CONSTRUCTING A MODEL OF THE BLOOD FLOW IN THE HUMAN LIVER USING CONTRAST-LOADED CORROSION CASTING AND MICRO-CT IMAGING

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Objectives: Hypothermic machine perfusion (HMP) of livers is being developed as a potentially better preservation method than cold storage. The challenge is to define the optimal perfusion settings for HMP. A computer model of the hepatic flow and microcirculation might be helpful to optimise such protocols. The aim of this study is to obtain detailed anatomical data on the liver vascular architecture.
Materials and Methods: Livers were injected with different concentrations of contrast (Barium) loaded Batson's™#17 corrosion kit via the hepatic artery (HA) and portal vein (PV). Casts were subsequently scanned with high resolution micro-CT imaging to obtain digital 3D datasets of the blood vessels. Mimics (Materialise, Leuven, BE) was used for image processing and quantitative analysis using the Medcad centerline module.
Results: Two human livers discarded for transplantation were casted following HMP. The casts were scanned in globo with a resolution near 110 µm, followed by scans of dissected cubes (approx. 1x1x1 cm³) at 10 µm resolution. HA and PV as well as the hepatic vein (HV) were clearly distinguishable in the digital images. Mean radii ± standard deviation (in mm) of the 2nd to 5th generation branches for the HA, were 2.91±0.63/1.78±0.53/1.13±0.37/0.83±0.20. For the PV and HV, 1st to 5th generation radii were 7.34/6.30±1.36/4.00±1.52/ 2.09±0.52/1.49±0.31 and 13.18/5.02±1.20/2.43±0.58/1.70±0.45/1.13±0.19 mm, respectively.
Conclusions: The combination of casting and micro-CT imaging provides unique data on the human hepatic circulation. It allows to digitally visualize the complex architecture of the liver blood vessels and to provide high resolution data for quantitative morphological analysis as well as for 3D computational models of blood flow.