Cardioprotective potential of subcutaneous and visceral adipose-derived stem cells

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Background: Adipose-derived stem cells (ASC) from both subcutaneous and visceral adipose tissues have been studied individually and separately. No studies have been performed to directly compare their biological properties and therapeutic function in treatment of congestive heart failure (CHF). This study was therefore designed to comparatively analyze their biological properties and cardiac therapeutic function.

Methods: Rat subcutaneous and visceral adipose tissues were excised for isolation of ASC. Morphology, yield, proliferation, surface markers, differentiation potential, and cytokine secretion of the subcutaneous ASC (S-ASC) and visceral ASC (V-ASC) were analyzed. To assess their therapeutic capacity, a rat model of myocardial infarction (MI) was established by occlusion of the LAD. Seven days after the LAD occlusion, S-ASC (n = 11), V-ASC (n = 11), and cell culture medium (n = 7) were injected into the infarct rim, respectively. Cardiac function of the infarcted hearts was then monitored with MRI for six months.

Results: Both S-ASC and V-ASC exhibited a fibroblast-like morphology and expressed stromal cell markers (CD29, 90 and 105). No significant expression of hematopoietic markers (CD11b, 34 and 45) was detected. Under appropriate conditions, both cells could differentiate to adipocyte- and osteocyte-like cells. Both of them expressed a significant level of HGF, IGF and VEGF. As to their differences, visceral fat tissue had a 3-times greater yield of ASC relative to subcutaneous fat. Moreover, V-ASC showed a lower colony-formation rate (9.8 ± 1.0%) compared to S-ASC (13.5 ± 2.6%). In contrast, S-ASC showed a significantly greater growth rate (Doubling time, 17.9 ± 0.9 hours in first two weeks) relative to V-ASC (Doubling time, 26.0 ± 2.6 hours in first two weeks). Both S-ASC and V-ASC-treated hearts showed a significantly greater left ventricular ejection fraction (LVEF, 58.3 ± 14.5% and 56.7 ± 3.1%) than the control hearts (LVEF, 47.2 ± 15.9%) at end of six months of recovery period. LVEF between the two ASC-treated groups was not significantly different. Finally, the implanted stem cells were readily detected in vivo with MRI for 6 months. Myocardial tissue sections showed existence of ASC and their locations matched with MRI signals.

Conclusions: S-ASC and V-ASC share several major biological characteristics. Both provide comparable significant improvement on cardiac function. We conclude that the subcutaneous and visceral adipose tissues are equally effective cell sources for cell therapy of congestive heart failure.