Tissue Flap Preconditioning with Adipose Derived Stem Cells and Hyperbaric Oxygen Treatment: A Guinea Pig Model

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INTRODUCTION: Complex wound, soft tissue reconstruction and transplantation are inherently complicated by ischemia and reperfusion. Efforts at minimizing these deleterious effects involve meticulous design and minimizing the ischemic period. Adjunctive measures have included free microvascular transfer, supercharging, caspase inhibitors and free oxygen radical scavengers.[1,2] In this study, we hoped to characterize the potential complementary effects of Hyperbaric Oxygen (HBO) Therapy and Stem Cell (ADSC) delivery in flap preconditioning.

MATERIALS AND METHODS: In this randomized controlled trial, the study group (n=6) received autologous ADSC injections subcutaneously, whereas the control group (n=6) received saline injections to the area of flap design.[3] Subsequently, half of the animal subjects were exposed to four consecutive HBO treatments. Following preconditioning, a pedicled flap was elevated and clinically assessed via study-blinded observer (Figure 1), alongside objective assessments of heat shock protein (HSP) 70 levels and quantification of TUNEL-positive cells.[4]

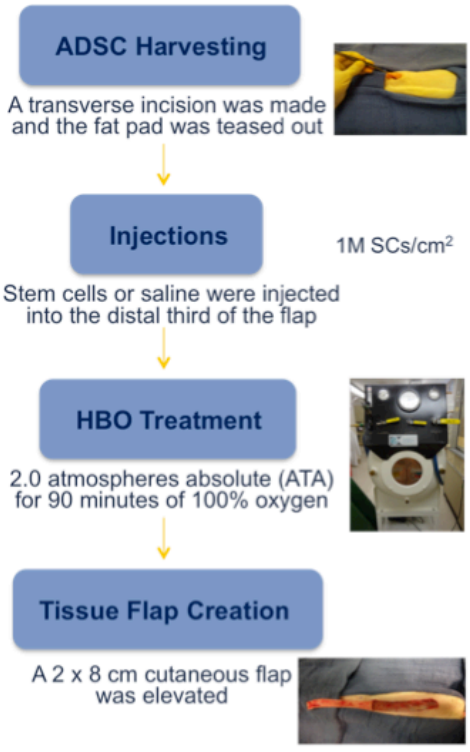

Figure 1. Research Design and Protocol

RESULTS: Serial clinical examinations monitored the consistency, color, vascularity and temperature of the skin flaps. The presence of venous congestion was significantly greater in the flaps that did not receive HBO therapy (26.7% vs. 0%, p=0.004). Distal flap necrosis was more often noted in the animal subjects who received ADSCs but were not exposed to HBO (46.7% vs. 6.7%, p=0.013) (Figure 2).

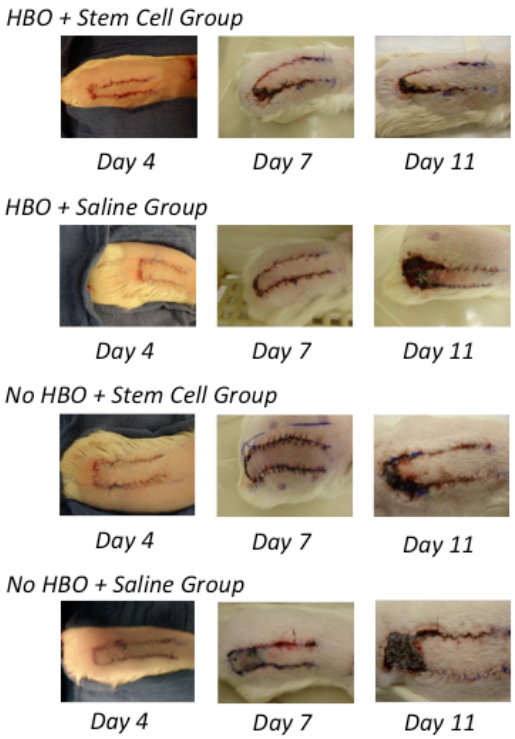

Figure 2. Clinical Appearance of Tissue Flaps

Preconditioning with HBO has been shown to provide cytoprotective effects, through the upregulation of HSP 70, and a statistically significant rise was detected in the HBO saline group (p=0.042). Similarly, the TUNEL apoptosis assay indicated that the percentage of apoptotic cells was greater in the HBO saline group (p=0.003).

CONCLUSIONS: Preliminary study findings support that HBO preconditioning of flaps improves tissue viability and survival rates.[5] The rise in HSP 70 levels in the HBO saline group suggests a potential response to a more stressful environment and possible cytoprotective effects of ADSC. Further investigation with a larger sample size is necessary to elucidate the optimal time for ADSC injection and the true effects of HBO treatment and ADSC combination on tissue flap survival.

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