P058

TINNITUS & HYPERACUSIS

Behavioral and Electrophysiological Perspectives on Attention and Working Memory in Tinnitus

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Abstract

Aim: Attention and working memory are pivotal in tinnitus generation and persistence, but existing studies often focus on limited attentional domains, leaving the broader impact unclear. Further the coexistence and severity of working memory and attention deficits in tinnitus sufferers is also ambiguous. This study aims to evaluate the effect of five attentional domains and working memory on individuals with tinnitus, utilizing both behavioral and electrophysiological measures

Population: Thirty individuals with continuous and subjective tinnitus (Tinnitus Group, TG), alongside thirty age, gender, and hearing-matched controls (Control Group, CG)

Methods: All participants underwent an Attention Network Task (ANT), which involved a modified flanker paradigm, followed by the Go-No go P300 paradigm, an auditory classification task and finally a 2-back working memory task, a visual target identification task. EEGs were recorded simultaneously using 32 channel equipment. SPSS was used for statistical analysis and further mediation analysis was carried out using Jamovi.

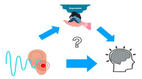
Results: ANT: Alerting and orienting attentions were similar between the groups. Executive attention was affected in TG. The TG had significantly poorer accuracy than the CG (t (58) = 3.071, p = 0.003) and lower P300 amplitude (t(58) = -2.186, p = 0.033).

Interpretation: Individuals with tinnitus have similar alerting, orienting, selective attention and involuntary attentional shift to those of healthy controls but had poor executive attentional scores indicating poor efficiency (Heeren et al., 2014). However the neurophysiological correlate for this executive attentional impairment could not be proved. Subsequent mediation analysis indicated that this correlation was not causal but rather associative.

Conclusion: The presence of tinnitus specifically impaired the executive attentional abilities. Further, a deficit in the working memory abilities in individuals with tinnitus could impair the resource allocation process thereby delaying the conflict resolution process. Future therapies on tinnitus could focus on training the individual for better conflict resolution rather than solely targeting the attentional mechanisms.

Objectives

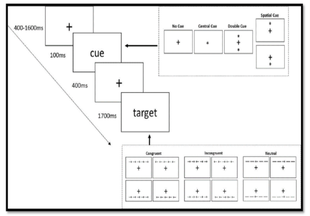
- To assess if tinnitus affects attention as a whole or just selected domains
- To identify if depression is a mediating factor for the attentional abilities
- To compare the working memory abilities in individuals with and without tinnitus



Materials and Methods

- Study design - Parallel group comparison study
- Study duration- 03 years
- Study setting – Department of speech and hearing, Kasturba hospital, Manipal
- 60 participants (2 groups)
- Age range – 20- 55 years
- Gender ratio: 23: 7 per group

Attentional Network Task (ANT)



Differential attentional scores

Alerting : No cue – Double cue

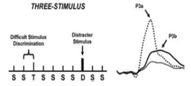
Orienting : Centre cue – Spatial Cue

Executive: Incongruent – Congruent

P300 Go – No-Go task

- 3 tones
- Standard (80%), Rare (10%) and Distractor (10%)
  (1000Hz, 2000Hz and Buzzer tone)
- 70dB,10ms RT & FT, 300 stimuli, ISI : 1400-1600 ms

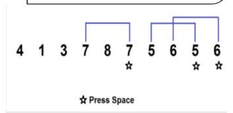
Outcome measures
- ✓ RT – Frequent & rare
- ✓ P300a & P300b latency and amplitude



2-back test

- Numbers 1-9 (Random – MatLab)
- 300 stimuli (75 targets)
- ISI – 600 -1600ms

Outcome measures
- ✓ RT & Accuracy
- ✓ P3 latency and amplitude (Target)

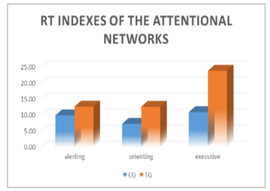


Results

Behavioral Correlates - ANT

1. **Reaction Time :** TG- longer RT (F (1, 58) = 4.355, p = 0.041, η2=0.070) ANCOVA (PHQ-9) N.S (p> 0.05)
2. **Attentional Indexes:** Poor Executive attention in TG (p=0.002).The results remained significant even after ANCOVA (PHQ-9) (p=0.000)

- Alerting (p=0.571) and orienting (p=0.264) attentions were similar



The RT indexes for three attentional networks for CG and TG

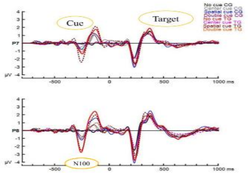
Electrophysiological Correlates ANT

1. P300 (Executive Attention)

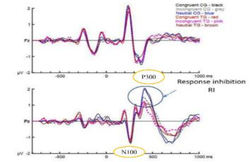
- ANOVA for P300 → TG had smaller P300 amplitude [congruent (p=0.021) & Neutral (p=0.012)].
- ANCOVA (PHQ-9) – N. S. (p=0.150)
- **Response inhibition -** TG had smaller inhibition and greater variability within the group, But N.S. (t (58) = 1.169, p = 0.247)

2. N100 (Alerting and Orienting Attention)

- Good difference in the N100 amplitude with respect to the different cue condition,
- No cue - lowest amplitude (p=0.000).



P300 responses for Flanker conditions for TG and CG



N100 responses for cue conditions for TG and CG

Mediation Analysis – ANT

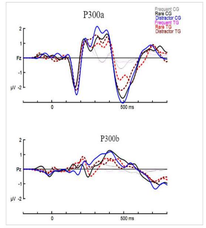
(P300 amplitude → Reaction time)
Depression scores (PHQ-9) → Mediator
Significant direct effect (Z= -2.714; p=0.007) between the P300 amplitude and the reaction time with 94.5% mediation and no indirect link through PHQ-9

P300 Go- No-Go paradigm

No statistically significant difference between groups

Electrophysiological measures

P300a and P300b latency (t (51) = 0.132, p = 0.895) and amplitude (t (51) = -0.547, p = 0.587)



P300a and P300b waveform for Go-No-Go paradigm for CG and TG at Pz

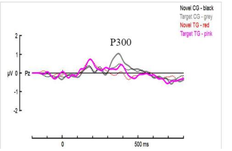
2- Back Task

Behavioral measures

- Accuracy: TG poor accuracy (*p= 0.003)*

Electrophysiological measures

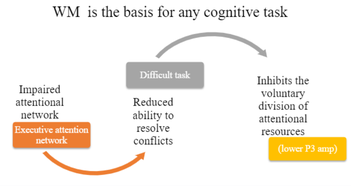
- Amplitude - TG lower P300 amplitude (*p= 0.033)*
- ANCOVA (PHQ) - still significant (*p= 0.038)*



P300 waveform for 2-back test for CG and TG at Pz

Discussion & Conclusion

- ✓ Tinnitus specifically impairs the executive attentional abilities and the WM , leaving the alerting, orienting, selective and pre-attentional abilities intact
- ✓ A cortical signature for the executive attentional deficit could not be measured → defect in response production stage
- ✓ Depression – Covariate factor not causal
- ✓ Future therapies need to focus on cognitive training



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