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Calculation of pressure drop in the developmental stages of the medaka fish heart and microvasculature SREYASHI CHAKRABORTY, Purdue University, PAVLOS VLACHOS, Purdue University, Professor of Mechanical Engineering — Peristaltic contraction of the developing medaka fish heart produces temporally and spatially varying pressure drop across the atrioventricular (AV) canal. Blood flowing through the tail vessels experience a slug flow across the developmental stages. We have performed a series of live imaging experiments over 14 days post fertilization (dpf) of the medaka fish egg and cross-correlated the red blood cell (RBC) pattern intensities to obtain the two-dimensional velocity fields. Subsequently we have calculated the pressure field by integrating the pressure gradient in the momentum equation. Our calculations show that the pressure drop across the AV canal increases from 0.8mm Hg during 3dpf to 2.8 mm Hg during 14dpf. We have calculated the time-varying wall shear stress for the blood vessels by assuming a spatially constant velocity magnitude in each vessel. The calculated wall shear stress matches the wall shear stress sensed by human endothelial cells (10-12 dyne/sq. cm). The pressure drop per unit length of the vessel is obtained by doing a control volume analysis of flow in the caudal arteries and veins. The current results can be extended to investigate the effect of the fluid dynamic parameters on the vascular and cardiac morphogenesis.

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