AbstractID: 14319 Title: Development of a Dynamic Perfusion Phantom for Validation of Dynamic Contrast Enhanced (DCE) Imaging

Purpose: To practically apply image-based perfusion measurements as biomarkers in clinical trials, validation and credentialing are necessary. To support these efforts, this investigation seeks to develop technology for building MRI and CT compatible phantoms capable of realistically simulating blood flow and exchange in normal and diseased tissue.

Materials and methods: The proposed phantom design includes: a bifurcating vascular network embedded in a tissue-mimicking equivalent and a series of "tissue compartments" that exhibit differential perfusion. We previously established the ability to produce vasculature networks using a selective laser sintering rapid prototyping technique. In our current efforts, we are optimizing the design and fabrication of "tissue compartments" to facilitate fluid exchange at different levels of perfusion. These compartments are fabricated using a salt leaching technique, whereby salt crystals of 106-1000μm are placed into a cylindrical mold, then infused with a mixture of 13% polycaprolactone/chloroform (by weight) and dried. The fabricated compartments are soaked in water to dissolve the salt, leaving behind a porous spongey plastic cylindrical structure. The porous compartments are placed inside a flow chamber to determine their discharge volumetric flow rate.

Results: We have successfully produced "tissue compartments" with 80-94% void space, for which a given inflow volumetric rate of 1404 ml/min results in a discharge rate of 1012.8± 170.4 ml/min (30% flow retardation). Compartments (sample size = 6) fabricated from salt crystals of 106-180μm, 300-600μm and 710-1000μm diameters show the least variability in percent of void space.

Conclusions: It is possible to assemble a vascular phantom with tunable perfusion compartments that mimic capillary mass flow below the typical spatial resolution of CT imaging. Continued work will show that a decrease in void space with increased concentrations of PCL/chloroform will produce perfusion rates typical of healthy and diseased parenchyma.

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