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Northeastern University

New Insights into the Brain, Consciousness and More with QUTE-CE MRI Quantitative Vascular Mapping

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Opportunity

- Brain function requires a complex organization of vessels to allocate blood to meet regional demands.
- The distribution and utilization of these vessels are driven by brain evolution, health and function
- We created a quantitative MRI technique to non-invasively measure and characterize cerebral blood volume in 173 regions across the whole brain
- Spatial mapping of regional changes between functional states provides insights into the neural circuits responsible for sensation, memory and consciousness

Approach

Technique

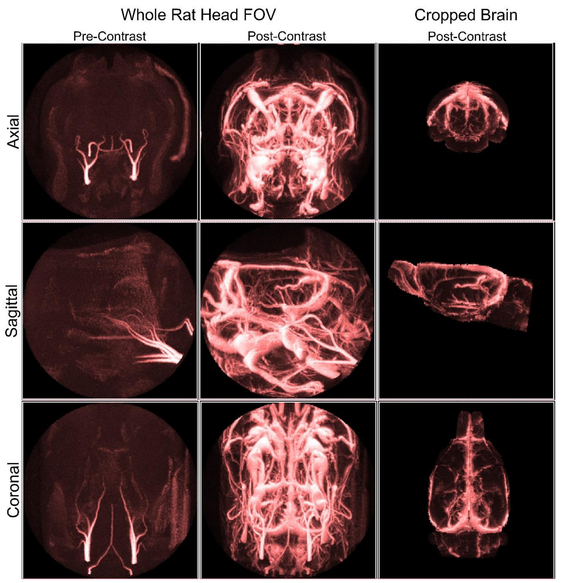
- *UTE MRI:* "ultra-short" measuring times using cutting edge advances for new ways of looking at the brain
- *FDA Approved Contrast Agent:* Allows for easier translation to humans

Study

- *Animals*: 11 Male SD Rats
- *Equipment*: 7 Tesla MRI machine here at NEU
- *Varied:* State of the animal's brain

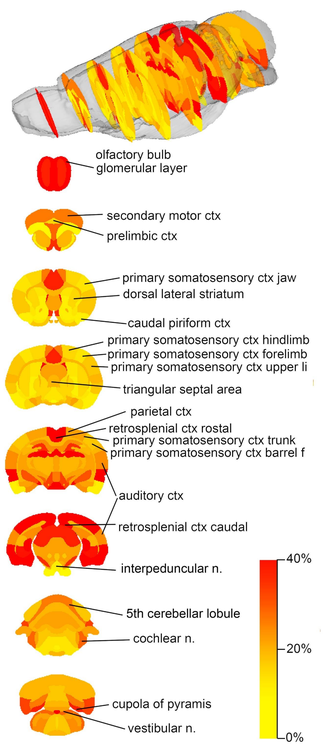
Analysis

- Software and analysis approach was built from the ground up
- Allows for robust processing and dealing with difficult technical issues
- Let's us identify changes in brain circuits with absolute measurement



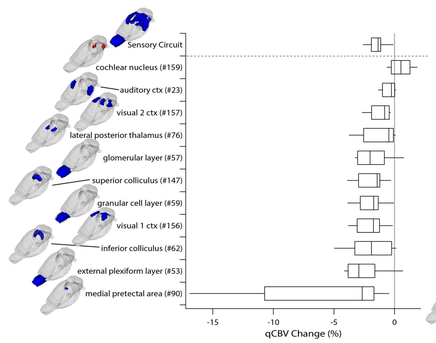
Results

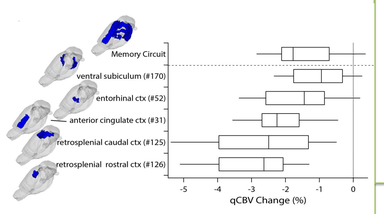
Vascular Brain Atlas

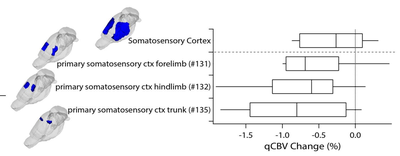


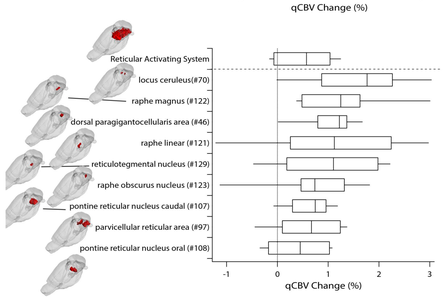
Sensory, memory provide a basis for consciousness

Changes Under Anesthesia



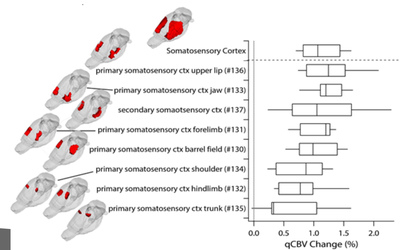


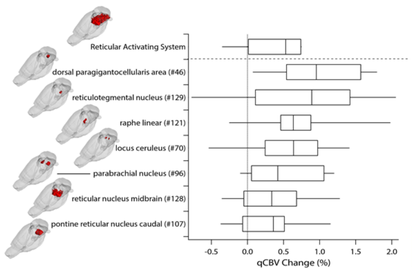




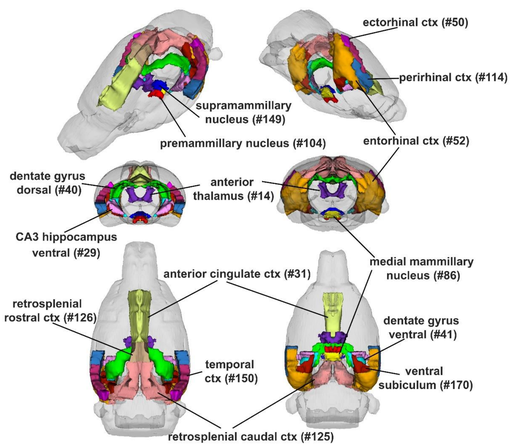
- Many regions with significant changes
- These were largely organized in certain circuits of high neuroscientific importance

Changes In Hypercapnia





Impact



The unique feature about my innovation/research is: quantitatively measuring the distribution of the blood in the brain.

This addresses the problem of: difficulty in measuring this clinically and in basic science.

Basic Neuroscience

- Provides a powerful new tool for investigating the brain
- Combination with anatomical rat brain atlas already is providing new insights

Clinic

- Use of ferumoxytol allows for human translation
- Next steps for human imaging are underway
- Could provide new diagnostic tools for many illnesses

List of references and other materials can be found at https://docs.google.com/document/d/12kj2YpXqtOpQMm3W98mAXBaH9_JuHMXTBBA-aH0FhpM/edit?usp=sharing