Extracranial brain draining veins in mouse: assessment by High Resolution Ultrasound and MR angiography of the neck

Marcello Mancini – Institute of Biostructures and Bioimaging, National Research Council, Naples, Italy
Giuseppe Palma – Institute of Biostructures and Bioimaging, National Research Council, Naples, Italy
Enrico Tedeschi – Department of Advanced Biomedical Sciences, University "Federico II", Naples, Italy
Adelaide Greco – CEINGE-Biotecnologie Avanzate, Naples, Italy
Monica Ragucci – IRCCS Fondazione SDN, Naples, Italy

Background
Animal models may help in understanding the pathogenesis of many neurological diseases. Recently, vascular abnormalities in Multiple Sclerosis have been suggested as a possible contributing factor, but no studies discussed the anatomy of the mouse head/neck vasculature with a focus on the venous side.
Objectives
To assess the feasibility of depicting venous extracranial vessels in mice by High-Resolution Ultrasound (HRUS) and non-contrast-enhanced Magnetic Resonance Angiography (MRA). To understand venous anatomy of the mouse compared to human, in order to set-up a model of venous occlusion and test if this may contribute to vascular-related neurological diseases.
Methods
5 Wild-type mice underwent, under general anaesthesia, transverse and longitudinal HRUS of the neck (Vevo2100 Visualsonics) with a 40 MHz electronic probe, using Color and Power-Doppler modes for blood flow quantification and vessels identification. On a 9.4T Bruker-Biospec scanner, equipped with a volume transmitter coil and four-channel rat brain receiver coil, an axial multi-slice 2D Time-Of-Flight MRA was acquired covering the whole neck and the lower part of the brain.
Results
Vascular anatomy and haemodynamics, including vascular diameters, lengths, branch points and flow velocities, were measured by HRUS. The integration with MRA permitted a more confident identification of the neck veins and their relationships with the nearby anatomic structures. A complex venous network with bilateral anastomoses connecting the major veins was observed: large external and anterior jugular veins drain the muscle and salivar gland tissue, while small internal jugular vein and vertebral venous plexus drain the cerebral veins.
Conclusion
HRUS and MRA can provide a complete visualization of the cerebral venous drainage system and its function in the murine neck, quantifying the proportion of blood leaving the brain through the internal jugular and vertebral veins. As the mouse neck venous anatomy is not similar to human, *in vivo* imaging of normal vessels is necessary before the evaluation of disease models.

Keywords: Magnetic Resonance, Ultrasound Angiography, mouse, neck anatomy