BIOMATH SEMINAR

Friday, Nov 20

1-2 pm

Harris 4119

Translating near-infrared spectroscopy O_2 saturation data for the noninvasive prediction of spatial and temporary hemodynamics during exercise

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Abstract: Image-based studies conducted at rest have shown that atherosclerotic plaque in the thoracic aorta (TA) correlates with adverse wall shear stress (WSS), but there is a paucity of such data under elevated flow conditions. We developed a protocol to obtain phase contrast MRI (PC-MRI) measurements in the TA and its branches during three-tiered supine cycling, and relate these measurements with corresponding blood pressures to noninvasive tissue oxygen saturation (StO2) and oxygen extraction (CexO2) acquired during cardiopulmonary exercise testing. Subjects completed a cycling exercise protocol at rest and 130%, 150%, and 170% of resting heart rate (HR) during assessment with near-infrared spectroscopy (NIRS) and PC-MRI. Flow distributions (FD) from PC-MRI were related to regional StO2 so NIRS data can ultimately be used to set boundary conditions for computational fluid dynamics (CFD) modeling during exercise. Local quantification of WSS indices by CFD revealed progressively favorable time-averaged values with increasing exercise levels, but improvements in oscillatory shear index beyond rest were unchanged across exercise levels. Linear correlations were found between FD to the carotid branches and descending aorta vs local CexO2. A blueprint is subsequently provided for using this NIRS data in future CFD studies of the TA under simulated exercise conditions without having to conduct full-scale imaging studies during exercise.