A Comparison of Techniques for Predicting Brain Blood Flow from the Neck
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Objective:
This study aims to compare cost-efficient Doppler Ultrasound (DU) techniques, to magnetic resonance imaging (MRI) in predicting blood flow from the neck to the head; this cohort serves as a healthy control group for future studies with concussed patients. In a healthy individual total cerebral blood flow volume (BFV) is equivalent to bilateral BFV of Internal Carotid Artery (ICA) and Vertebral Artery (VA) which is proportional to 42% of the Middle Cerebral Artery (MCA) BFV.

Question:
Is 42% of cumulative, bilateral BFV of ICA and VA measured by DU, proportional to BFV of MCA, measured by MRI?

Methods:
40 healthy, physically active, university aged (18 to 34 years) participants (20 males, 20 females) free of concussion for the past 2 years completed screening questionnaires (NPDI and SCAT5) prior to undergoing DU (Logiq e Ultrasound System, GE Healthcare) and MRI (Siemens, 3T Systems) evaluation. BFV of bilateral ICA and VA is measured by DU and bilateral MCA BFV is measured by MRI.

Results:
A linear correlation was found for both sexes when comparing BFV measured by MRI and DU (r=0.367, p=0.033). Further analysis via Bland Altman plots did not find a fixed bias, when comparing the BFV measured by MRI to those measured by DU, indicating the two techniques are closely related in their measurement outcomes. There were, however, proportional biases found when both sexes were evaluated together and for the male only group. These indicate that DU overestimates when compared to MRI at the upper limits of the techniques. No proportional bias was found for the female group (β = 0.186, p=0.541).

Discussion:
For mTBI/Concussion injuries, DU is a more readily available imaging resource and with its strong agreement to MRI, it demonstrates reliability in predicting cerebral BFV. Continued research using DU to evaluate cerebral BFV from the neck will allow healthcare providers an accessible means of monitoring cerebral BFV changes over the course of concussion recovery. This will in turn help identify specific areas of dysfunction after head injury, and the accompanying whiplash effect with mTBI/concussions which will assist in determining targeted treatment and diagnostic priorities.