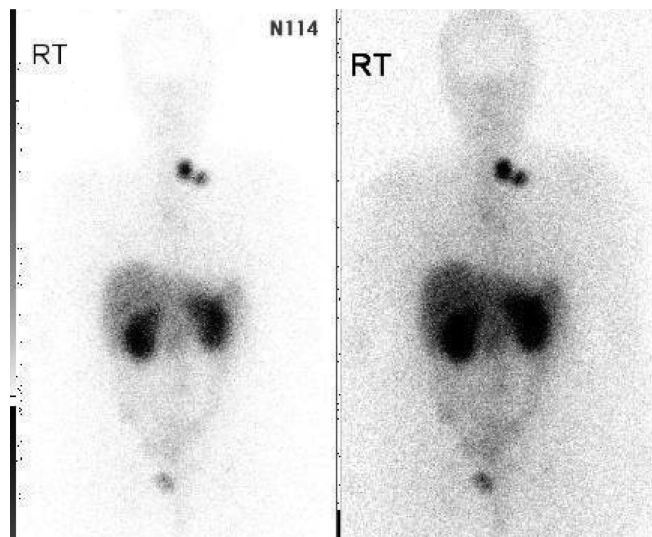
- Pulsatile tinnitus may be chronic and debilitating.
- The etiology of pulsatile tinnitus is usually vascular in origin.
- Pulsatile tinnitus may be very difficult to diagnose despite an extensive workup.
- A search for extracranial nodal vascular compression should be carried out in all patients who experience unexplained pulsatile tinnitus.

(Case Report continued from previous page)

her first cytoreductive operation in June, 2008 with removal of her extensive intra-abdominal carcinoid. This cytoreductive procedure included a resection of her small bowel primary, mesenteric lymphadenectomy, omental resection, liver biopsy, pelvic and peritoneal resection of her tumor implants, bilateral salpingo-oophorectomy, and a cholecystectomy. She had an uneventful postoperative recovery. She returned for the second phase of her cytoreduction, a procedure designed to remove metastatic adenopathy in her left supraclavicular region and left superior mediastinum. We also planned a resection of a large cystic lesion in her right thyroid lobe. She was injected with 5.9 mCi of In-111 pentetreotide, OctreoScan™ (Covidien, Mansfield, MA), one week prior to her scheduled procedure as part of a planned intraoperative hand held, gamma probe-directed superior mediastinal and lower neck lymphadenectomy. The preoperative planar whole body OctreoScan® revealed two areas of increased radiotracer uptake in the left lower neck/upper mediastinum (Fig. 1). Multislice computed tomography (CT) examination with OctreoScan® and single photon emission computed tomography (SPECT) fusion revealed a 2.5 x 1.9 x 1.2 cm somatostatin receptor avid lymph node located in the superior mediastinum at the thoracic inlet and a second group of radiotracer avid small nodes in the scalene fat pad of the left supraclavicular region (Fig. 2). SPECT/CT sagittal sections clearly showed an enlarged lymph node compressing the left vertebral artery near its origin from the subclavian artery (Fig. 3). Surgery was uneventful. With gamma probe guidance, the large metastatic lymph node was removed from the underlying vertebral and subclavian artery. In addition, the scalene nodes were removed along with the entire scalene fat pad. A right thyroid lobectomy was performed. When the patient awoke from anesthesia, she immediately noticed that her pulsatile tinnitus was gone. Final pathology revealed a 25 x 18 x 10 mm superior mediastinal lymph node that was almost completely replaced by a metastatic carcinoid tumor. A total of 6 metastatic lymph nodes were identified within the scalene fat pad. A follicular adenoma with cystic degeneration was found in the right thyroid lobe.

