Long-term balance training enhances sensorimotor GABA Levels in older adults: A 7 T longitudinal magnetic resonance spectroscopy study

Xinyu Liu¹,²,³, Selin Scherrer⁴, Sven Egger⁴, Songi Lim²,³, Benedikt Lauber⁴, Wolfgang Taube⁴, Lijing Xin²,³

1. Laboratory for functional and metabolic imaging (LIFMET), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland. 2. Center for Biomedical Imaging (CIBM), Switzerland. 3. Animal Imaging and Technology, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland. 4. Department of Neurosciences and Movement Science, University of Fribourg, Fribourg, Switzerland.

METHODS

- Sixteen healthy volunteers (66 – 79 years old, 8 males / 8 females) gave informed consent prior to the study and participated MR measurements at 7T (Siemens, Erlangen, Germany) for both sessions. MPRAGE sequence was used to acquire images for the voxel positioning. B0 field inhomogeneity was optimized using first- and second-order shims with FAST(EST)MAP. Localized 1H single-voxel spectra from the sensorimotor cortex are acquired by the semi-adiabatic sSPECIAL and MEGA-sSPECIAL sequences.

- After the first MRS session, participants underwent three months of progressive, multifaceted balance training. They trained around 3 times per week (a total of at least 30 trainings) for 45 minutes in supervised group sessions. After three months, they underwent the second MRS session with the same protocols as the first one.

- MR spectra were averaged after frequency drift and phase correction using FID-A and analyzed by LCModel for quantification. Metabolites with CRLB larger than 30% were considered as non-detected. The resulting metabolite concentrations were corrected for tissue composition and unsuppressed water signal was used for metabolite quantification. A paired t-test was used to test metabolite concentration difference between two MRS sessions.

RESULTS

- Figure 1 shows the voxel location in this study. Representative spectra obtained using the two sequences are shown in Figure 2.

- MEGA-sSPECIAL detected a significant increase in GABA concentration in the post-training session compared to pre-training (p < 0.01) (Figure 3 left).

- We found no significant metabolite concentration difference between pre- and post-training sessions using short TE method (Figure 3 right).

CONCLUSION

- Our findings of increased sensorimotor GABA levels as a result of long-term balance training suggest that decline in cortical GABA level in older adults could be mitigated in the training process.

- The finding sheds new light on the plasticity of GABAergic system in elderly population.

This work was supported by the Swiss National Science Foundation (grants n° 32003B_197687). We acknowledge access to the facilities and expertise of the CIBM Center for Biomedical Imaging, a Swiss research center of excellence funded and supported by Lausanne University Hospital (CHUV), University of Lausanne (UNIL), École Polytechnique Fédérale de Lausanne (EPFL), University of Geneva (UNIGE) and Geneva University Hospitals (HUG).