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Tinnitus: The Humming Ear

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Abstract

Statement of the Problem:

This provides an overview of Tinnitus and its management. It is very useful for students of Otology and clinicians practicing Audio vestibular medicine. This introduces the physicians to a systematic approach of assessing the gravity of the ailment which is per se a very difficult subject to master and to thereby treat the patients suffering from this morbidity. The cornerstone of managing a patient of Tinnitus is first and foremost to obtain a specific and good history. This is to be followed by thorough clinical and audiological examinations. The general practitioner is the first professional to be involved in management of a patient suffering from tinnitus followed by specialists in Otorhinolaryngology and Audiovestibular medicine. The key concepts in assessing, diagnosing and managing the clinical manifestations of tinnitus are briefly discussed.

Aristotle described Tinnitus not as a symptom of a disease but as a physiological sensation. In the history of Renaissance medicine Paracelsus dealt with the association of deafness and tinnitus. In the nineteenth century, the French physician Rene Laennec who invented the stethoscope concluded that Tinnitus is an acoustic hallucination, since he could not hear anything using his instrument.

By the turn of the twentieth century, tinnitus research took a new turn. It was concluded that the presence of tinnitus was always more or less associated with hearing impairment and the physiology of tinnitus is connected with neurophysiological research. There is Objective as well as Subjective tinnitus. Duration of tinnitus of less than three months is considered Acute, otherwise it is regarded as Chronic. Tinnitus treatment is diversified as its pathophysiology. It is one of the most challenging tasks faced by the medical fraternity, since it has a moderately negative impact on patient's Quality of life. Various modalities of treatment like Hearing Aids, Cochlear Implants, Tinnitus Maskers etc. or its combinations are offered as solutions to the patients. Tinnitus Retraining Therapy (TRT) to retrain the brain to habituate to the tinnitus signal and thereby get the patient to reclassify tinnitus as a neutral stimulus. Recent advances in the field of treatment of tinnitus like Cognitive Behaviour Therapy (CBT), Biofeedback (BF) and Neurofeedback (NF), Magnetic and Electrical Brain Stimulation, Acoustic Co-ordinated Reset Neuromodulation and Music Therapy is discussed.

Keywords: Tinnitus, Neurophysiology, Retraining Therapy, Neural stimulus

Introduction

According to Dennis McFadden (1982) Tinnitus is the conscious expression of a sound that originates in an involuntary manner in the head of its owner, or may appear to him to do so. Tinnitus can be perceived as a formless sound, either tonal or complex in nature, that resembles environmental sounds for example ringing , hissing, buzzing, escaping steam, florescent light, running engine, humming etc.

According to Jastreboff (1995) Tinnitus is the perception of sound that results exclusively from activity within the central nervous system without any corresponding mechanical, vibratory activity within the cochlea, and not related to external stimulation of any kind. It is believed that this kind of perception occurs as a result of neuronal activity at a sub cortical level of the auditory pathway the cortex plays a predominant role.

Tinnitus is considered a disorder of sound tolerance and is rarely a harbinger of serious pathology, but careful clinical assessment is required.

CLASSIFICATION

DAUMEN & TYLER (1992) - MULTIPLE CLASSIFICATIONS.

BASED ON PATHOLOGY:

- NORMAL TINNITUS –is experienced by most people without HL lasting < 5 mins. less than a week.
- PATHOLOGICAL TINNITUS-–lasts more than 5 mins. more than once a week & is usually experienced by people having HL.

BASED ON SEVERITY:

- ACCEPTABLE TINNITUS– it does not bother the person (non clinical).
- UNACCEPTABLE TINNITUS : it is disturbing to the patient.

BASED ON DURATION:

- TEMPORARY TINNITUS—Short term tinnitus, probably due to temporary dysfunction of the auditory system, such as after noise exposure in a club or drug exposure.
- PERMANENT TINNITUS –It may be either constant or intermittent.

