

Case Report

Resolution of Long Standing Tinnitus Following Radiofrequency Ablation of C2-C3 Medial Branches – A Case Report

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Disclaimer: See Page E97

Manuscript received: 07-09-2013

Revised manuscript received:

09-20-2013

Accepted for publication:

10-01-2013

Free full manuscript:
www.painphysicianjournal.com

Tinnitus is described as an auditory phantom perception analogous to central neuropathic pain. Despite the high prevalence of this debilitating symptom, no intervention is recognized that reliably eliminates tinnitus symptoms; a cause has yet to be determined.

A 65-year-old healthy man presented with a 3 year history of left-sided tinnitus. Full workup performed by the primary care physician including blood tests for electrolyte imbalance, consultations by 2 independent otolaryngologists, and imaging did not reveal abnormalities to provide etiology of the tinnitus. No other complaints were noted except for occasional minimal left sided neck pain. Cervical spine x-ray showed degenerative changes with facet hypertrophy more pronounced on the left side.

Subsequently, the patient underwent diagnostic left-sided C2-C3 medial branch block, resulting in complete resolution of tinnitus for more than 6 hours. After successful radiofrequency ablation of left C2-C3 medial branches, the patient became asymptomatic. At one year follow-up, he continued to be symptom free.

Sparsely studies have shown interaction between the somatosensory and auditory system at dorsal cochlear nucleus (DCN), inferior colliculus, and parietal association areas. Upper cervical nerve (C2) electrical stimulation evokes potentials in the DCN, eliciting strong patterns of inhibition and weak excitation of the DCN principal cells. New evidence demonstrated successful transcutaneous electrical nerve stimulation (TENS) of upper cervical nerve (C2) for treatment of somatic tinnitus in 240 patients. This case indicates that C2-C3 facet arthropathy may cause tinnitus and radiofrequency ablation of C2-C3 medial branches can provide an effective approach not previously considered.

Key words: Radiofrequency ablation, tinnitus, neuropathic pain, cervical medial branch block, cervical pain, auditory phantom perception

Pain Physician 2014; 17:E95-E98

Tinnitus is defined as a perception of sound in proximity to the head in the absence of an external source (1). The American Tinnitus Society estimates that 50 million people in the United States have chronic tinnitus, which is defined as tinnitus persisting for greater than 6 months (2). Of these 50 million individuals, 12 million have debilitating symptoms that interfere with activities of daily living. The exact cause of tinnitus is unknown, but it has been associated with a variety of pathologies in humans including advanced age,

vascular abnormalities, conductive hearing loss, depression, insomnia, and ototoxic medications (3).

Tinnitus can be divided into 2 categories: objective and subjective (somatic). Objective tinnitus initiates as a sound generated within the head and is audible to another person as a sound stemming from the ear canal. Subjective, or somatic, tinnitus is heard only by the patient and is most commonly of ontological origin. Somatic tinnitus has been associated with disorders of the head and neck, specifically localized to the ear ipsilateral to the somatic dysfunction along

with no vestibular complaints and no abnormalities on neurologic exam (4).

Currently, no intervention has been recognized that can reliably eliminate the symptoms of tinnitus. Shore, Levine, and Szczepaniak (3,5,6) have collected large amounts of data over recent years linking neural pathways and the somatosensory system as a source of tinnitus including studies. Studies have shown an interaction between the somatosensory and auditory system at the dorsal cochlear nucleus (DCN), inferior colliculus, and parietal association areas (4). Subjective, or somatic, tinnitus has been described as an auditory phantom perception analogous to central neuropathic pain.

Despite the high prevalence of debilitating disease, no documented intervention in the literature has been recognized that can reliably eliminate the symptoms of tinnitus and the etiology has yet to be determined. In this discussion, we describe the case of a 65-year man with chronic tinnitus who had complete resolution of symptoms following radiofrequency ablation of the C2-C3 median branches.

CASE REPORT

A 65-year-old otherwise healthy Caucasian man presents to the pain management clinic with left sided cervical neck pain and an associated left sided tinnitus present for the past 3 years. The patient's past medical history was significant for lumbar disc disease status post posterior lumbar fusion L3-L5. The cervical neck pain was intermittently present, non-radiating, and worse with flexion and extension. The left sided tinnitus was constant and worsened with the same movements that aggravated the neck pain. There was no complaint of tinnitus involving the right ear. The patient denied any depression, but stated that the tinnitus often interfered with his sleep.

Full workup performed by the patient's primary care physician for his chronic tinnitus included blood tests for electrolyte imbalance, consultations by 2 independent otolaryngologists, and imaging which did not reveal abnormalities to provide etiology of the tinnitus. Neurologic evaluation was also benign. Cervical spine x-ray showed degenerative changes with facet hypertrophy more pronounced on the left side. Due to the neck pain, a diagnostic medial branch block of C2-C3 was offered to the patient.

After signing informed consent, the patient was brought to the fluoroscopy suite, placed in a prone position on the fluoroscopy table, and the left neck was prepped and draped in sterile fashion. A 3½ inch

Quincke spinal needle was used and directed toward the left C2-3 transverse process using live fluoroscopic AP and lateral views. The needle was advanced until bony contact was made at the lateral aspect of C2-C3 at the facet line. Aspiration was negative for blood or cerebrospinal fluid (CSF). A mixture of 0.25% bupivacaine with 2% lidocaine 1:1 and 6 mg of betamethasone was injected at this site. The total volume injected was 0.5 milliliters. A sterile bandage was placed. The patient reported relief of his cervical neck pain as well as tinnitus symptoms within minutes of the procedure. The patient was observed for 30 minutes and then discharged home without incident. Follow-up with the patient revealed complete resolution of his tinnitus for more than 6 hours.

