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PCL-PDMS-PCL copolymer-based microspheres mediate cardiovascular differentiation from embryonic stem cells

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PCL-PDMS-PCL COPOLYMER-BASED MICROSPHERES MEDIATE CARDIOVASCULAR DIFFERENTIATION FROM EMBRYONIC STEM CELLS

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Poly-ϵ-caprolactone (PCL) based copolymers have received much attention as drug or growth factor delivery carriers and tissue engineering scaffolds due to their biocompatibility, biodegradability, and tunable biophysical properties. Copolymers of PCL and polydimethylsiloxane (PDMS) also have shape memory behaviors and can be made into thermoresponsive shape memory polymers for various biomedical applications such as smart sutures and vascular stents. However, the influence of biophysical properties of PCL-PDMS-PCL copolymers on stem cell lineage commitment has not been well understood. In this study, PDMS was used as soft segments of varying length to tailor the biophysical properties of PCL (hard segments)-based co-polymers. While low elastic modulus (<10 kPa) of the tri-block copolymer PCL-PDMS-PCL affected cardiovascular differentiation of embryonic stem cells, the range of 60-100 MPa PCL-PDMS-PCL showed little influence on the differentiation. Then different size (30-140 μm) of microspheres were fabricated from PCL-PDMS-PCL copolymers and incorporated within embryoid bodies (EBs). Mesoderm differentiation was induced using bone morphogenetic protein (BMP)-4 for cardiovascular differentiation. Differential expressions of mesoderm progenitor marker KDR and vascular markers CD31 and VE-cadherin were observed for the cells differentiated from EBs incorporated with microspheres of different size, while little difference was observed for cardiac marker α-actinin expression. Small size of microspheres (30 μm) resulted in higher expression of KDR while medium size of microspheres (94 μm) resulted in higher CD31 and VE-cadherin expression. This study indicates that the biophysical properties of PCL-based copolymers impact stem cell lineage commitment, which should be considered for drug delivery and tissue engineering applications.

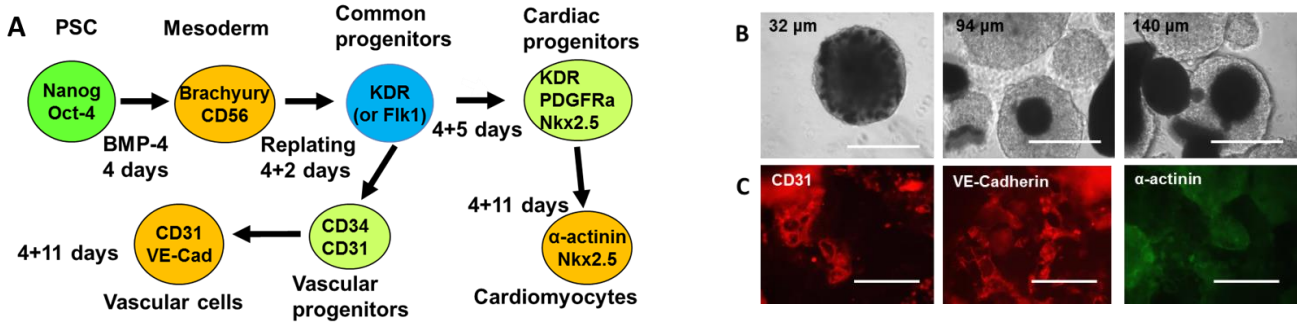

Figure 1 – A: Schematic illustration of cardiovascular differentiation of embryonic stem cells.
B: Embryoid bodies (EBs) incorporating PCL-PDMS-PCL microspheres of different size. Scale bar: 200 μm.
C. The expression of cardiovascular markers in the cells differentiated from EBs incorporated with microspheres. scale bar: 100 μm.