BASED ON SITE:

- Middle Ear
- Peripheral neural.
- Central neural.

BASED ON ETIOLOGY :

- Noise induced.
- Meniere's Disease.
- Ototoxicity.
- Presbyacusis.
- Unknown etiology.

EPIDEMIOLOGY

As tinnitus is a common symptom in a wide range of ontological pathologies, it is not surprising to find its prevalence high in clinical population. Approximately 1 in 10 people are affected by it. For about 1 in 200, tinnitus has a severe effect on the activities of daily living. Tinnitus is common in people with a HL but the degree of hearing impairment correlates poorly with tinnitus severity. About 1 in 10 people presenting with tinnitus ha a normal audiogram. Temporary tinnitus is a very common symptom experienced by people of all ages . (Coles : 1996). So it can be said that, eventually, only 0.5 to 2 % population at a given place is affected by tinnitus.

TINNITUS AS A SYMPTOM

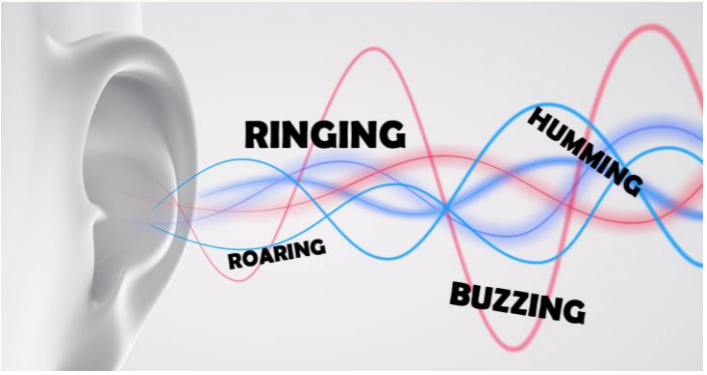
There are two types of tinnitus that the physician & the patient opt to experience:-

OBJECTIVE TINNITUS

- When the patient's tinnitus can be heard by the physician-----Audible Tinnitus----where it corresponds to blowing, respiration, pulsating, rough in character or when there is rapid succession of popping sounds.
- Conditions associated with this type are : Patent Eustachian tube / Cardiac Vascularities / Vascular tumors in middle ear /ME muscle contractions.
- Objective tinnitus is very rare.

SUBJECTIVE TINNITUS :

- This is most frequently encountered. Here the patient can hear the sound.
- Conditions associated with this type are : Otological disorders (SNHL is a common finding) / Dental Pathology / Myositis /Intoxication /Allergy / Intoxication of systems /CV Pathologies /Metabolic dysfunctions / Trauma / Neurological diseases.



PSYCHOLOGICAL FACTORS

Most sufferers of tinnitus realize that fatigue & stress playa major role in the severity of their complaint.

Psychological Effects of tinnitus were reported by Rubunistern & Erlandsson in 1991 :

- **Emotional Distress**– Irritation / Annoyance / despair / Lack of concentration / sleep disturbances.
- **Interpersonal Complaints**– Lack of understanding / Negative impact of relationships (relatives / friends / colleagues).
- **Somatic Distress Symptoms**—Headache / Tension in jaw muscles / Neck pain /Dizziness / Hypersensitivity to sounds.

Following are the three dimensions of tinnitus complaint behaviour

EMOTIONAL : Depression / Anger / Irritability / Anxiety.

AUDIOLOGICAL : Perceptual difficulties (hearing problems in demanding social situations).

INTRUSIVENESS : Continuous focusing of tinnitus, concentration difficulties, insomnia.

NON-PULSATILE TINNITUS

Pathophysiology :-

The most prevalent presentation of tinnitus in the general population is that of a Subjective Non-Pulsatile sound. The exact mechanism behind tinnitus ignition is not fully understood, it is now considered that any pathology than can potentially damage the auditory pathways has the potential to result in tinnitus.

