OTOLARYNGOLOGY

Openventio PUBLISHERS

ISSN 2470-4059 Open Journal http://dx.doi.org/10.17140/OTLOJ-SE-5-103

Special Edition
"New Frontiers in Tinnitus, Hearing Loss and Hyperacusis"

Mini Review

Corresponding author
Neha Taneja, MASLP
Assistant Professor II
Department of Audiology and Speech Language Pathology
Amity Medical School
Amity Univeristy, Haryana, India
Tel. +91 8860592030
E-mail: neha.aslp04@gmail.com

Special Edition 5
Article Ref. #: 1000OTLOJSE5103

Article History
Received: December 6th, 2017
Accepted: March 5th, 2018
Published: March 9th, 2018

Citation
Taneja N. Mini review on tinnitus and cognition. *Otolaryngol Open J*. 2018; SE(5): S10-S13. doi: 10.17140/OTLOJ-SE-5-103

Mini Review on Tinnitus and Cognition

Neha Taneja, MASLP*

Department of Audiology and Speech, Language Pathology, Amity University, Haryana 122413, India

ABSTRACT

Introduction: Cognitive characteristics plays an important role in tinnitus-related distress. Auditory characteristics are not the sole determinants of tinnitus-related distress rather the cognitive factors play a crucial role in regulating psychological adaptation to tinnitus distress.
Objective: The present mini-review aims to briefly summarize and establish an association between tinnitus and cognition.
Results and Discussions: The results of the previous literature studies show that tinnitus and cognition are two closely associated concepts. The cognitive characteristics play a role in linking the severity of tinnitus to tinnitus-related distress. A combination of the clinical determinants (auditory and cognition) helps provide the best rehabilitation for psychological adaptation to tinnitus. Controlling the cognitive characteristics helps in establishing better psychological adaptations. Cognitive behavioral therapy helps reduce annoyance due to tinnitus rather than completely eliminating annoyance.
Conclusion: Auditory factors are not the only determinants of tinnitus-related distress. Annoyance associated with tinnitus is more closely related to cognitive characteristics relative to auditory factors such as pitch and loudness only. Cognitive mechanisms actively interplay between the severity of tinnitus and the distress caused due to tinnitus. Cognitive interventions such as cognitive behavioral therapy are therefore considered necessary for psychological adaptations.

KEYWORDS: Tinnitus; Cognitive characteristics; Cognitive behavioral therapy (CBT).

INTRODUCTION

The cognitive characteristics play an important role in the clinical incidence of tinnitus. The term cognition is defined as the substantial varieties of human activities such as perception, sensation, reasoning, problem-solving, memory, consciousness, and attention.[1,2] Tinnitus is defined as the auditory perception in the ears or in the head in the absence of an external auditory stimulus.[3] The functional role that cognition plays in tinnitus is difficult to ignore.[1] Tinnitus can be extremely disturbing and can cause emotional discomfort due to depression and anxiety.[3-9] To combat the effects of tinnitus, it is important to treat annoyance caused as a consequence of tinnitus.[3] Annoyance caused by tinnitus can be taken care of by treating the affected clinical parameters of tinnitus such as pitch, loudness, etc.[3] However, studies support that loudness alone is not a detrimental factor that determines the degree of distress caused by tinnitus, as the auditory parameters are not the only determinant characteristics of tinnitus.[3] Considering these perspectives, cognitive characteristics play an important role to determine the distress caused by tinnitus.[1,3] The severity of tinnitus, personality traits, and cognitive characteristics lead to distress closely associated with tinnitus.[1,3] Cognitive characteristics play an integral role as a mediator between the severity of tinnitus and the distress caused due to tinnitus.[3] Cognitive characteristics help control the psychological adaptations of tinnitus. Thus, to support the rehabilitation of tinnitus affected patients, cognitive intervention may be implemented to combat functional and emotional distress caused by tinnitus.[1,3]

METHODOLOGY

Various databases like Google, Google Scholar, Medline (National Center for Biotechnology

ISSN 2470-4059 http://dx.doi.org/10.17140/OTLOJ-SE-5-103

Information (NCBI), US National Library of Medicine) PubMed were searched for the terms "*tinnitus*", "*cognition*", "*cognitive characteristics*", "*association between tinnitus and cognition*", "*role of cognitive behavioral therapy in tinnitus management*". The important findings were documented in a narrative manner.

