Supporting Information

Nanoengineered Electroconductive Collagen-Based Cardiac Patch For Infarcted Myocardium Repair

by

Katsuhiro Hosoyama,[1] Manuel Ahumada,[1,2] Christopher D. McTiernan,[1,2] Darryl R. Davis,[3,4] Fabio Variola,[5] Marc Ruel,[1] Wenbin Liang,[4,6] Erik J. Suuronen,[1*] and Emilio I. Alarcon[1,2*]

*Ealarcon@ottawaheart.ca and Esuuronen@ottawaheart.ca

[1]Division of Cardiac Surgery, University of Ottawa Heart Institute, Ottawa, Canada, K1Y 4W7. [2]Bionanomaterials Chemistry and Engineering Laboratory & Department of Biochemistry, Microbiology, and Immunology, Faculty of Medicine, University of Ottawa, Ottawa, Canada, K1H 8M5. [3]University of Ottawa Heart Institute, Division of Cardiology, Department of Medicine, University of Ottawa, Ottawa, Canada, K1Y 4W7. [4]Department of Cellular and Molecular Medicine, University of Ottawa, Ottawa, Canada, K1H 8M5. [5]Department of Mechanical Engineering, University of Ottawa, Canada, K1N 6N5. [6]Cardiac Electrophysiology Lab, University of Ottawa Heart Institute, Canada, K1Y 4W7.
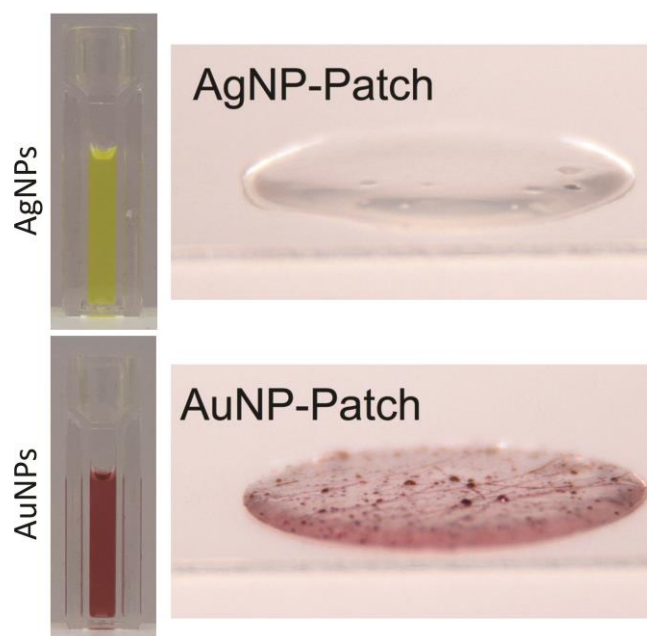
Figure S1. Left: Representative macro images of cardiac patches. AgNP- (top) and AuNP-containing (bottom) collagen fibers are aligned onto the elastic hydrogels. Right: Representative macro images of AgNP (top) and AuNP (bottom) solutions. Collagen-capped AgNPs and AuNPs are suspended into trifluoroethanol.
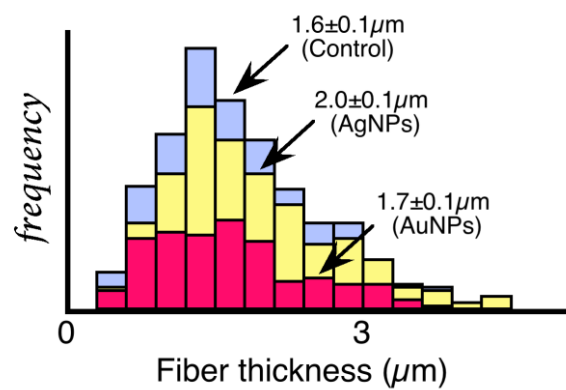
Figure S2. Histograms of collagenous fiber thickness with or without AgNPs and AuNPs. Values were calculated from SEM measurements (100 individual fibers).