PERIPHERAL MECHANISMS :

- Discordant damage of cochlear hair cells.
- Calcium channel dysfunction.
- Glutamate receptors.

CENTRAL MECHANISMS

- Increased spontaneous firing.
- Increased central neural synchrony.
- Reorganization of the cortical auditory map.

PULSATILE TINNITUS:

Pathophysiology :-

Here the perception of sound is not that of a continuous form. The perceived sound takes on the form of a pulsation, clicking, or fluttering. Pulsatile tinnitus is classified either as Synchronous or non-Synchronous,depending on whether the tinnitus takes on the characteristics of a
pulsation in synchrony with the patient's heart.

PATHOLOGICAL CAUSES OF PULSATILE TINNITUS :

(I) VASCULAR :

- ARTERIAL– Atherosclerotic carotid artery / av fistula /av malformation / Intracranial aneurysm / Dissection of carotidartery / vascular compression of the 8th nerve.
- VENOUS- Jugular bulb abnormalities / Dural venous sinusstenosis /venous hum etc.

(II) MICROVASCULAR :

- Glomus tumor/ Paget's disease/ Cholesterol granuloma of ME/ Menningioma of ME / Cavernous haemangioma / Histiocytosis X.

(III) CIRCULATORY :

- Increased cardiac output (Anaemia/ thyrotoxicocis/ pregnancy) / Aortic murmurs.

(IV) PERCEPTUAL :

- Conductive HL / Cochlear trauma.

(V) OTHERS :

- Benign intracranial hypertension / SSC dehiscence syndrome.

NON-SYNCHRONOUS PULSATILE TINNITUS :

Tinnitus manifesting itself as a train of rhythmical clicks or a buzzing sound or fluttering noise or sensation that is not synchronous with the pulse.

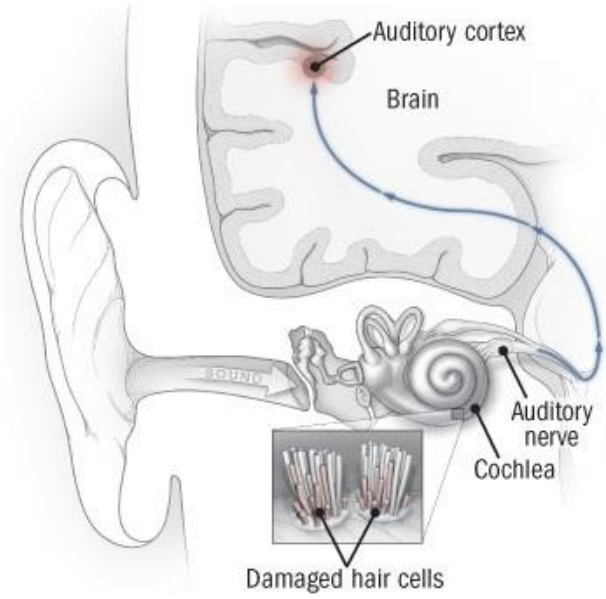
Example : Myoclonic activities related to middle ear muscles & head- neck muscles (palatal myoclonus).

MANAGEMENT OF TINNITUS

Jastreboff (1990) : published the 'Neurophysiological Model' which demonstrated the link between the Auditory system & other somatosensory pathways. During the recent past, it has been demonstrated that tinnitus can be influenced by stimuli from outside the auditory system— for example , many people with tinnitus can modulate their symptom by touching the face, clenching their teeth, changing their gaze etc. This model was subsequently used to produce a clinical application that became known as"tinnitus retraining therapy"(TRT). This form is currently employed to form the basis of a novel form of tinnitus therapy. A thorough History & Examination is warranted before proceeding with the investigations. Several specific
/specialist investigations may be required in certain specific forms of tinnitus.

INVESTIGATIONS

- Basic audiometry.
- Tinnitus specific audiological measurements.
- Imaging.
- Tinnitus questionnaires.
- Other questionnaires.
- Visual analogue scales



MAINSTREAM TREATMENTS

EXPLANATION & REASSURANCE.
HEARING AIDS.