## Discussion

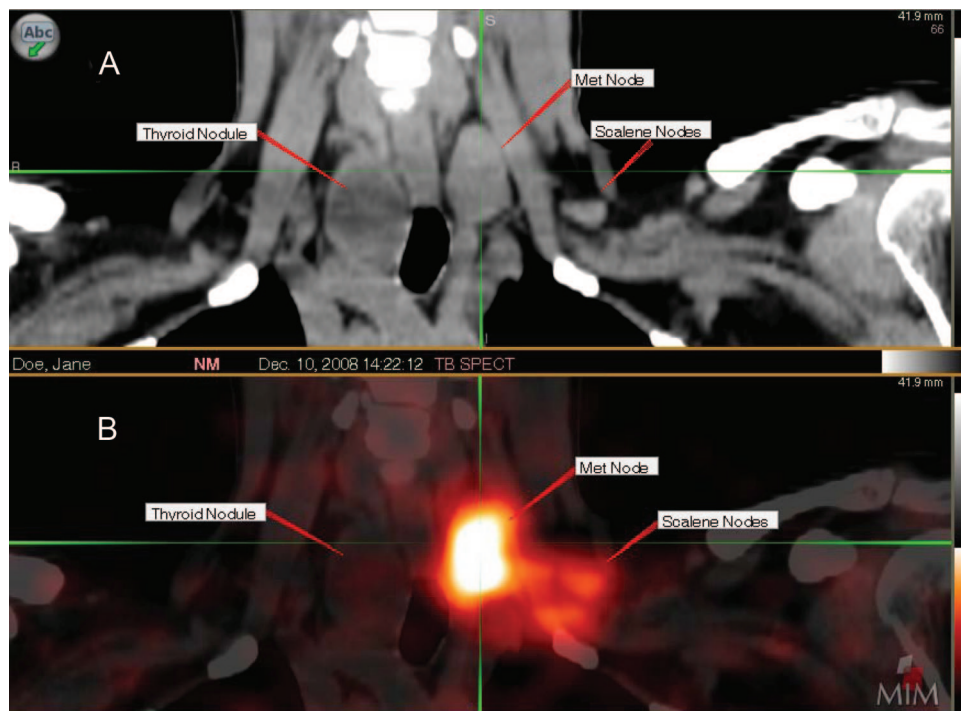
Pulsatile tinnitus is often a chronic, disabling condition, in which the etiology may be elusive. Although pulsatile tinnitus represents only a small percentage of tinnitus cases, the majority of patients have a treatable underlying etiology. A thorough history and physical exam is mandatory, including auscultation of the head and neck for bruits, otoscopic



**Fig. 1** Whole body planar In-111 pentetreotide (OctreoScan®) images in anterior projections at two different intensities. Two focal somatostatin receptor avid lesions are evident in the left superior mediastinum and left supraclavicular space.

exam of the tympanic membranes, lumbar puncture with CSF pressure measurements, as well as appropriate radiographic examinations.<sup>5</sup> The cause of pulsatile tinnitus is very frequently vascular in nature, arterial or venous, but remains undetermined in approximately 25% of patients even with extensive workup. Among patients with arterial tinnitus, carotid and subclavian atherosclerotic disease are most frequent. Among patients with venous tinnitus, sigmoid sinus diverticulum and venous hum were the most common.<sup>3,7</sup> Benign intracranial hypertension or pseudotumor cerebri is frequent and often overlooked.<sup>5</sup> Occasionally pulsatile tinnitus may be a sign of an impending life-threatening condition, such as internal carotid artery dissection.<sup>8</sup> Subclavian artery stenosis/obstruction with the development of collateral circulation between the vertebral artery and subclavian artery (via muscular branches of the occipital and deep cervical arteries) can be an underlying cause of pulsatile tinnitus.<sup>9</sup> There is a single report describing the resolution of intractable pulsatile tinnitus after the bypass of a segment of aortic coarctation.<sup>10</sup> Vascular loops in contact with the vestibulocochlear nerve (CN VIII) as a cause of pulsatile tinnitus is controversial. Chadha and Weiner in a systematic review and meta-analysis of observational studies found that subjects with pulsatile tinnitus were 80 times more likely to have a contacting vascular loop than patients with nonpulsatile tinnitus.<sup>11</sup> However, Gultekin and co-workers utilizing temporal magnetic resonance imaging (MRI) in 55 patients with unexplained tinnitus and 44 age- and sex-matched controls found no statistically significant differences between the patient and control groups for the anatomical type of vascular loop, the vascular contact, and the angulation of the CN VIII at the cerebellopontine angle.<sup>12</sup>

