Abstract Submitted
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Experimental assessment of the impact of cardiac output and valve orientation on bioprosthetic pulmonary valve performance using magnetic resonance velocimetry[1] NICOLE SCHIAVONE, CHRISTOPHER ELKINS, DOFF MCELHINNEY, JOHN K. EATON, ALISON MARSDEN, Stanford University — Tetralogy of Fallot (ToF), a congenital heart defect that affects 1 in every 2500 newborns annually, requires surgical repair of the right ventricular outflow tract (RVOT) and subsequent placement of an artificial pulmonary valve. The longevity of bioprosthetic valves is highly variable and there are no standard clinical guidelines regarding their placement or size selection during surgery. This work analyzes the hemodynamics in an RVOT model representative of ToF anatomy using magnetic resonance velocimetry at cardiac outputs of 2 L/min, 3.5 L/min, and 5 L/min and two different valve orientations. We also acquired images of the valve at 1500Hz to observe instantaneous leaflet motion. The velocity fields revealed key differences among all cases in the location of reverse flow regions, systolic jet shape, and flow asymmetry. High-speed camera images showed that effective valve orifice area, leaflet closing dynamics, and the flutter frequency of the leaflet tips also varied with cardiac output and valve orientation. In particular, the 2 L/min case produced more asymmetry, stronger recirculation regions, and a smaller orifice area than the other cases, which could contribute to uneven leaflet fatigue and allow for calcification that may lead to early valve dysfunction.

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