

Computational Analysis of Cardiac-Derived Progenitor Cells and Their Extracellular Vesicles in Congenital Heart Defect Patients

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Abstract

Congenital heart disease affects 9 out of every 1000 live births. Improvements in surgery have greatly aided survival of these patients, though now has created need for therapies that improve cardiac function. Many of these repairs result in abnormal physiology, putting extra strain on the heart and lead to failure. Hypoplastic left heart syndrome for example, places a large burden on the right ventricle (RV) and many of these patients will develop RV failure. In cases where RV function falls below 35%, the 18-month transplant-free survival falls to 30% or less. In addition to transplant, the reduced RV function can lead to cognitive and physical impairments due to end-organ damage. We have recently developed computational models based on pediatric progenitor cells and extracellular vesicles (EVs) that can accurately predict a variety of cellular functions related to cardiac repair. When applied to new data sets, the models can predict with >80% accuracy cellular proliferation, angiogenesis, and suppression of fibrosis and inflammation. We have now applied these to patients from our 2 ongoing clinical trials in patients with hypoplastic left heart syndrome. Using clinical data and patient multi-omic sequencing data, we can make predictions regarding the efficacy of cell therapy, as well as identify potential mechanisms of EV- and cell-mediated cardiac repair and regeneration.

Bio



My research focuses on molecular pathways of cardiac dysfunction following myocardial infarction, as well as novel bioengineered therapeutic strategies to prevent heart failure. Current projects range from research on transgenic mouse models, the effects of oxidative stress on progenitor cell function, biomaterials for cardiac repair and cellular delivery, to the computational modeling of cell and exosome function following delivery.

Academic appointments Professor of Biomedical Engineering, 2019 – Present

Secondary appointments:

1. Professor of Medicine, 2013 – Present
2. Professor of Pediatrics, 2013 – Present

Other administrative appointments:

1. Associate Chare of Graduate Studies, 2016 – Present
2. Director, Children's Heart Research and Outcomes Center

Education:

1994 – 1998, B.A. in Biology, Rutgers, The State University of New Jersey

1998 – 2003, Ph.D. in Molecular and Systems Pharmacology, Emory University

2003 – 2006, Postdoc, Brigham and Women's Hospital of Dr. Richard Lee

Editorships and Editorial Boards:

2015 – 2021 Scientific Reports Editorial Board

2016 – 2021 Circulation Research Editorial Board

2021 – Present Extracellular Vesicle Editorial Board