

ABSTRACT

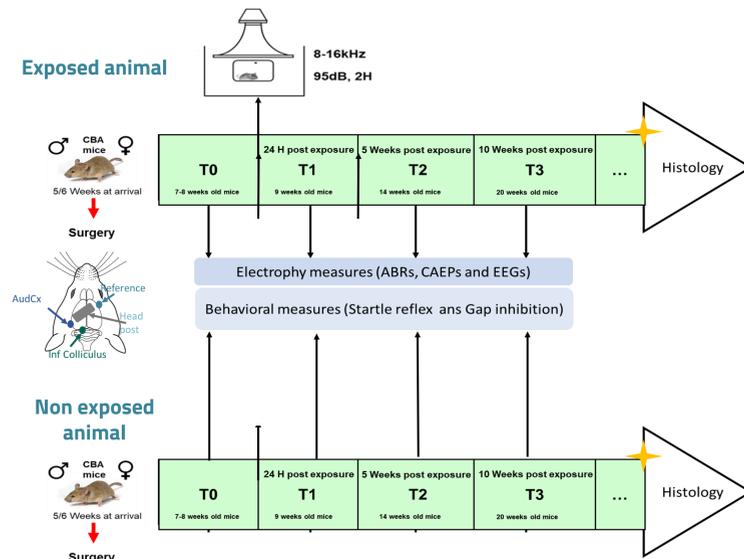
Hyperacusis is characterized by an **intolerance to everyday sounds** perceived as painfully loud, significantly disrupting daily life (1). This condition affects nearly 9% of the population (2,3) and is often accompanied by hearing loss. Studies suggest hyperacusis may result from the **central nervous system's adaptation to peripheral sensory loss**, leading to **unregulated amplification** of auditory stimuli. This process would maintain neural activity levels after sensory impairment, but can distort auditory perception (4, 5). Imaging studies also shows increased sound-evoked activity in several auditory regions in hyperacusis patients, indicating a **disruption in the balance of neuronal excitation and inhibition** (6, 7). Despite extensive research, effective treatments for hyperacusis remain limited due to the complexity of its neural mechanisms and the **lack of preclinical models**. Our study aimed to correlate **behavioral changes** in animals, measured by startle response tests, with **neurophysiological changes** indicative of hyperacusis.

We utilized techniques to measure **both peripheral and central auditory function in awake animals** (7, 8), proposing that increased central activity compensates for peripheral sensory loss.

OBJECTIVES

Our goal is to identify a combination of neural biomarkers and behavioral changes reliably characterizing the presence of hyperacusis.

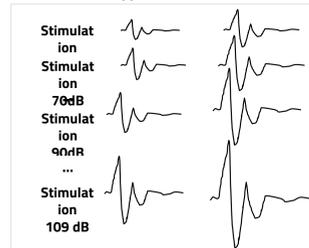
MATERIALS & METHODS



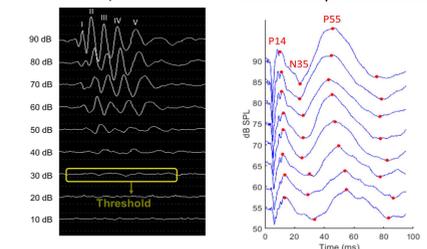
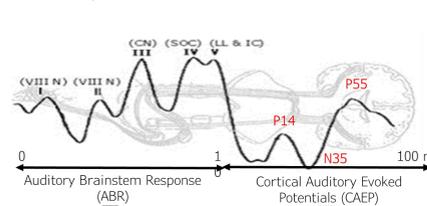
1/ Subjective measure: startle reflex – Intensity function

HYPERACUSIS ASSESSMENT Startle test

Measuring startle intensity at different intensities enables us to assess the presence of hyperacusis.



