

Low-Level Laser Therapy to the Bone Marrow Reduces Scarring and Improves Heart Function Post-Acute Myocardial Infarction in the Pig

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Abstract

Objective: Cell therapy for myocardial repair is one of the most intensely investigated strategies for treating acute myocardial infarction (MI). The aim of the present study was to determine whether low-level laser therapy (LLLT) application to stem cells in the bone marrow (BM) could affect the infarcted porcine heart and reduce scarring following MI.

Methods: MI was induced in farm pigs by percutaneous balloon inflation in the left coronary artery for 90 min. Laser was applied to the tibia and iliac bones 30 min, and 2 and 7 days post-induction of MI. Pigs were euthanized 90 days post-MI. The extent of scarring was analyzed by histology and MRI, and heart function was analyzed by echocardiography.

Results: The number of c-kit⁺ cells (stem cells) in the circulating blood of the laser-treated (LT) pigs was 2.62- and 2.4-fold higher than in the non-laser-treated (NLT) pigs 24 and 48 h post-MI, respectively. The infarct size [% of scar tissue out of the left ventricle (LV) volume as measured from histology] in the LT pigs was 3.2 – 0.82%, significantly lower, 68% ($p < 0.05$), than that (16.6 – 3.7%) in the NLT pigs. The mean density of small blood vessels in the infarcted area was significantly higher [6.5-fold ($p < 0.025$)], in the LT pigs than in the NLT ones. Echocardiography (ECHO) analysis for heart function revealed the left ventricular ejection fraction in the LT pigs to be significantly higher than in the NLT ones.

Conclusions: LLLT application to BM in the porcine model for MI caused a significant reduction in scarring, enhanced angiogenesis and functional improvement both in the acute and long term phase post-MI.