One week later, successful radiofrequency ablation of the C2-C3 medial branches was performed. RF was performed at 80 degrees Celsius for 90 seconds using a 22-gauge RF needle with a 5 mm active tip. After the ablation procedure, the patient became asymptomatic. Both his cervical neck pain and tinnitus were resolved. At one-year follow-up, the patient continued to be symptom free.

DISCUSSION

Research indicating the relationship between the somatosensory and auditory system suggests interaction at the DCN, inferior colliculus, and parietal association areas. The unearthing of the neural mechanisms involved in tinnitus is difficult in humans due to lack of studies, but animal models have aided in the discovery of the neural basis for tinnitus (5).

Levine's (3) dorsal cochlear nucleus hypothesis defines somatic tinnitus as tinnitus associated with disorders of the head and neck with localization to the ear ipsilateral to the somatic dysfunction along with no vestibular complaints and no abnormalities on neurologic exam. This hypothesis was centered on a series of case reports, which fulfilled the criteria for somatic tinnitus as described by Levine, along with a neurological model to correlate the clinical criteria to neurophysiologic and anatomic findings. The DCN hypothesis states that tinnitus occurs due to increased afferent sensory inputs from the face (trigeminal nerve), the external and middle ears (facial, glossopharyngeal, and vagus nerves), and the neck (C2 dorsal root) which all project on the medullary somatosensory nucleus (MSN). The MSN then projects to the ipsilateral DCN leading to its disinhibition, increased excitation of the auditory pathway, and as a result, tinnitus in the pa-

tient. This has been replicated in several animal species including the rat, chinchilla, and hamsters where increased spontaneous activity in neurons of the DCN have been matched to tuned frequencies associated with behaviorally measured tinnitus pitch (5).

It also has been observed that tinnitus can be modulated with movements of the head and neck (6). A study by Rubinstein et al (7) in 1990 found that 30% of those with tinnitus can modify their symptoms using forceful movements of the jaw and pressure applied to the temporomandibular joint. This is further supported by evidence found in a 2003 study by Levine et al (8) which showed that about 80% of "non-clinical" subjects who had ongoing tinnitus at the time of testing could modulate their tinnitus with head and neck contractions and approximately 60% of those with no tinnitus at the time of testing could elicit a tinnitus-like auditory perception with contractions of the head and neck. These results were also similar in the profoundly deaf patients in the study. This furthermore strengthens the tie between the somatosensory system and its influence on the auditory system. Our patient was able to modulate the severity of his tinnitus with similar maneuvers as stated above.

Evidence recently demonstrated successful transcutaneous electrical nerve stimulation (TENS) of the upper cervical nerve (C2) for the treatment of somatic tinnitus in 240 patients. It is believed that TENS of the C2 nerve leads to increased activation of the DCN and increased inhibition of the auditory system (9). This study helps to further implicate the role of the upper cervical nerves in somatic tinnitus and as a target area for possible treatment for those with chronic tinnitus.

Our case report represents a classic presentation of somatic tinnitus. Upper cervical nerves have been implicated in the development of tinnitus along with other nerves innervating the head and neck region. The tinnitus our patient presented with was ipsilateral to the facet arthropathy in the affected C2-C3 region. The symptoms of the tinnitus were amplified with modulation of the position of the neck. We feel that the increased sensory inputs from the C2 region in our patient led to disinhibition of the DCN and subsequent tinnitus, which was present for years before our treatment.

In discussion of the therapy applied to this patient, radiofrequency is a minimally invasive neurolytic technique that was developed more than 25 years ago and has demonstrated success at reducing pain in several chronic pain conditions, including trigeminal neural-

gia, chronic low back pain, postherpetic neuralgia, and complex regional pain syndrome. Even though this procedure is rarely associated with severe adverse effects, the potential for complications exists. They include infection, bleeding, parathesias, and neuritis. Specifically, certain safety issues characteristic for cervical procedure should be addressed. In selecting the equipment for radiofrequency (RF), the issue of sharp vs. blunt needle technique favors the use of blunt needles. Rare instances of needle tip migration have resulted in the injected material causing arterial clogging and secondary spinal cord infarction (10).

Specifically in cervical RF patients, a complication recently described in the literature is the "dropped head syndrome," which may be associated with multi-level bilateral RF ablative procedures (11). Dropped head syndrome is defined as severe weakness of the extensor muscles of the neck leading to a "chin on chest" appearance (12). It is usually associated with a specific generalized neuromuscular diagnosis, including amyotrophic lateral sclerosis, Parkinson's disease, myasthenia gravis, polymyositis, genetic myopathies, hypothyroidism, radiation therapy, cancer, or isolated neck extensor myopathy of unknown etiology. Practitioners should be aware of this complication of cervical radiofrequency ablation; therefore, attempting bilateral multiple level procedures are not recommended at this time.

CONCLUSION

We feel the radiofrequency ablation procedure done at the C2-C3 levels interrupted the neural excitation pathway, which led to the resolution of the tinnitus in our patient. We believe we effectively blocked the sensory inputs from the upper cervical levels, which treated our patient's chronic disease.

While it was not our original intention to treat the chronic tinnitus present in our patient, the result, along with the knowledge we have of upper cervical regions and their projection to the DCN, is one that may provide alternative treatment options for patients with somatic tinnitus. Our case report indicates that C2-C3 facet arthropathy can cause tinnitus and radiofrequency ablation of the C2-C3 median branches may present an effective treatment modality not previously considered.

DISCLAIMER

There was no external funding in the preparation of this manuscript.

Conflict of interest

Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity in-

terest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

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