2/ Objective measure: threshold, amplitudes, latency



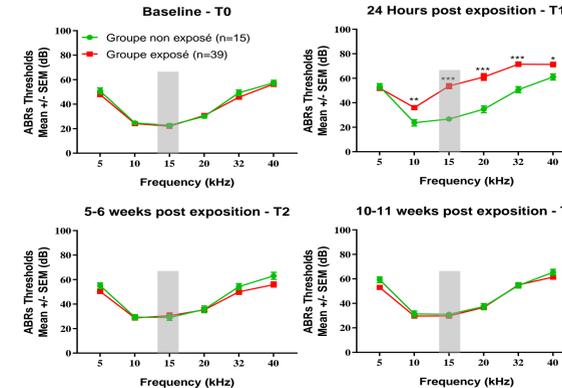
ABRs (Auditory Brainstem Responses):

- Auditory nerve (Wave I)
- Cochlear nucleus (Wave II)
- Superior olivary complex (Wave III)
- Lateral lemniscus (Wave IV)
- Inferior colliculus (Wave V)

CAEPs (Cortical Auditory Evoked Potentials):

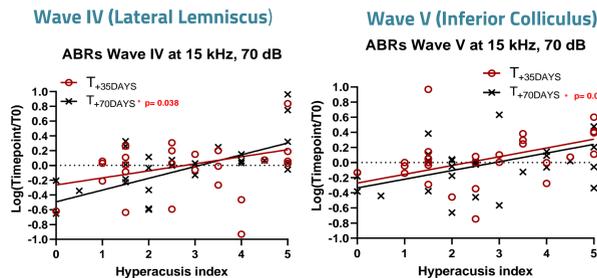
- **First wave:** reflects activity in the **thalamus** (medial geniculate body).
- **Second wave:** reflects activity in the **auditory cortex**

RESULTS

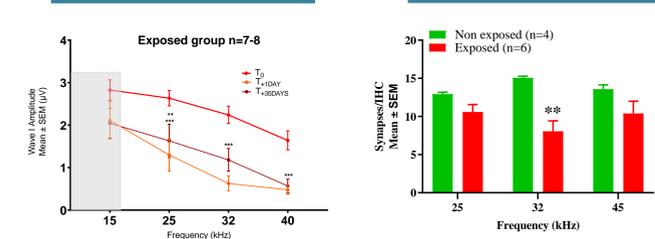


One day after exposure, auditory thresholds are significantly increased, but full recovery is observed five weeks post-exposure.

Noise exposure leads to temporary hearing loss.

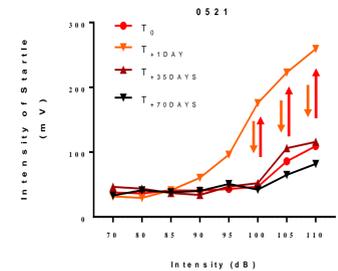
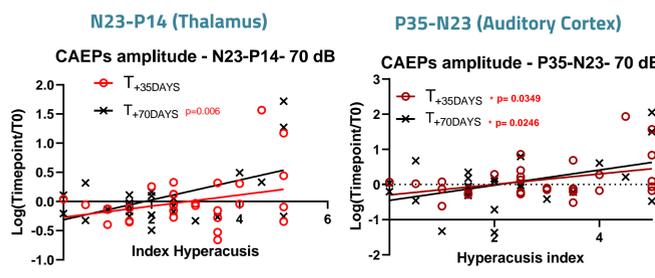


No permanent Hearing loss



A non-temporary reduction in Wave I amplitude is observed, along with a decrease in ribbon synapses.

Our model induces synaptopathy.



Hyperacusis Index Startle Response Scoring (0-5)

1. Increase in Startle Intensity
Score: 0 → 5
(No increase → Maximum increase)

2. Decrease in Startle Latency After Noise Exposure
Score: 0 → 5
(No decrease → Maximum decrease)

Correlation between hyperacusis index and increased central response

Pertinent biomarker: Simultaneous increase of behavioral & neural response to sounds

CONCLUSION

- Development of techniques and models from scratch distinguishing between hearing loss, tinnitus, and hyperacusis
- For the first time correlation between changes in perception—reflected in behavioral modifications—and electrophysiological alterations
- Pertinent biomarkers: simultaneous increase of behavioral & neural response to sounds

BIBLIOGRAPHY

- (1) Fackrell K. et al. 2022 ; (2) Hall, A. J et al. 2016 ; (3) Smit, A. L. et al 2021 ; (4) Schaette, R. & et al. 2006 ; (5) Ransdell, J. L. 2012 ; (6) Knipper et al. 2013; (7) Auerbach et al. 2021 ; (8) Postal. et al. 2022 ; (8) Dejean C. et al. 2023