Intensity distribution segmentation in ultrafast Doppler and scanning laser confocal microscopy for evaluate vascular changes associated with aging and neurodegeneration

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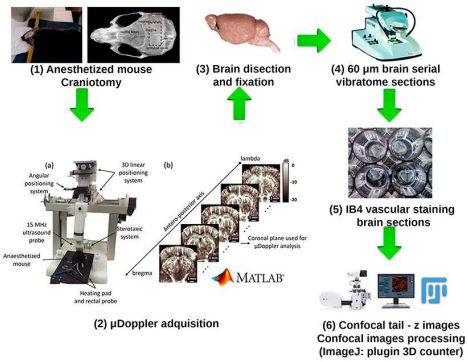
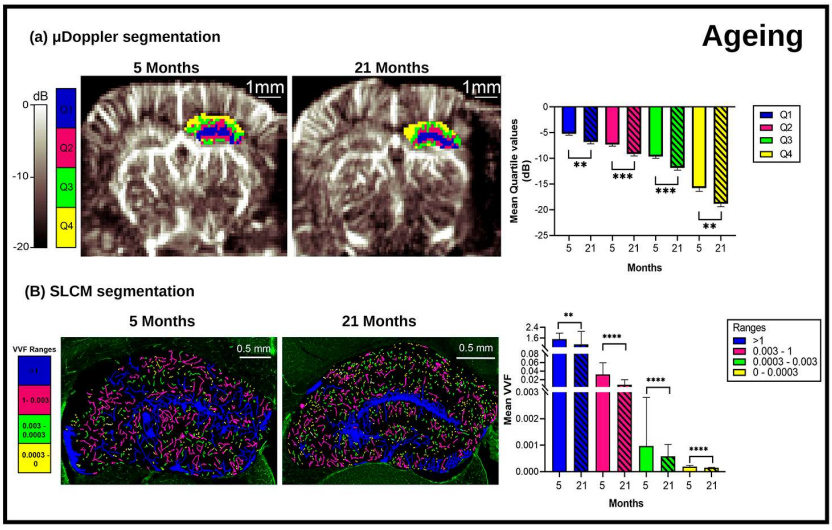
INTRODUCTION

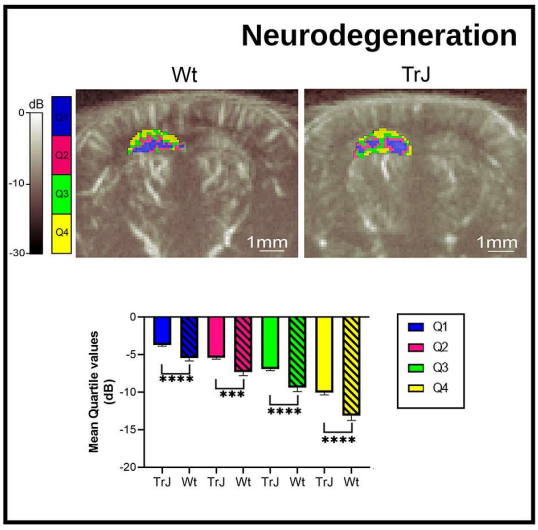
The hippocampus plays an important role in learning and memory[1,2]. Understanding the relationship between blood flow and vascular structure is relevant. Ultrafast Doppler (μDoppler)[3] and scanning laser confocal microscopy (SLCM)[4] are powerful imaging modalities that can measure in vivo cerebral blood volume (CBV) and post mortem vascular structure, respectively. We apply both imaging modalities of hippocampi vasculature in mice brains. We introduce a segmentation of CBV distribution obtained from μ Doppler and show that this mice-independent measurement is correlated with vessel volume fraction (VVF) distribution obtained from SLCM. We are able to associate CBV with vascular structure - and track its longitudinal changes - at the artery-vein, venules, arteriole, and capillary levels. Recently we apply this strategy to compare CBV in wild type and Trembler-J mice, as Charcot-Marie-Tooth neurodegenerative model[5]. We believe that this combined approach can be a powerful tool for studying other acute (e.g., brain injuries), progressive (e.g., neurodegeneration) or induced pathological changes.

MATERIALS AND METHODS



RESULTS





CONCLUSIONS AND PERSPECTIVES

- CBV in the hippocampus was quantified by segmenting each μDoppler image in quartiles of their intensity distribution.
- The vascular structure was characterized by SLCM, obtaining the VVF distribution.
- High μDoppler signals are related to specific vessel locations with large VVF.
- Significant changes were found in the mean quartile values and vasculature due to ageing.
- Our approach allowed us to associate μDoppler measurements with the vascular structure.
- Doppler segmentation analysis in Trembler-J mice indicates that they have higher cutoff values compared to wild-type mice.
- The combination of μDoppler and SLCM imaging, with the segmentation of their images, appear to be valuable tools in the study of conditions with vascular components such as neurodegenerative diseases.

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