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HYPERACUSIS

Development of an awake animal model for hyperacusis screening

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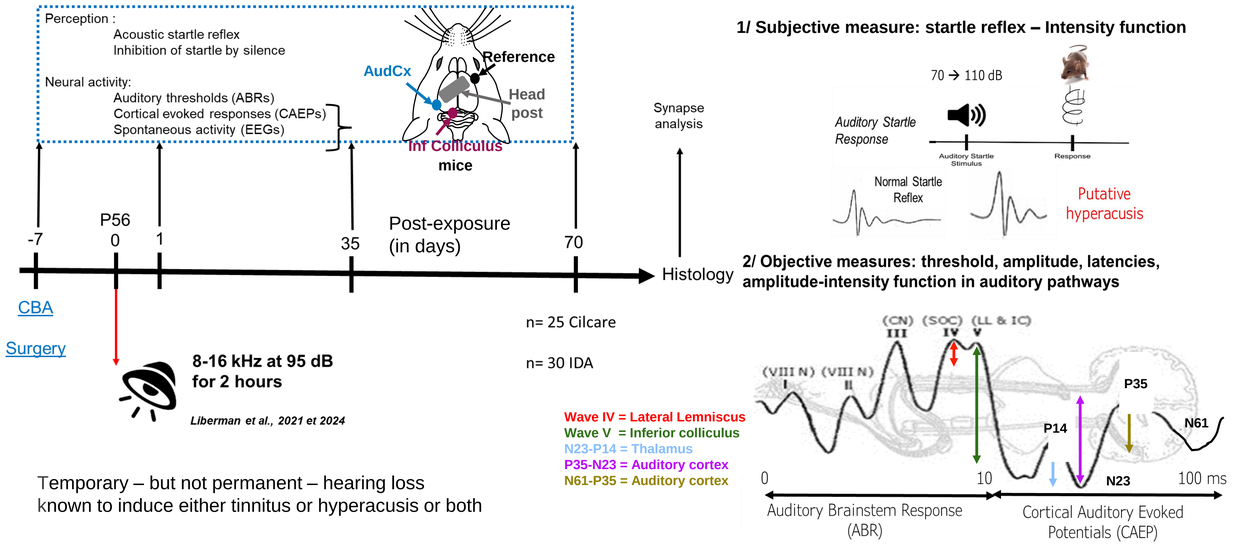
Abstract

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**.

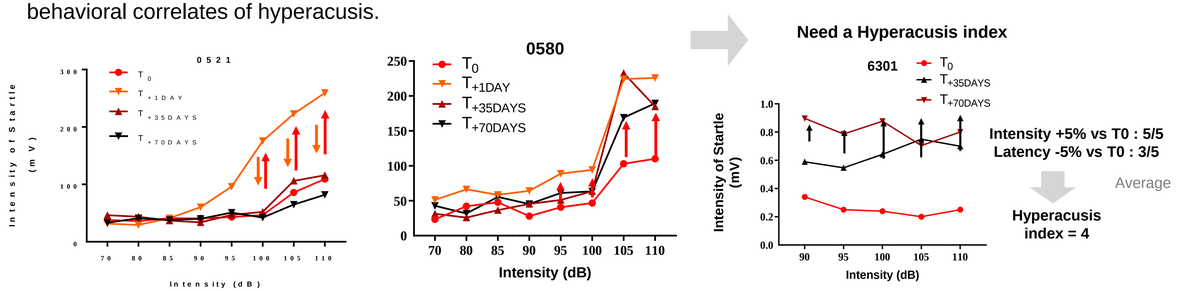
Materials & Methods



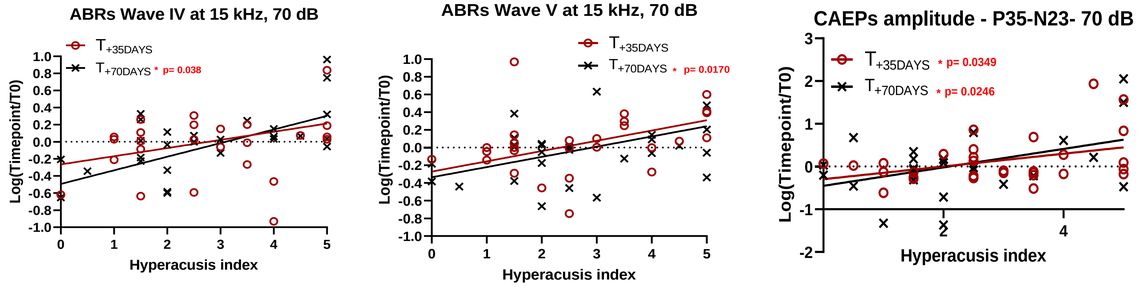
Temporary – but not permanent – hearing loss known to induce either tinnitus or hyperacusis or both

Results

- The noise exposure caused an **increase of the startle reflex** amplitude in some animals, known to be possible behavioral correlates of hyperacusis.



- Positive correlations between the **Hyperacusis Index** and the amplitude of the **evoked response** to sounds in the **inferior colliculus** and the **auditory cortex**.
- The correlation appeared between **5 to 10 weeks** after the noise exposure.



Conclusion

- An **increase of the startle reflex amplitude** after an acoustic trauma seems to correlate well with an **increased central auditory evoked response**, even in the absence of peripheral changes.
- Following a temporary hearing loss, a subset of animals could be identified as possibly suffering from **hyperacusis** based on their **simultaneous increase** of their behavioral and neural response to sounds.
- These results open the door to a better characterization of **pathophysiological mechanisms** which impact the central auditory system after a noise induced temporary hearing loss.

Bibliography

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