Directed Coherence in the Resting Tinnitus Brain

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INTRODUCTION

Subjective tinnitus is characterized by a conscious auditory phantom perception in the absence of any physical sound source. Most of the current models that try to explain the neuronal mechanisms of tinnitus concentrate on the central auditory system. However, little is known about the involvement of other brain areas in tinnitus and how they communicate with each other. It has been suggested that global synchrony of long-range connections are sufficient for a conscious perception of an external stimulus (Dehaene et al. 2006). Thus, in this analysis we concentrated on the gamma frequency band (30-100 Hz).

IDEA OF THE STUDY:

HUB MAPPING

- Networks of any kind can be described by their hubs. The example below shows the flight connections of an Airline in the US. In this context, a hub is an airport where many flights arrive and depart.

- Functionally connected neurons in the brain build a similar network. The goal of this study was to describe them by mapping the hubs of these global networks.

- Connectivity between neuronal cell assemblies usually has a direction. Using the direction of the connectivity one can identify IN-hubs that receive information from other areas and OUT-hubs drive other areas. The example to the left shows three OUT-hubs in a directed network.

DATA ACQUISITION

Machine:

148-channel whole-head magnetometer system (MAGNES TM 2500 WH, 4D Neuroimaging, San Diego, USA) installed in a magnetically shielded and quite room (Vakuumschmelze Hanau).

Recording:

5 Minutes of Spontaneous Activity with eyes open.
Sampling rate: 678.17 - downsampled later to 600 Hz
Hard-wire high-pass filter: 0.1 Hz

SAMPLE

Tinnitus Group:
23 Subjects (5 female), Age: 45.4 +/- 14.1 years
Tinnitus Side:
left: 8, right: 5, both sides: 8, in the head: 1, no: 1
Tinnitus Questionnaire Score:
mean: 25.1, range: 3 - 59

Control Group:
24 Subjects (11 female), Age: 43.9 +/- 18.4 years

CONCLUSION

We found significant differences in IN-going and OUT-going hubs between tinnitus sufferers and controls:

- OUT-going hubs were increased in the left auditory cortex and frontal areas.
- IN-going hubs were decreased in the left temporal area and increased in the right temporal area.

We suppose that global changes in the gamma band are sufficient for the conscious perception of the tinnitus tone.

REFERENCES


Fig 1. IN and OUT hubs

A two-way ANOVA (frequency x group) was calculated for each voxel. Voxels with a significant group effect at p < .005 are displayed.

Fig 2. Post hoc tests

T-tests were applied vor all significant effects.
*p < .05, **p < .01, ***p < .001