

**COCHLEAR SYNAPTIC TINNITUS – CAN IT BE CURED**RAMARAPPU SOWMYA<sup>1\*</sup>, DASARI MAHESH<sup>2</sup>
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**ABSTRACT**

**Objective:** The objective of this study was to determine the tinnitus demography, etiology, treatment options, and their response in a Tertiary Care Teaching Hospital.

**Methods:** The study was conducted on patients above 21 and below 80 years who presented with tinnitus and hearing loss to ENT outpatient department (OPD) of Dr. Patnam Mahender Reddy Institute of Medical Sciences (PMRIMS), Chevella from May 2019 to February 2020. To identify the cause of tinnitus, the following investigations were considered: Pure-tone audiogram; tympanometry; blood investigations, color Doppler ultrasonography to evaluate blood flow disturbance in the vertebral and basilar artery, middle/inner ear high-resolution computerized tomography scan (CT), and, in the case of suspicion of vestibular Schwannoma or neurovascular conflict, magnetic resonance imaging/angio-CT (MRI/Angio-CT) was done.

**Results:** Among the patients attending ENT OPD with tinnitus, those with idiopathic cochlear synaptic tinnitus were identified, and 100 were selected and treated with various modalities of pharmacological treatment available for the same found that no specific drug was 100% effective in relieving the symptom.

**Conclusion:** The present study treated tinnitus of cochlear origin with various drugs and followed up with patients for 3 months. They were assessed with tinnitus sample case history questionnaire, and the study concluded that no pharmacological treatment effectively treats cochlear synaptic tinnitus.

**Keywords:** Tinnitus, Cochlear origin, Hearing loss, Audiogram, Carbamazepine, Piracetam.

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**INTRODUCTION**

Patients with auditory issues frequently complain about tinnitus. It is a symptom that haunts the person who has it, making it difficult for them to focus, sleep, and maintain their mental health. With worsening hearing loss, tinnitus prevalence increases [1]. It is estimated to impact 15–20% of people worldwide, and in 1–3% of instances, the quality of life is seriously affected [2]. The patient has described the sounds as roaring, hissing, swishing, rustling, or clicking at various pitches and volumes. One or more sounds may be heard by patients. The symptom may be constant or intermittent, perceived in one or both ears, inside the head, or outside the body [3]. There are two types of tinnitus – “Subjective which can only be heard by the patient” and Objective “which can even be heard by the examiner using a stethoscope.” Subjective tinnitus is again subclassified into conductive, sensor neural, and central. Some examples are impacted wax, fluid in the Middle ear, acute and chronic otitis media, abnormally patent eustachian tube, Meniere’s disease, otosclerosis, presbycusis, noise trauma, ototoxic drugs, and tumors of the eighth nerve [4]. Many use the term tinnitus to designate subjective tinnitus and somatosound to designate objective tinnitus. None of the treatment techniques have shown consistently positive effects in all patients due to the many etiologies of tinnitus, the inability to evaluate tinnitus’s perception, and the unknown mechanism and precise physiological processes involved in tinnitus [5,6]. A number of ideas on the genesis of tinnitus were put forth in the second half of the 20<sup>th</sup> century, and several medicines and surgical procedures were created with variable degrees of efficacy [7]. Despite these developments, tinnitus remains a crippling affliction with no permanent solution that occasionally leads to suicide [8]. Although there are no statistics available for the Indian population, the tinnitus problem there is just as serious and worrying [9]. There are not enough research in India about tinnitus and the effects it has on people. As a result, the present study aims to ascertain the demographics, etiology, available treatments, and responsiveness to tinnitus.

**METHODS****Source of data**

The study was conducted on patients above 21 and below 80 who presented with tinnitus and hearing loss to ENT outpatient department (OPD) at Dr. Patnam Mahender Reddy Institute of Medical Sciences, Chevella, from May 2019 to February 2020.

**Method of collection of data**

- Detailed history taking and subjective assessment of the tinnitus using the tinnitus sample case history questionnaire (TSCHQ).
- Clinical examination.
- Auditory assessment and imaging wherever appropriate.
- Patients were followed up for 3 months and were assessed for tinnitus relief.

**Inclusion criteria**

The following criteria were included in the study:

- Minimum age 18 years and maximum 80 years.
- Absence of psychiatric disease.
- Noise-induced hearing loss.
- Sensory neural deafness.
- Subjective tinnitus.

**Exclusion criteria**

The following criteria were excluded from the study:

- Tinnitus as treatment side effects.
- Pulsatile tinnitus.
- Tinnitus due to systemic, vascular, or diabetic disease, anxiety, and depression.
- Tinnitus due to external and middle ear causes.
- Specific disorders like Meniere’s disease.
- Vestibular Schwannoma or cerebellopontine angle tumors.