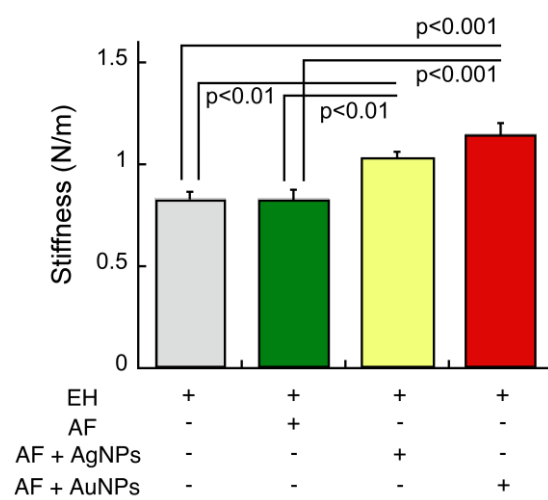
Figure S3. Stiffness of cardiac patches assessed by atomic force microscopy (AFM). Error bars correspond to standard errors. P-values were calculated from Tukey-Kramer test (n=10). EH, elastic hydrogel; AF, aligned fiber.
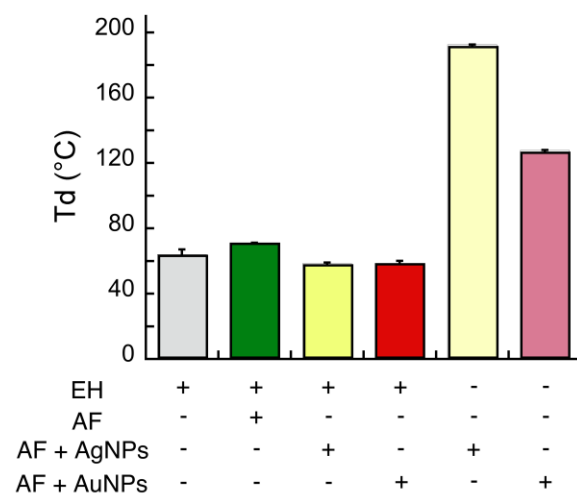
Figure S4. Denaturation temperatures for cardiac patches and collagen fibers measured using differential scanning calorimetry (DSC). Error bars correspond to standard errors (n=3). Td, denaturation temperature; EH, elastic hydrogel; AF, aligned fiber.
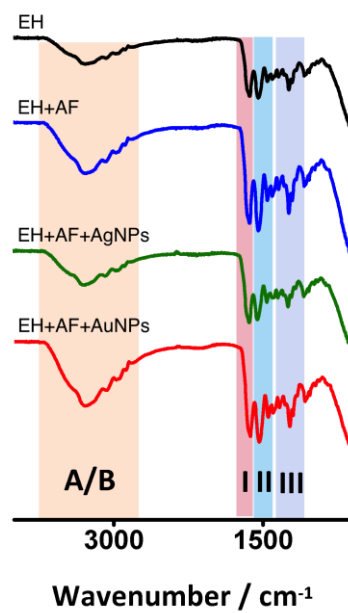
Figure S5. Result of Fourier transform infrared (FTIR-ATR) analysis of cardiac patches. Spectra correspond to representative examples for each time of cardiac patch. Highlighted in the plots are shown representative regions for characteristic IR vibrations of collagen.
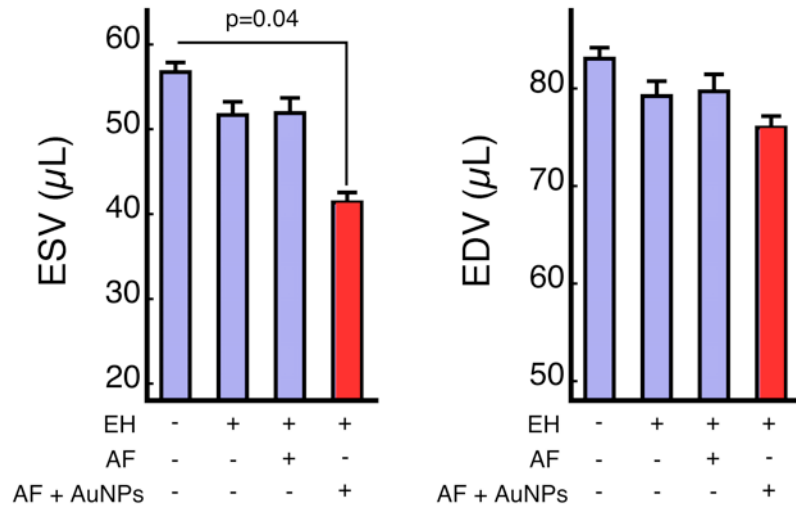
Figure S6. End-systolic left ventricular volume (ESV) and end-diastolic left ventricular volume (EDV) in 35 day post-MI animals implanted with the different experimental groups. The sample size was 14 in control, 9 in EH, 11 in EH+AF, and 14 in EH+AF-AuNPs. P-values were calculated from Tukey-Kramer test. EH, elastic hydrogel; AF, aligned fiber.
