Neuropathological findings in tinnitus: a human post-mortem study

Faris Almasabi[1,2,3], Faisal Alosaimi [1,3,4], Anouk Walters[1], Minerva Corrales Terrón[1], Jasper V. Smit1[5], Yasin Temel[1,3], Marcus L.F. Janssen[1,6] and Ali Jahanshahi[1,3]

1 School for Mental Health and Neuroscience, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, The Netherlands

2 Department of Physiology, Faculty of Medicine, King Khalid University, Abha, Saudi Arabia.

3 Department of Neurosurgery, Maastricht University Medical Centre, Maastricht, The Netherlands

4 Department of Physiology, Faculty of Medicine, King Abdulaziz University, Rabigh, Saudi Arabia

5 Department of Ear Nose and Throat/Head and Neck Surgery, Zuyderland, Heerlen, The Netherlands

6 Department of Clinical Neurophysiology, Maastricht University Medical Centre, Maastricht, The Netherlands

Key words

Tinnitus, Human post-mortem, Dorsal raphe nucleus

Abstract

Introduction

Tinnitus is a phantom perception of sound often accompanied by increased anxiety and depressive symptoms. The underlying pathophysiology of tinnitus is suggested to be located in the auditory circuitry and associated brain regions. Although, there is a clear link between tinnitus and psychological wellbeing, only little is known about the serotonergic system in tinnitus pathophysiology. Here, we conducted a descriptive study on the pathological changes in the auditory and non-auditory brain regions of persons with tinnitus using histological and immunohistological techniques.

Martials and methods

Paraffin embedded brain samples from persons with tinnitus and matched controls were obtained. Samples were obtained from the medial geniculate body (MGB), inferior colliculus (IC) and dorsal raphe nucleus (DRN). Nissl staining was performed for cell density and surface-size measurements. Next, anti-glial fibrillary acidic protein (GFAP) and iba-1 stainings were utilized to assess astrocyte and microglia glial cells, respectively. Additionally, the DRN was stained for phenylalanine hydroxylase-8 (PH8) and tyrosine-hydroxylase (TH), which were used to visualize respectively serotonergic and dopaminergic neurons.

Results

Cell density in the MGB and IC was reduced in the persons with tinnitus. The reduction of neurons in the IC was accompanied by a reduction in the number of astrocytes. No difference in the number of microglia nor in cell surface-size was seen in all regions.

No neural cell loss was observed in the DRN, interestingly the number of PH8 positive neurons was reduced, while the number of TH positive neurons showed no difference.

Discussion and conclusion

In this first human post-mortem study, we have shown that in persons suffering from tinnitus the number of neurons in the MGB and IC were reduced. The reduction of astrocytes might look odd at first, but lines up with findings in post-mortem studies in depressive and other psychological disorders. The reduction of DRN neurons that express PH8 shows a possible role of the serotonergic system in the neuropathology of tinnitus. Our results should be handled carefully due to self-evident limitations of post-mortem studies, nonetheless these findings yield novel ideas that add to current concepts of the neuropathophysiology of tinnitus.