**Methodology**

With the exception of those who had a co-occurring psychiatric condition, all patients who had a history of tinnitus and visited the OPD

were included after receiving informed consent. To discover tinnitus-related illnesses and other health conditions, all patients completed a thorough medical history after providing personal information, including an otological examination. The following factors were taken into account when analyzing the data: age, sex, occupation, laterality of tinnitus, duration of tinnitus, and treatment used. To identify the cause of tinnitus, the following investigations were considered: Pure-tone audiogram; tympanometry; blood investigations such as hematocrit, blood biochemistries, thyroid studies, and lipid profile; color Doppler ultrasonography (Doppler) to evaluate blood flow disturbance in the vertebral and basilar artery; middle/inner ear high-resolution computerized tomography scan (CT); and, in the case of suspicion of vestibular Schwannoma or neurovascular conflict, magnetic resonance imaging/angio-CT(MRI/angio-CT). After ruling out conductive deafness and systemic causes of tinnitus, 100 patients were selected and given various modalities of drug treatment available and followed for 3 months for relief of the tinnitus with the help of TSCHQ and PTA.

**RESULTS**

There are varying degrees of epidemiological data regarding age distribution. Our study showed that 64% of patients were in the <50 age group (Fig. 1). In the present study, out of 100 samples, the male prevalence of 64% was more than females 34%. The left ear was affected more than the right or bilateral ear; this may be due to considerable variation in tinnitus laterality with age and gender (Table 1). The study included patients with tinnitus of different durations, most of which were presented within 6 months of their tinnitus origin (Fig. 2). Among the 100 patients studied, most were from agricultural backgrounds and housewives (Table 2). Among the patients attending ENT OPD with tinnitus, those with idiopathic cochlear synaptic tinnitus were identified, and 100 were selected and treated with various modalities of pharmacological treatment available for the same and found that no specific drug was 100% effective in relieving the symptom (Fig. 3).

**DISCUSSION**

In this study, we have treated cochlear synaptic tinnitus with various drugs available. In a Cochrane review about anticonvulsants for tinnitus in the ear, nose, and throat disorders group, two trials have used carbamazepine [10-13]. These studies used a validated questionnaire as outcome measurement. A test by Donaldson in 1981 [14] showed that treatment with carbamazepine 200 mg twice a day for 2 months resulted in a non-significant positive effect in 45% compared to 21% in the placebo group on a self-assessment score. A trial by Hulshof *et al.* [12] in 1985 showed that treatment with carbamazepine 150 mg 3 times a day for 30 days resulted in a non-significant negative effect in 8% compared to 13% in the placebo group on a self-assessment score. Thus, this review did not prove the effectiveness of carbamazepine in the treatment of tinnitus, measured through validated questionnaires [3]. In a study conducted by Sao Paulo Medical School, Brazil [15], 50 patients, 28 females, and 22 males; mean age of 50.9 years of I.V. Lidocaine was used as a 1-time relief measure. The patients who experienced relief after the I.V. Lidocaine were treated with oral carbamazepine in ascending dosages (50-600 mg/day). The results were classified as tinnitus abolition (18%), marked relief (32%), partial relief (26%), unchanged (22%), or worsening (2%). This study showed that 50% of patients treated with carbamazepine maintained the remission of tinnitus [15]. Hence, there are contradicting results in the literature showing the effectiveness of carbamazepine in the management of tinnitus. There is a lack of literature on using piracetam to manage tinnitus. However, one study in German literature looked into the effectiveness of piracetam in the management of tinnitus [16]. This prospective randomized clinical study conducted on 39 patients who were reported with tinnitus and sudden hearing loss to the Out-patient department. The therapeutic efficacy of piracetam was compared with that of naftidrofuryl. The parameters evaluated were hearing improvement and the reduction in the intensity of tinnitus. Improvement in a hearing was 15 dB (Piracetam) versus 18.5 dB (Naftidrofuryl). Tinnitus improved amounted to 27 dB (Piracetam) and

