Engineered progenitor cell-derived nanovesicles for cardiac therapy

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Recent research highlights the pivotal role of small extracellular vesicles (sEVs), specifically exosomes, in facilitating cellular communication. These nanovesicles are essential for the efficacy of stem and progenitor cell therapies, particularly in the context of cardiac recovery after injury. sEVs serve not only as potential biomarkers reflecting the cellular environment but also as vehicles for biomolecules including miRNAs, which are key regulators of cellular functions including inflammation, cell proliferation, and mobilization. Our study delves into the heterogeneity of miRNA content within sEVs, recognizing that not all encapsulated miRNAs are beneficial. Employing computational methods, we have examined the relationship between cellular and sEV RNAs, noting their variance with donor age. This correlation has implications for vital cellular processes such as angiogenesis, fibrosis, inflammation, and mesenchymal cell migration. Focusing on cardiac health, we identified specific miRNAs linked to cardiac disease progression and repair. Leveraging these findings, we engineered sEVs from cardiac progenitor cells, selectively modifying their miRNA content to either eliminate detrimental miRNAs or enhance them with beneficial ones identified through computational analysis. These modified sEVs were tested in a rat ischemia-reperfusion injury model, demonstrating their potential as a novel therapeutic strategy for cardiovascular diseases. This research not only contributes to the understanding of sEVs and miRNAs in cardiac therapy but also opens new avenues for targeted treatment approaches in cardiovascular medicine.