LITERATURE REVIEW

A reasonably large number of literary records[2,17-20] exist reporting the relation between tinnitus and cognition. Cognitive intervention plays[21] a crucial role in reducing the distress caused due to tinnitus and helps in psychological adaptation. Several researchers have reported that tinnitus has been a cause of interference[4] in daily activities involving cognition such as social interactions, concentration, and sleep. Many mechanisms have been put forth to explain the causes of tinnitus. Among the many theories to explain the origin of tinnitus; central auditory pathways are considered crucial for the development of tinnitus.[4] Cognitive-behavioral therapy (CBT) plays a promising role in the treatment of tinnitus-related distress.[4] Also previous studies which has been carried out support that tinnitus affects cognition to the extent that it reduces cognitive capacity needed to perform tasks that require voluntary, conscious, effortful, and strategic control.[5] Further, in order to find the association between tinnitus and cognition authors used Stroop test.[6] Cognition efficacy was measured in tinnitus patients using a Stroop test. Reaction time as a measure of cognitive functioning was found to be slow in tinnitus patients in word reading and category naming tasks.[2,6,16] Tinnitus distress has been found to be reduced by cognitive behavioral therapy.[7] Among the effective treatments for managing tinnitus; Cognitive behavioral therapy[8] as been found to be effective in the management of tinnitus implementing relaxation, and restricting cognitive thoughts to promote habituation. This helps tinnitus patients in dealing with associated psychological conditions.[8] Various tests such as neurocognitive tests have helped compare the abilities of people with bothersome tinnitus against gender, age and education-matched normative population.[9] Results of the study reflected[9] that from a first testing session showed deficits in immediate recall of heard words, learning, learning rates, and the use of a serial order encoding strategy. Results from the same study also highlighted that the initial reliance on serial order encoding and later, increased intrusion of incorrect words towards normal levels indicative of less demanding strategies to compensate for weakness in associative memory for semantic categories.[9] Further studies support that the dysfunctional[10] cognitive abilities have been found to play an important role in determining the degree of tinnitus distress. Catastrophic and avoidance of thoughts helps provide an explanation for depression among tinnitus patients. Cognitive behavioral therapy has been found to play an important role in treating these patients.[10] Authors reported that[11] tinnitus is associated both with modality-specific deficits along the auditory processing system and an impairment of cognitive control mechanisms that are involved both in vision and audition (i.e., that are supra-modal). It was reported that this deficit in the top-down cognitive control is a key factor in the development and maintenance of tinnitus. This may also explain some of the cognitive difficulties reported by tinnitus sufferers.[11] Researchers found that tinnitus impairs cognitive function by impacting the executive control of attention.[12] Clinical management of patients reporting tinnitus and cognitive difficulties require an understanding of the reciprocal association between tinnitus and cognitive function, with additive effects of depression, anxiety and somatic cognitive bias.[12] The future directions postulated by this study was to establish the impact of advancing age, anxiety, hearing loss, depression and tinnitus duration, and distress upon cognitive function in people with invasive tinnitus.[12] Authors have found that tinnitus has been characterized as hissing and buzzing tones in the absence of any external source. Tinnitus can even lead to emotional and cognitive impairment.[13] Thus, patients with tinnitus find difficulty in performing cognitive tasks. The hippocampus has been found to be related to pathophysiology of tinnitus.[13] Findings from another such study suggest that the computer-based cognitive training program is associated with self-reported changes in memory, attention and perception of tinnitus.[14] Neuroplastic changes in the brain systems have been reported to play a crucial role in cognitive control. Cognitive training programs may play an important role in the future treatment of patients with tinnitus.[14] Also amplification devices such as hearing aids helps to provide rehabilitation benefits to patients with tinnitus. An improvement on the Reading Span test marked[15] by a high score in both the hearing loss and tinnitus group together relative to the hearing loss group was recorded in this study. Following the use of hearing aids, patients with tinnitus receive an extra benefit in terms of cognitive function by rehabilitation.[15]