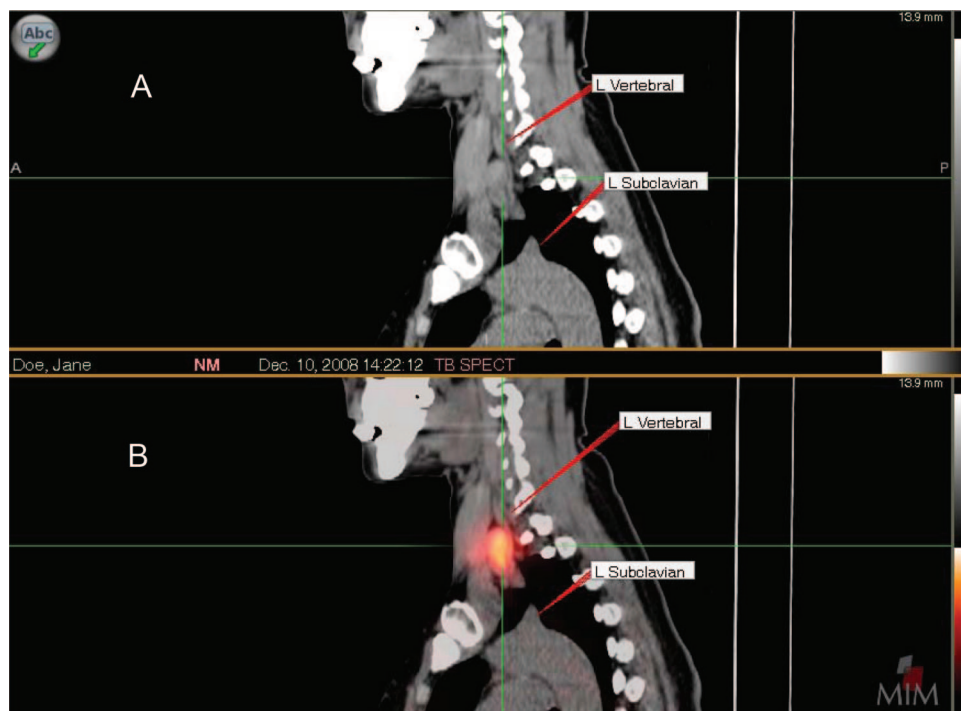
**Fig. 2** *A*: Coronal computed tomography (CT) section of the lower neck and superior mediastinum. An enlarged left-sided lymph node and scalene fat pad nodes are evident. A right-sided thyroid cystic nodule is present. *B*: OctreoScan® single photon emission computed tomography/computed tomography (SPECT/CT) fusion of top image. Metastatic lymph nodes are intensely avid for the radiolabeled somatostatin receptor analogue. The thyroid cystic lesion is non-avid for the radiotracer.



Carcinoid tumor patients often experience significant delays in diagnosis due to their vague complaints and symptoms that mimic common diseases. As a result, at initial presentation, many of these patients may have extensive metastatic disease that requires staged cytoreductive operations. Rather frequently, we see metastatic carcinoid tu-

ors that are located in the upper mediastinum and/or left lower neck. Such tumors have the potential to cause extracranial vascular compression and may, in turn, cause related neurologic manifestations, including pulsatile tinnitus, as in our case. Based on our recent experience, tumor compression of an extracranial vessel should be in the

**Fig. 3** Sagittal computed tomography (CT) section (*A*) and OctreoScan® single photon emission computed tomography/computed tomography (SPECT/CT) fusion (*B*) images. The metastatic lymph node (in color) compresses and displaces the proximal left vertebral artery just superior to its take off from the left subclavian artery.



differential diagnosis when dealing with any patient who has unexplained pulsatile tinnitus.

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