Using Models to Advance Medicine: Mathematical Modeling of Stem Cell Therapy for Left Ventricular Remodeling After Myocardial Infarction

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The human heart is an essential organ with a limited ability to regenerate and repair. After a myocardial infarction (MI), permanent cell death and a decreased ability of the heart to heal are the major causes of morbidity and mortality globally. This research presents a new mathematical model to investigate stem cell therapy options for left ventricular remodeling following myocardial infarction [1, 2]. The model not only effectively depicts and predicts the interactions between cardiac cells and the immune system, but it also accurately models the post-MI regeneration of cardiomyocytes using stem cell therapy with oxygen restoration. The resulting system of nonlinear ordinary differential equations (ODE) is numerically studied to demonstrate the new model's functionality and performance. The optimal time of stem cell injection for various oxygen restorations is determined. The proposed nonlinear ODE model can capture the complex biological interactions involved in post-MI remodeling and can serve as a platform for *in silico* simulations to optimize post-MI stem cell therapy. It has the potential to provide researchers with a predictive computational tool to better understand the MI pathology and develop various cell-based therapy options.

Keywords: Myocardial infarction; Heart regeneration; Cardiomyocytes; Immune system; Stem cells therapy

MSC2020: 92C30; 92C50

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