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Investigating the Flow and Biomechanics of the Embryonic Zebrafish Heart BRENNAN JOHNSON, DEBORAH GARRITY, LAKSHMI DASI, Colorado State University, CARDIOVASCULAR AND BIOFLUIDS LAB, CSU TEAM — Understanding flow and kinematic characteristics of the embryonic heart is a prerequisite to devise early intervention or detection methods in the context of congenital heart defects. In this study, the kinematics and fluid dynamics of the embryonic zebrafish heart were analyzed through the early stages of cardiac development (24-48 hours post-fertilization) in vivo using optical microscopy and high-speed video. Endocardial walls and individual blood cells were segmented from raw images and were tracked through the cardiac cycle. Particle tracking velocimetry analysis yielded quantitative blood cell velocity field, chamber volume, and flow rate information. It was seen that the pumping mechanism starts as a combined peristaltic and suction pump while the heart is in the tube configuration and transforms into a positive displacement pump after cardiac looping. Strong two-phase nature of the fluid is evident. This work provides us new understanding of the spatio-temporal characteristics of kinematics and blood cell velocity field inside the developing heart.

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