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Quantification of hepatic flow distribution using particle tracking for patient specific virtual Fontan surgery WEIGUANG YANG, UCSD, IRENE VIGNON-CLEMENTEL, INRIA France, GUILLAUME TROIANOWSKI, Stanford University, SHAWN SHADDEN, Illinois Institute of Technology, V. MOHHAN REDDY, JEFFREY FEINSTEIN, Stanford University, ALISON MARSDEN, UCSD — The Fontan surgery is the third and final stage in a palliative series to treat children with single ventricle heart defects. In the extracardiac Fontan procedure, the inferior vena cava (IVC) is connected to the pulmonary arteries via a tube-shaped Gore-tex graft. Clinical observations have shown that the absence of a hepatic factor, carried in the IVC flow, can cause pulmonary arteriovenous malformations. Although it is clear that hepatic flow distribution is an important determinant of Fontan performance, few studies have quantified its relation to Fontan design. In this study, we virtually implanted three types of grafts (T-junction, offset and Y-graft) into 5 patient specific models of the Glenn (stage 2) anatomy. We then performed 3D time-dependent simulations and systematically compared the IVC flow distribution, energy loss, and pressure levels in different surgical designs. A robustness test is performed to evaluate the sensitivity of hepatic distribution to pulmonary flow split. Results show that the Y-graft design effectively improves the IVC flow distribution, compared to traditional designs and that surgical designs could be customized on a patient-by-patient basis.

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