Low Level Laser Phototherapy Arrests Pre-Existing Aortic Aneurysm in Apolipoprotein E-Deficient Mice

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Background: Using high-frequency ultrasonography (HF-u/s), we showed that low level laser phototherapy (LLL) inhibits the formation of abdominal aortic aneurysms (AAA) in apolipoprotein-E-deficient (Apo-$E^{-/-}$) mice. This study tests the effect of LLL on the progression of pre-induced AAA.

Methods: AAA was induced in Apo-$E^{-/-}$ mice (age16-20 weeks [w]) by infusion of angiotensin-II using osmotic minipumps (1000ng/kg/min, 4w). HF-u/s (40MHz, 0.01mm resolution, Vevo-770, VisualSonics)(B- and M[motion]-modes) was used to measure the maximum cross-sectional diameter (MCD) of the suprarenal abdominal aorta and the anterior wall displacement (AWD). The aortas of mice that developed aneurysmal dilatation at 2w over baseline were then exposed retroperitoneally and treated with LLL (780nm, 2Joules/cm^2, 9min) or sham-operated. HF-u/s was repeated at 4w to determine the effect of LLL on the pre-induced aneurysms.

Results: The aortas that developed AAA >50% MCD at 2w continued to grow (on the average) as per HF-u/s measurements at 4w. However, LLL halted further dilatation (MCD, 2w vs 4w, non-treated [n=8]: 2.10±0.2 vs 2.33±0.28mm, p=0.04 by paired 2tt-test; LLL [n=10]: 2.24±0.32 vs 2.09±0.56mm, p=0.2). Direct comparison showed a 19% increase in control vs treated (ΔMCD[4w-2w]: 0.23±0.26 vs -0.15±0.33mm, $p<0.02$ by Mann-Whitney-u-test). Individually, of all mice with AAA ≥40% dilatation at 2w, 7(58%) of 12 non-treated, but none of 12 LLL, had an increase in MCD (>1SD) after 4w ($p<0.004$ by Fisher Exact). M-mode of the aortic wall at the site of MCD showed a marked decrease in AWD in control animals at 4w vs 2w reflecting a marked decrease in wall elasticity (ΔAWD= -0.03±0.04mm. $p<0.02$). This difference was not observed in LLL treated animals (0.0±0.04, $p>0.9$).

Conclusions: LLL prevents *de novo* development and, as shown here, arrests the progression of pre-existing aortic aneurysms and its associated deterioration in the biomechanical integrity of the aortic wall in Apo-$E^{-/-}$ mice.