CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

S0522

Project Title

Regenerative Potential of Healthy vs. Diabetic Adipose-derived Stem Cells in the Setting of Biomimetic Hydrogel Scaffold

Abstract

Objectives/Goals

Patients with diabetes posses a significantly impaired wound healing potential, due in part to a failure of diabetic tissues to re-vascularize oxygen-deprived areas of injury. Adipose-derived stem cells (ASCs), an abundant and easily isolated source of adult mesenchymal stem cells, have been shown promote neovascularization when applied to non-healing wounds, and are thought to act mainly through the release of pro-angiogenic cytokines, such as VEGF. My goal was to investigate the effect of diabetes on ASCs behavior and pro-angiogenic potential in the setting of a 5% collagen-pullulan biomimetic hydrogel scaffold.

Methods/Materials

ASCs were harvested from 4-month old wild-type and diabetic mice for in vitro and in vivo analysis of their regenerative potential. Cell proliferation, survival and morphology were first assessed in vitro following seeding within the hydrogel scaffold. In vitro angiogenesis-related gene expression was quantified using RT-PCR and protein quantification. Moving in vivo, the effect of diabetes on ASCs seeded hydrogel support of wound healing and tissue regeneration was assessed through the use of incisional wound and ischemic flap models. Wound healing was analyzed by quantifying the number of blood vessels in healed tissue, and the level of angiogenic cytokines as measured by RNA and protein analyses.

Results

The in vitro analyses demonstrated that while there is no significant difference between wild-type and diabetic ASC proliferation and survival following hydrogel seeding, diabetes does impair the morphology of the ASCs in this setting. Moreover, diabetic ASCs displayed a significantly lower expression of angiogenic cytokines compared to wild-type cells. This functional impairment was consistent with our in vivo findings, which demonstrated that hydrogels seeded with ASCs from wild-type mice significantly increased the rate of wound healing and tissue survival compared to hydrogels seeded with ASCs from diabetic mice.

Conclusions/Discussion

This data shows that diabetes significantly impairs the regenerative potential of ASCs in the setting of a therapeutic bioscaffold. Future studies are planned repeating this experiment on murine diabetic wounds, with the results of this combined work providing valuable insights for the design of cell-based therapies for high-risk diabetic patients.

Summary Statement

Diabetes significantly impairs the regenerative potential of ASCs in the setting of a therapeutic bioscaffold.

Help Received

The experiments and research were conducted at Stanford University, Department of Surgery.