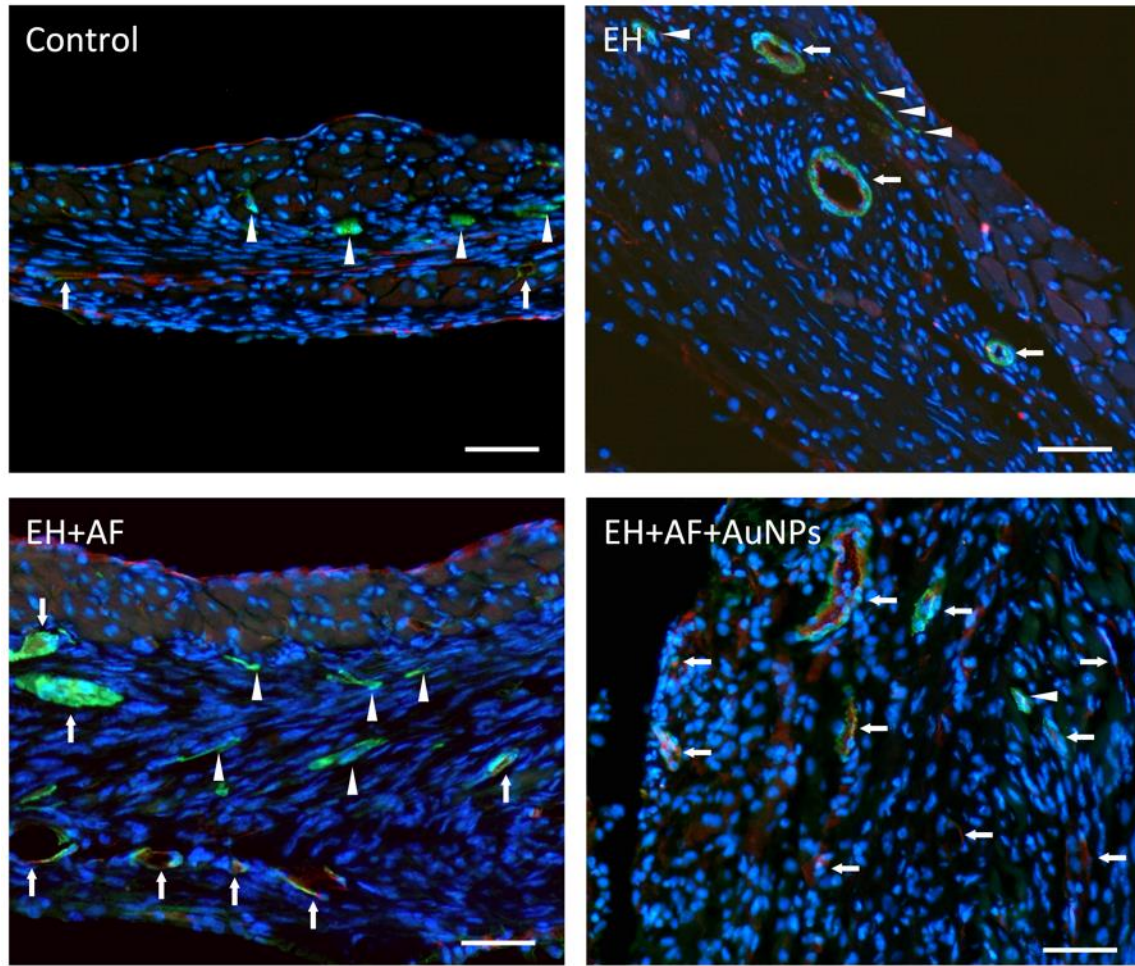
Figure S7. Representative images of CD31 (red) and aSMA (green) immunostaining of the murine heart at day 28 post-implantation. Arrows indicate vascular and arrowheads indicate aSMA$^+$ myoblasts. Scale bar = 50 μm. EH, elastic hydrogel; AF, aligned fiber.
