

Tinnitus: Our Current Understanding

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ABSTRACT

Tinnitus is still very much a mystery with despite all the advances in science. Many theories and hypothesis proposed to explain the origin but still it is poorly understood. Still most common acceptance associated with tinnitus is that it is a type of phantom phenomenon. This article aimed to review tinnitus and our current understanding on definition, types, probable pathophysiological mechanisms, associated trigger factors and current available treatment options.

Keywords: Tinnitus, Pathophysiology, Classification, Treatment.

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I. INTRODUCTION

Tinnitus is an unpleasant perception of sound in ear and sometimes head. Majority of patients there is no acoustic source for this abnormal sensation [1]. Tinnitus is widely prevalent as few studies conducted to know the prevalence in general population many of which goes unreported, or patients is not bothered enough to seek doctor help. Epidemiology studies from USA have reported 8% to 25.3% prevalence in population [2]-[4]. Similar prevalence of 4.6% to 30 % found in studies from other nations [5]-[7].

II. HISTORY OF TINNITUS

Tinnitus is derived from Latin word tinniere, meaning to ring, this is characterized as a phantom phenomenon in majority of patient with no organic pathology to explain the complaint of sound in ear [8]. Egyptian papyrus from 17th dynasty famous medical text titled crocodilopolis which most probably recorded during 1650-1532 BCE era. This is the earliest written data which point towards tinnitus, which they described as bewitched ear or humming [9]. Ancient Assyrian clay tablet from 700 BCE describe three types of tinnitus sound in ear: singing, speaking, and whispering [10].

III. TYPES OF TINNITUS

Literatures are available classifying tinnitus into two broad groups.

a) *Subjective / Objectives*

Since 1683 clinicians are aware of different presentation of abnormal sound in ear, French otologist Jean Marc Jesparditard in 1812, classified well known classification of tinnitus into false and true. True tinnitus is when patient as well clinician both are able hear, this is known objective tinnitus in present day practice. While in false tinnitus only patient himself or herself is hearing a sound in ear which clinician cannot hear is known as subjective tinnitus in

current practice. Our current understanding on these two types of tinnitus has remained almost same since 1812 [11].

IV. WHICH SOUND IN EAR SHOULD BE CLASSIFIED AS TINNITUS?

Which sound in ear should be classified as tinnitus is a big issue, because of the chronic nature and associated morbidity. As proposed in 1992 by R Dauman & RS Tayler during Fourth international tinnitus seminar in Bordeaux, France. According to this criterion any noise in ear or head lasting for at least 5 minutes and occurring at interval of at least twice a week will be defined as tinnitus [12].

V. DIFFERENT CLASSIFICATIONS OF TINNITUS IN LITERATURE

a) *According to Triggering Factor*

1) Primary tinnitus: when there is no identifiable triggering factor (idiopathic). Tinnitus associated with sensorineural hearing loss also classified as primary tinnitus [13].

2) Secondary tinnitus: Tinnitus appearing with a known ongoing organic pathology [14].

3) Somatosensory tinnitus: Origin of somatic tinnitus is alteration in somatosensory proprioceptive projection from structures near ear, neck, temporomandibular joint [15].

b) *According to Site of Impairment in Auditory System [16]*

1) Peripheral;

2) Central;

c) *According to Duration of Presentation [14]*

1) Acute tinnitus: symptoms duration is in the last 6 months.

2) Chronic tinnitus: Patients usually have complaints lasting beyond 6 months.

VI. ETIOLOGY OF TINNITUS

Tinnitus is not a disease but manifestation of ongoing underlying pathologies in the patient [15]. A single Pathomechanism is difficult to explain the varied ways of presentation of tinnitus.

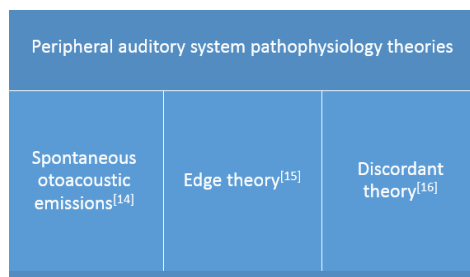


Fig. 1. Peripheral auditory system pathophysiology theories.