SOUND THERAPIES----- NOVEL SOUND THERAPIES

- NEUROMONICS.
- SERENADES.
- NOISE CANCELLATION.
- ACOUSTIC CR NEUROMODULATION.
- Sound therapy with vagal nerve stimulation.
- Mute button.
- A thorough History & Examination is warranted beforeproceeding with the investigations.
- Several specific / specialist investigations may be requiredin certain specific forms of tinnitus.

COMBINATION TREATMENT MODALITIES

- COGNITIVE BEHAVIOURAL THERAPY.
- OTHER PSYCHOLOGICAL TRATMENTS--- includesMindfulness Meditation and Acceptance & Commitment Therapy (ACT).
- ELECTROMAGNETIC STIMULATION
- SYSTEMIC DRUG TREATMENTS.
- REGIONAL DRUG TREATMENTS.
- INTRATYMPANIC DRUG TREATMENTS.
- COMPLEMENTARY & ALTERNATIVE MEDICINE :- - Acupuncture / Aroma therapy / Chiropractic / Craniosacral therapy / Herbal medicine / Ginkgo biloba / Homeopathy / Ear candles / Hypnotherapy / Massage / Meditation / Osteopathy/Reflexology/Reiki / Shiatsu / Tai chai / Yoga etc.
- LASERS.
- SURGERY.
- DIETARY TREATMENTS / SUPPLEMENTS : Arginine A.A.) / Beta Carotene (Vit. Precursor) /Calcium (Mineral) /Club moss &Unroasted coffee (Herbal)/ Cornus (Fruit)/ Folic acid (Vitamin) /Foxglove & Garlic (Herbal) /Magnesium , Manganese, Potassium (Mineral) / Omega-3 (Fish oil) /Melatonin (Hormone) /N-Acetylcysteine (Antioxidant) / Vitamin A, B1, B3, B6, B12,C,E / Zinc / Wobezym (Enzyme formula)/ Ipriflavone (Bioflavinoid).

AUDIOLOGICAL TEST BATTERY

Hall & Haynes (2001) recommended the following Audiological evaluation for tinnitus patients :--

(I) PTA for octave frequencies from 250 to 10 KHz. and inter octave frequencies of 1,3,5 & 6 KHz.

(II) High frequency audiometry above 10 KHz. if thresholds for lower frequency signals are within normal limits and the results of OAE are also normal.

(III) Word recognition performance of patient should be at most comfortable level.

(IV) Impedance measurements (Tympanometry) & Acoustic Reflex (AR) to be done with caution.

(V) AR measurement is contraindicated in patients reporting Hyperacusis (dislike of sounds above a certain intensity) especially at levels exceeding the Loudness Discomfort Level (LDL's).

LOUDNESS DISCOMFORT LEVELS

Tinnitus patients who report a sound tolerance problem, LDL (Loudness Discomfort Levels) should be measured as a part of initial investigation.

These measures are repeated at each successive times to document changes in sound tolerance overtime and to provide information for counselling purposes.

Some individuals who have severe tinnitus hear sounds as distorted and some have hyperacusis (reduced tolerance to sounds) or phonophobia (fear of sounds).

Tinnitus can be referred to one ear, or both ears, or to a location inside the head. The anatomical location of the physiological abnormality of chronic subjective tinnitus, however, is rarely in the ear butmore often in the auditory nervous system.

ALLIED CONDITIONS

- MUSICAL HALLUCINATION.
- ACOUSTIC SCHOCK.
- LOW FREQUENCY NOISE COMPLAINT.
- EXPLODING HEAD SYNDROME

MAIN TAKEAWAYS :

Post covid-19 tinnitus is an entity to be reckoned with now by the clinician. Emergence of idiopathic tinnitus with normal hearing has to be taken into consideration.