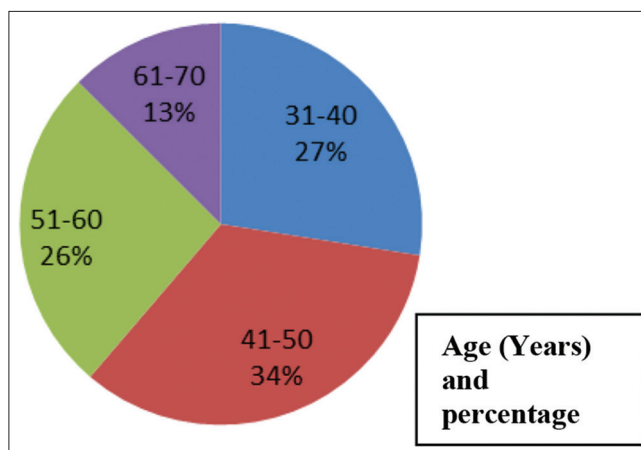


Fig. 1: Age-wise distribution of samples

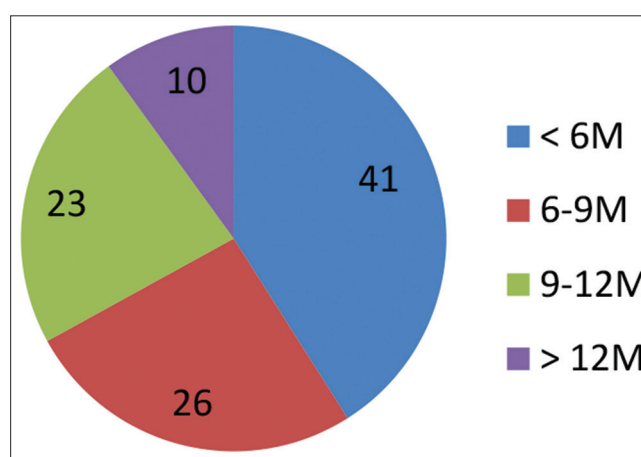


Fig. 2: Duration of tinnitus

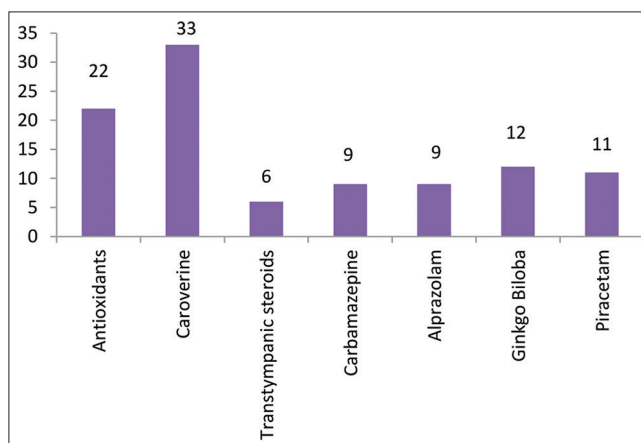


Fig. 3: Various modalities of pharmacological treatment

Table 1: site of tinnitus

Site of tinnitus	Number of patients	Percentage
Right	34	34
Left	38	38
Bilateral	28	28
Total	100	100

19.9 dB (Naftidrofuryl). Thus, this study showed that piracetam could be used to treat acute tinnitus [15]. An analysis was performed to examine

Table 2: Distribution of cases based on occupation

Occupation	Number of patients	Percentage
1. Student	12	12
2. Housewife	32	32
3. Agriculture	40	40
4. Business	06	06
5. Teacher	06	06
6. Others	04	04
Total	100	100

whether a single infusion of caroverine, a quinoxaline-derivative, can be used successfully in treating inner ear tinnitus. Microiontophoretic experiments in guinea pigs have shown that caroverine acted as a potent competitive alpha-amino-3-hydroxy-5-methyl-4-isoxazole-propionic acid (AMPA) receptor antagonist and, in higher dosages, a non-competitive N-methyl-d-aspartate (NMDA) antagonist. According to our findings on the pathophysiology of inner ear tinnitus (cochlear-synaptic tinnitus), these forms of tinnitus occur when the physiological activity of the NMDA and AMPA receptors at the subsynaptic membranes of inner hair cell afferents is disturbed. In total, 60 patients with inner ear tinnitus of assumed cochlear-synaptic pathophysiology were included in the study: After computerized randomization, 30 were treated with caroverine and 30 with placebo. For a response to having occurred, tinnitus had to show a reduction in both subjective rating and psychoacoustic measurement (tinnitus matching). In the caroverine group, 63.3% responded to therapy immediately after the infusion. In the placebo group, none of the patients treated showed a significant response according to the defined success criteria [17]. However, Saletu *et al.* reported that caroverine might not have any therapeutic effect on tinnitus beyond that seen with a placebo [18]. Still, so much research is needed to resolve the conflict in these results, and as of now, no particular treatment is satisfactory in relieving the tinnitus symptom.

## CONCLUSION

No treatment for tinnitus has been well established, and no specific therapy is satisfactory in all patients. Tinnitus is a symptom of different pathologies, is challenging to measure, and has other underlying mechanisms. Many treatment modalities have been tried with varying success. Surgical procedures for treating tinnitus such as auditory nerve section, and cochlear destruction, have been tried. There is little evidence of effectiveness and may even make tinnitus worse. In the present study, we treated tinnitus of cochlear origin with various drugs and followed up with patients for 3 months. They were assessed with TSCHQ, and the study concluded that no pharmacological treatment effectively treats Cochlear synaptic tinnitus.

## AUTHORS' CONTRIBUTIONS

The first author of the study, RS, performed the research work and wrote the first draft of the manuscript; the second author, DM, collected the literature, corrected the manuscript, and managed the statistics.

## CONFLICTS OF INTEREST

The authors declared, "No conflicts of interest."

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