Prevention of Abdominal Aortic Aneurysm in Apolipoprotein E-Deficient Mice by Low Level Laser

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Background: We found that low level laser irradiation (LLLI), used widely for pain and acceleration of wound healing, modifies cellular processes essential to progression of abdominal aortic aneurysm (AAA). We showed that LLLI reduces gene expression of MCP-1, IL-1α, IL-1β, and IL-6 in activated macrophages, reduces MCP-1 and IL-1β from porcine aortic smooth muscle cells (SMC), and increases SMC proliferation and elaboration of collagen I+III. This study tests the effect of LLLI on AAA growth *in vivo.*

Methods: Apolipoprotein $E^{(-/-)}$ mice (n=21, 12-13wks) were infused with angiotensin-II by subcutaneous minipumps (1000ng/kg/min, 4wks). The abdominal aortas were exposed retroperitoneally. Ten aortas were irradiated with LLL (780nm, 2Joules/cm^2, 9min), and 11 were sham-operated. High-frequency ultrasound (40MHz, .01mm resolution) was used to quantify AAA growth from baseline to 4wks. The suprarenal aneurysm-prone (SR) and infrarenal (IR) segments were excised at 4wks and sectioned (5μ) for histopathology (250μ intervals) and immunohistochemistry.

Results: By histomorphometry, the maximum cross-sectional diameter of the SR segments normalized to IR segments was greater in the non-treated (SR/IR, mean±SD, control-vs-LLL: 1.99±0.64 vs 1.4±0.16, p=0.01). These measurements correlated strongly with those of the high-frequency ultrasound (r=.83, p<0.0001). Medial disruption occurred near the orifice of the celiac or superior mesenteric arteries with evidence of attempted repair by fibromuscular hyperplasia. The ratio between the length of medial disruption and the area of collagen (sirius red) at these sites was higher in the non-treated (9.3±4.7 vs 5.3±3.1, p=0.03). Fewer Mac-2+ macrophages were found in areas of attempted repair in LLLI treated mice (p=0.02 by Mann-Whitney).

Conclusion: Enhanced matrix reinforcement and modification of the inflammatory response at sites of arterial injury are prominent mechanisms by which LLLI prevents AAA progression in this model.