All these patients needs to be monitored at a quarterly level to see any improvement or deterioration. Role of audiometrtic procedures in these types of patients is very important. History of covid infection should be mandatory for all patients reorting to audiometric clinics. Co-morbities do not affect the tinnitus as it is important during the history taking process. Vaccines : no effect on tinnitus---social media myth.

SOCIAL MEDIA & TINNITUS- Following groups are active:

- Tinnitus Sufferers (North Dakota, USA).
- Tinnitus Support Group (UK/ NZ/ USA/ Canada/ Kenya).
- Tinnitus Research Initiative (Science & Research).
- Tinnitus Success Stories.
- Tinnitus Cure.
- Tinnitus Treatment.
- Tinnitus Hub (Amsterdam, Netherlands).
- Tinnie Tinnitus Chat Groups.
- Tinnitus Support India.
- Tinnitus Pakistan.

HIGHLIGHTS

- These are all private groups on fb but they seem to be very active.

PEOPLE WHO ARE USUALLY EXPOSED TO LOUD MUSIC

- ELDERLY.
- MUSICIANS.
- MILITARY PERSONNEL.
- THOSE WORKING IN ENVIRONMENT HAVING LOUD NOISE.

HYPERACUSIS

It is an unusual tolerance to ordinary environmental sounds. This is considered a precursor to tinnitus. Prevalence is 8 to 15 %. Mostly hyperacusis & tinnitus is present together & it is associated with HL. Multiple theories are there for the pathophysiology of hyperacusis. the most common being the dysfunction of 5-HT which happens in migraine, PTSD, depression etc., may lead to increased auditory gain that may be responsible for hyperacusis. Measurement of LDL's is necessary to diagnose this condition. TRT / Psychological treatments & CBT is effective.

MISOPHONIA

It is defined as a group of patients who dislike particular sounds irrespective of the level of the sound. This indicates a strong dislike or hatred for the sound. Phonophobia is a subset of this as it indicates a fear of sound. The onset is usually peripubertal around 12 years of age. Dearth of information regarding its incidence & prevalence. Sounds that trigger this phenomenon is usually sounds produced by other human beings like eating , chewing, breathing, whistling & lip smacking.

Repetitive sounds may also trigger this like clipping of finger nails, clicking the top of a pen . There is lack of data regarding the audiological status of the patients with misophonia. Pathophysiology & management is still a matter of conjecture.

- The purpose of these groups is to find support & strength through others that understand living withtinnitus.
- Used for global connection to support one another.
- They share enlightening ideas to help cope with tinnitus.
- They deal with all tinnitus related issues.
- Their baisic idea is to educate the people about tinnitus& help them to live with tinnitus.

CONCLUSIONS

Most people with tinnitus go through a process of habituation & the impact of the symptoms lessens with time. For about 1 in 200, tinnitus has a severe effect on the activities of daily living. A blocked sensation in ears is common in patients of tinnitus without any evidence of ET dysfunction. Interventions that improve hearing are often helpful & various audiological and psychological management strategies for tinnitus have been developed. Disorders of sound tolerance are common but terminology is confused, pathophysiology is unclear and many questions remain regarding management.

BEST CLINICAL PRACTICE

- Thorough audiological investigation.
- Stress on history taking including that of co-morbidities.
- Role of drugs for certain conditions.
- Correct counselling----negativity should be avoided & appropriate referrals for audiometry
  / hearing therapy / mental health services.
- Judicial use of surgery & H.A.'s to correct the H.L.associated with tinnitus.

FUTURE RESEARCH

No reliable method to consistently measure tinnitus. There is no universally accepted effective drug treatment. Multidisciplinary approch has to be taken outside E.N.T. & Audiology. Basic research has introduced different routesto allow investigation of pathophysiology, diagnosis & treatment of the different presentations of this condition. Tinnitus research has benefitted our understanding of how the auditory system and the brain perceive & process sound.

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