Advances in Human Tissue Engineering

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Regenerative medicine strategies often rely on cells to repair or replace damaged tissues. But the capacity of differentiated cells to regenerate functional tissues is adversely affected by aging. Indeed, a high proportion of tissue engineering applications that have been clinically successful – i.e. venous reconstruction, bladder replacement – have been applied in children, using cells derived from these youthful subjects. However, the vast majority of patients who need tissue replacements are elderly. Many investigators have developed tissue engineering technologies using cells that are derived from young animals, with the hopes of being able to extend these technologies to cells from elderly humans. Our initial work in arterial regeneration exploited cells derived from young animals, which we have shown could be used to "grow" new arteries that are functional in these same animals. However, our initial attempts to translate these strategies to cells derived from elderly humans have met with important stumbling blocks. Specifically, we have shown that limitations in cellular replicative lifespan are an important limitation for tissue engineering in the elderly, but that this roadblock can be partially overcome by gene therapies to increase telomere length However, increases in cell lifespan do not de facto reverse all of the consequences of cellular aging. If autologous cells are to be used to re-grow tissues, it is likely that, in many cases, a "younger" cell source will have to be identified. This has led our group to investigate the functional utility of adult stem cells for vascular reconstruction. While preliminary results are promising, we have yet to understand whether adult stem cells are immune to the adverse effects of human aging.