**WHOLE HEART REGENERATION WITH HUMAN IPS CELL-DERIVED HEART PROGENITORS**

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*Objective*: In US, about 50,000 people die each year due to the limited donor hearts for transplant. Thus the future treatment of heart disease requires the development of personalized therapeutic strategies, such as patient-specific cardiac tissues or whole bio-artificial hearts for transplantation.

*Methods*: 12 to 16-week-old C57BL6/J mice were euthanized and the ascending aorta was cannulated with a blunted 20-gauge needle to allow retrograde coronary perfusion, followed with a decellularization process with enzyme and detergent treatments. In the meanwhile, human induced pluripotent stem (iPS) cells were induced for cardiovascular differentiation using our established protocol. Approximately 10 millions human iPS cell-derived multipotential cardiovascular progenitors (MCPs) were delivered into one acellular mouse heart through the connected cannula. After 20 days culture, the engineered heart constructs showed contractions, followed with histological, electrophysiological and drug response analyses.

*Results and Conclusion*: In this study, we engineered human heart tissues by repopulating whole decellularized mouse hearts with human iPS cell-derived MCPs. MCPs represent the earliest heart progenitors during human cardiogenesis. The seeded MCPs differentiated in situ into CMs, smooth muscle cells (SMCs) and endothelial cells (ECs) with high efficiency, which reconstructed the decellularized mouse hearts. The recellularized mouse hearts exhibited myocardium and vessel-like structures, contracted spontaneously with a rate of 40 to 50 beats/min, exhibited intracellular Ca2+ transients (CaiT) and responded as expected to various drug interventions. Overall we utilized a novel patient-specific cell resource, which is the iPS cell-derived MCPs, for engineering patient-specific heart constructs that could be beneficial to future heart disease therapy.