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Insights from Embryos and Engineered Tissues On Cardiac Development and Repair

Abstract: Congenital heart defects (CHD) represent a spectrum of errors in cardiovascular developmental cascades that include (1) abnormal cardiac lineage induction, migration, and expansion; (2) abnormal morphogenesis of functioning cardiac chambers and great vessels; and (3) adaptation to altered biomechanical and maternal/environmental factors. My research began and continues to investigate the biomechanical regulation of cardiac morphogenesis in the chick embryo and has expanded to explore the capacity of immature cardiac cells isolated from embryos or generated from multiple stem cell sources to form functional engineered cardiac tissues for repair. Cardiac and vascular morphogenesis occurs within a microenvironment of molecular, metabolic, and biomechanical cues that can identify the origins of CHD and adaptation that occurs prior to birth. These same biologic features may be essential to form engineered tissues with the structural and functional properties required to survive in hostile in vivo microenvironments and facilitate cardiac repair. Ultimately, insights from embryos and immature cardiac tissues require scale-up to large animal preclinical models for successful translation to therapies.