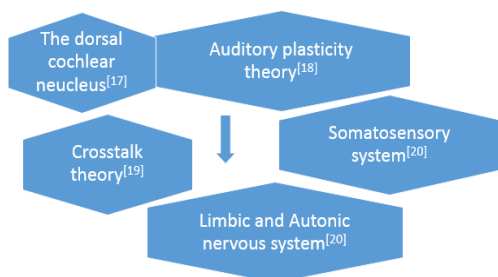


Fig. 2. Central auditory system pathophysiology theories.

a) Risk Factors and Diseases Associated with Complaints of Tinnitus

No single theory given above can explain the origin of tinnitus in various diagnosis in diseases affecting external ear, middle ear, and inner ear. In all the diseases associated with subjective tinnitus one basic thing which is clear is inadequate of altered sound stimulus reaching auditory cortex.

VII. EAR DISEASES AND PROBABLE EXPLANATION FOR ORIGIN OF TINNITUS

TABLE I: EAR DIAGNOSIS ASSOCIATED WITH COMPLAINTS OF TINNITUS [21], [22]

External Ear	Middle Ear	Inner Ear & Retro cochlear
Impacted wax	Otitis media	Presbycusis
Foreign body	Otosclerosis	Ototoxic medications
Loose hairs, dirt in canal	Cholesteatoma	Cochleitis
	Acute barotrauma (diving/snorkeling/scuba/flying/concussive explosive blasts)	Cochlear neuritis
		Meniere's disease
		Vestibular schwannoma
		Noise induced trauma
		Acute barotrauma (diving/snorkeling/scuba/flying/concussive explosive blasts)
		Traumatic brain injury (TBI)
		Autoimmune disorders
		Metabolic disorders (Hypothyroidism, Hyperthyroidism, Anemia)
		CVS & Blood vessels disorder (Hypertension, Atherosclerosis)

These diagnoses may explain trigger factors for development of subjective variant of tinnitus.

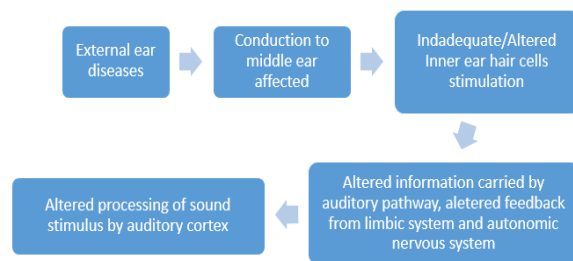


Fig. 2. Simplified Pathomechanism for tinnitus origin.

So, from the above list any deviation in course of travelling sound wave information by auditory pathway, by any pathology or even diseases affecting normal function of auditory nerve can manifest as tinnitus symptom [23].

Objective tinnitus: A somatic cause for tinnitus, with source of auditory stimulus including both auditory and nonauditory few physiological internal auditory stimuli include:

a. Continuous Tinnitus [24]

- 1) Patulous eustachian tube'
- 2) Stapedial muscle spasm'
- 3) Palatal myoclonus.

b. Pulsatile Tinnitus: Depending on the Site of Origin Has Been Classified into Three Type

- 1) Arterial.
- 2) Arteriovenous.
- 3) Venous [25].

A. Why Tinnitus is a Problem and Reasons Patient Seek Treatment

There are studies in literature in which main reasons for patients visiting a clinician or hospital to seek treatment have been done past they have shown that tinnitus affect sleep and leads insomnia episode along with severely affecting the quality of life, they are found to be associated with affecting patients psychotic and neurotic manifestation like depression and anxiety [26]-[29]. An original study published in 2018 by Emily J. Watts and others in Trends in Hearing have grouped 31 the problems associated tinnitus which severely affects quality of life as well as affects socially and economically into four groups [30]:

- a) Effects on hearing: problems associated with understating and speech and environmental sounds;
- b) Effects on lifestyle: in which insomnia affecting daily routine life is major problem;
- c) Emotional problems: patients start manifest psychiatric and neurotic problems like depression, anxiety, difficulty to concentrate, irritability episode, panic attack, very rarely suicidal tendencies;
- d) Effects on general health: patients complain of nonspecific pain, headache, chronic fatigue like symptoms, drug dependence and related problems [30].