RESULTS AND DISCUSSION

Cognitive characteristics play a mediating role between the severity of tinnitus and distress related to tinnitus.[3] The previous literature also highlights that cognitive characteristics such as the catastrophic interpretation of tinnitus plays an important role in the treatment and psychological adaptation of tinnitus patients.[1,3] It is therefore important to understand the reason that causes emotional distress. The clinical treatment must, therefore, incorporate loudness so as to identify it as a potential cause of tinnitus distress or to understand if cognition or personality leads to the arousal of emotional distress. A combination of these factors implemented in the treatment of tinnitus patients supports their psychological adaptation.[3]

Cognition refers collectively to varieties of mental and human activities. Such diverse activities can be attention, sensation, perception, language, thinking, reasoning, memory, problem-solving and consciousness.[2] Among these many cognitive variables attention plays an important role in moderating the adverse effects of tinnitus. Attention can be measured objectively through measuring reaction time.[2] Tinnitus noises can become bothersome when they start receiving attention.[16] If the tinnitus noises become more meaningful they will receive more attention. If they are perceived as threatening they can bring more emotional distress. The act of selectively attending and complaining of such noises can become a

ISSN 2470-4059 http://dx.doi.org/10.17140/OTLOJ-SE-5-103

source of interference of adaptive functions and affects mental concentration intrusively including essential daily activities such as sleeping as well. The relative intensity of tinnitus noise is also an important determining factor for intrusiveness.[2] Thus as mentioned above such cognitive activities such attention, perception, consciousness, etc., becomes vital influencers in relating meaning to this threatening sound/tinnitus noise which leads to tinnitus induced emotional distress. Hence the role of cognition becomes crucial with respect to tinnitus. Among the many treatment options, cognitive behavioral therapy (CBT) targets both emotional and cognitive aspects of tinnitus. At the same time, it is important to note that cognitive behavioral therapy helps to reduce annoyance due to tinnitus rather than completely eliminating annoyance.[1,3] Controlling the cognitive characteristics helps in better psychological adaptation.[3] Findings from previous studies highlight the role of cognitive factors in tinnitus-related distress relative to auditory factors which only triggers tinnitus generation while perception or distress is related to cognition. This fact is further strengthened by the findings which report that tinnitus may be equally severe in normal hearing individuals with tinnitus than in individuals with hearing impairment affected by tinnitus.

CONCLUSION

Literature increasingly shows that tinnitus and cognition may are inseparable concepts. Cognitive characteristics play an important role in determining psychological adaptation of tinnitus. Auditory factors (such as intensity) do not function as the only determinants for tinnitus-related distress. Cognitive mechanisms mediate a link between severity of tinnitus and distress from tinnitus. Cognitive interventions such as cognitive behavioral therapy are therefore considered essential for psychological adaptations.

CONFLICT OF INTEREST

The author declares that there is no conflicts of interest involved.

REFERENCES

1. Andersson G, Eriksson J, Lundh LG, Lyttkens L. Tinnitus and cognitive interference: Astroop paradigm study. *J Speech Lang Hear Res*. 2000; 43(5): 1168-1173. doi: 10.1044/jslhr.4305.1168

2. Andersson G, McKenna L. The role of cognition in tinnitus. *Acta Otolaryngol Suppl*. 2006; 126(Supp 556): 39-43. doi: 10.1080/03655230600895226

3. Lee SY, Kim JH, Hong SH, Lee DS. Roles of cognitive characteristics in tinnitus patients. *J Korean Med Sci*. 2004; 19(6): 864-869. doi: 10.3346/jkms.2004.19.6.864

4. Londero A, Peignard P, Malinvaud D, Avan P, Bonfils P. Tinnitus and cognitive-behavioral therapy. *La Presse Médicale*. 2006; 35(9-C1): 1213-1221.