B. Treatment Options Available

There is no confirmed pathophysiologic mechanism behind the origin of tinnitus that is why still despite all the advances in the science we do not have a gold standard treatment to treat tinnitus. Commonest problem found from various study for which patients usually come to see a clinician is reduced quality of life [30].

Majority of patients with tinnitus get accustomed to this annoying sound in ear, but 20% of the subjects with tinnitus come to see their clinician and seek help [31]. Objective tinnitus type by organic cause like ear wax, middle ear fluid, acute pressure changes in middle ear, eustachian tube nasal opening problem including patulous and oedema by rhinitis management ameliorate tinnitus symptoms and most patients feel great relief. But there is no specific tinnitus targeted therapy for subjective type. Subjective tinnitus can be managed under two broad categories [32].

1) Strategies focusing on decreasing the tinnitus intensity.

2) Approaches to relieve the symptoms of associated comorbidities which affect quality of life and are trigger factor of annoyance.

Methods of management incorporating both the above intentions include [37]:

1) Education and raising awareness.

2) Cognitive behavioral therapy (CBT) many studies have shown efficacy of CBT in improving lifestyle index [38].

3) Sound enrichment using ear-level sound generators or hearing aids.

4) Pharmacotherapy (we must remember there is no specific medicine approved by any drug regulating authority anywhere in world like US FDA, European medicine agencies), drugs used in general practice aim to manage insomnia, anxiety and depression associated with chronic and severe tinnitus [39], [40].

C. When to Refer a Tinnitus Case for Further Investigation and Management

Though subjective tinnitus cases are most common, sometimes patients with certain require further evaluation and referral to centers with adequate and required infrastructure with trained staffs:

1) Unilateral tinnitus with SNHL [41], [42].

2) Pulsatile tinnitus [43], [44].

3) Tinnitus with vestibular system complaints [45], [46].

4) Association with foul smell discharge, earache [47], [48].

5) Facial palsy with tinnitus [49]-[52].

6) Patients with CNS, Psychiatric and Neurotic symptoms, and signs [51]-[54].

D. Role of Surgery in Tinnitus Management [55]-[58]

Surgery as a form of treatment restricted to diagnosed organic pathologies causing tinnitus in diagnoses like:

1) Otitis media effusion;

2) Otosclerosis;

3) Unsafe CSOM;

4) Intractable Endolymphatic hydrops disease;

5) Perilymph fistula;

6) Vestibular schwannoma;

7) Cerebellopontine angle tumors.

VIII. NEWER METHODS OF TREATMENT

Many treatment approaches have been used to give relief from tinnitus complaints. Which include, acupuncture [59], application of magnets, biofeedback technique and related stress reduction exercise. Recently transcranial magnetic

stimulation is used in the management of intractable tinnitus [60,61]. Transcranial magnetic stimulation or TMS gives repetitive electromagnetic stimulation of low frequency to temporoparietal cortex, which is the site described in various pathophysiology theories leading to irregular activation and generation of tinnitus sound. Still relief is not permanent or long term from these newer forms of treatment methods.

IX. CONCLUSION:

Tinnitus is still a diagnosis of mystery widely prevalent in population with but with no confirmed pathophysiological mechanism to explain the origin and no gold standard treatment. Majority of patients ignore the problem, around 20% come to see their clinicians when tinnitus intensity becomes unbearable and start affecting the usual daily routine. Objective type of tinnitus has cure potential like, but majority of patients have subjective type where no organic cause found. Treatment form which decreases the intensity of tinnitus sound helps most, but at the same time management of comorbidities like anxiety, depression and related complaints is also important so that a healthy productive life is encouraged in patients.

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