5. Zenner HP, Pfister M, Birbaumer N. Tinnitus sensitization: Sensory and psychophysiological aspects of a new pathway of acquired centralization of chronic tinnitus. *Otol Neurotol*. 2006; 27(8): 1054-1063. doi: 10.1097/01.mao.0000231604.64079.77

6. Stevens C, Walker G, Boyer M, Gallagher M. Severe tinnitus and its effect on selective and divided attention: Acufenosevero y susefectossobre la atenciónselectiva y dividida [In Spanish]. *Int J Audiol*. 2007; 46(5): 208-216. doi: 10.1080/14992020601102329

7. Kaldo V. Cognitive behavioural therapy as guided self-help to reduce tinnitus distress (Doctoral dissertation, ActaUniversitatisUpsaliensis).

8. Martinez-Devesa P, Perera R, Theodoulou M, Waddell A. Cognitive behavioural therapy for tinnitus. The Cochrane Library. 2010.

9. Pierce KJ, Kallogjeri D, Piccirillo JF, Garcia KS, Nicklaus JE, Burton H. Effects of severe bothersome tinnitus on cognitive function measured with standardized tests. *J Clin Exp Neuropsychol*. 2012; 34(2): 126-134. doi: 10.1080/13803395.2011.623120

10. Conrad I, Kleinstäuber M, Jasper K, Hiller W, Andersson G, Weise C. The role of dysfunctional cognitions in patients with chronic tinnitus. *Ear Hear*. 2015; 36(5): e279-e289. doi: 10.1097/AUD.0000000000000168

11.Araneda R, De Volder AG, Deggouj N, et al. Altered top-down cognitive control and auditory processing in tinnitus: Evidences from auditory and visual spatial stroop. *Restor Neurol Neurosci*. 2015; 33(1): 67-80. doi: 10.3233/RNN-140433

12. Tegg-Quinn S, Bennett RJ, Eikelboom RH, Baguley DM. The impact of tinnitus upon cognition in adults: A systematic review. *Int J Audiol*. 2016; 55(10): 533-540. doi: 10.1080/14992027.2016.1185168

13. Vanneste S, Faber M, Langguth B, De Ridder D. The neural correlates of cognitive dysfunction in phantom sounds. *Brain Res*. 2016; 1642: 170-179. doi: 10.1016/j.brainres.2016.03.016

14. Kallogjeri D, Piccirillo JF, Spitznagel E, et al. Cognitive training for adults with bothersome tinnitus: A randomized clinical trial. *JAMA Otolaryngol Head Neck Surg*. 2017; 143(5): 443-451. doi: 10.1001/jamaoto.2016.3779

15. Zarenoe R, Hällgren M, Andersson G, Ledin T. Working memory, sleep, and hearing problems in patients with tinnitus and hearing loss fitted with hearing aids. *J Am Acad Audiol*. 2017; 28(2): 141-151. doi: 10.3766/jaaa.16023

16. Hallam RS, Rachman S, Hinchcliffe R. Psychological aspects of tinnitus. In: Rachman S, ed. *Contributionsto Medical Psychology*. Oxford, UK: Pergamon Press; 1984: 31-53.

ISSN 2470-4059 http://dx.doi.org/10.17140/OTLOJ-SE-5-103

17. Rossiter S, Stevens C, Walker G. Tinnitus and its effect on working memory and attention. *J Speech Lang Hear Res*. 2006; 49(1): 150-160. doi: 10.1044/1092-4388(2006/012)

18. Trevis KJ, McLachlan NM, Wilson SJ. Cognitive mechanisms in chronic tinnitus: Psychological markers of a failure to switch attention. *Front Psychol*. 2016; 24; 7: 1262. doi: 10.3389/fpsyg.2016.01262

19. Tegg-Quinn S, Bennett RJ, Eikelboom RH, Baguley DM. The impact of tinnitus upon cognition in adults: A systematic review. *Int J Audiol*. 2016; 55(10): 533-540. doi: 10.1080/14992027.2016.1185168

20. Vanneste S, Faber M, Langguth B, De Ridder D. The neural correlates of cognitive dysfunction in phantom sounds. *Brain Res*. 2016; 1642: 170-179. doi: 10.1016/j.brainres.2016.03.016

21. Lee SY, Kim JH, Hong SH, Lee DS. Roles of cognitive characteristics in tinnitus patients. *J Korean Med Sci*. 2004; 19(6): 864-869. doi: 10.3346/jkms.2004.19.6.864