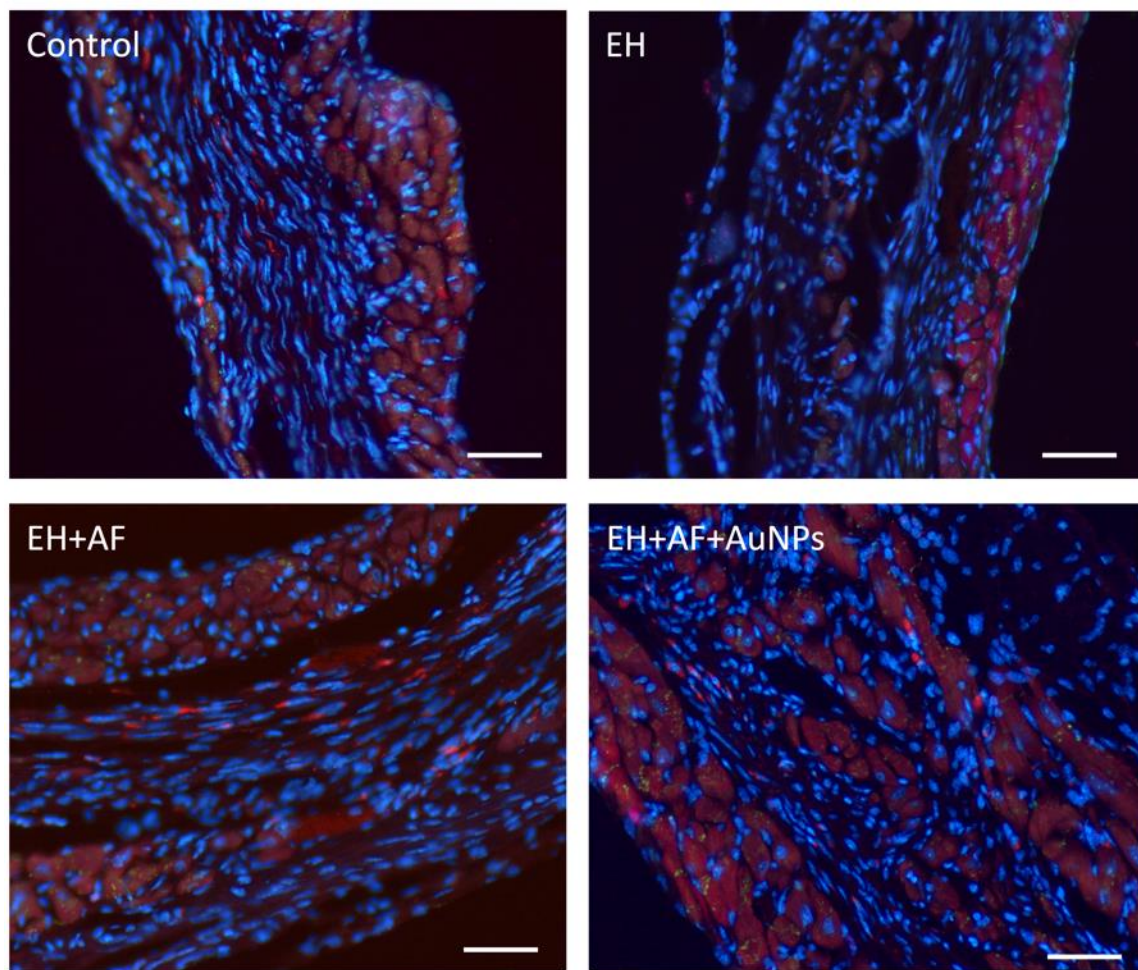
Figure S8. Representative images of troponin-I (red) and connexin-43 (green) immunostaining of the murine heart at day 28 post-implantation. Scale bar = 50 μm. EH, elastic hydrogel; AF, aligned fiber.
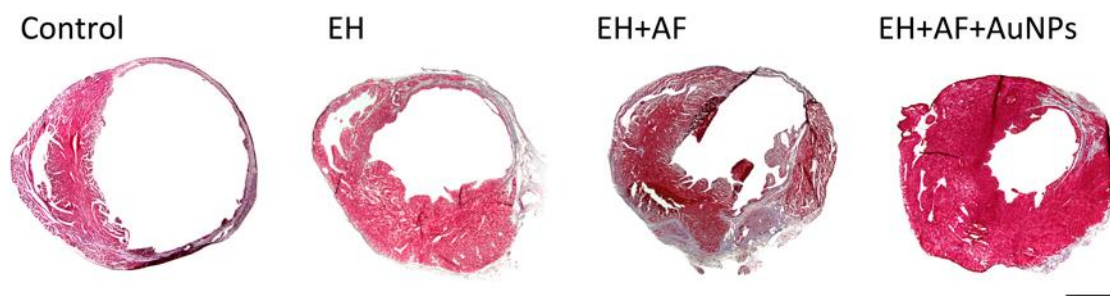
Figure S9. Representative images of Masson-Trichrome staining of the murine heart at day 28 post-implantation. Scale bar = 1 mm. EH, elastic hydrogel; AF, aligned fiber.
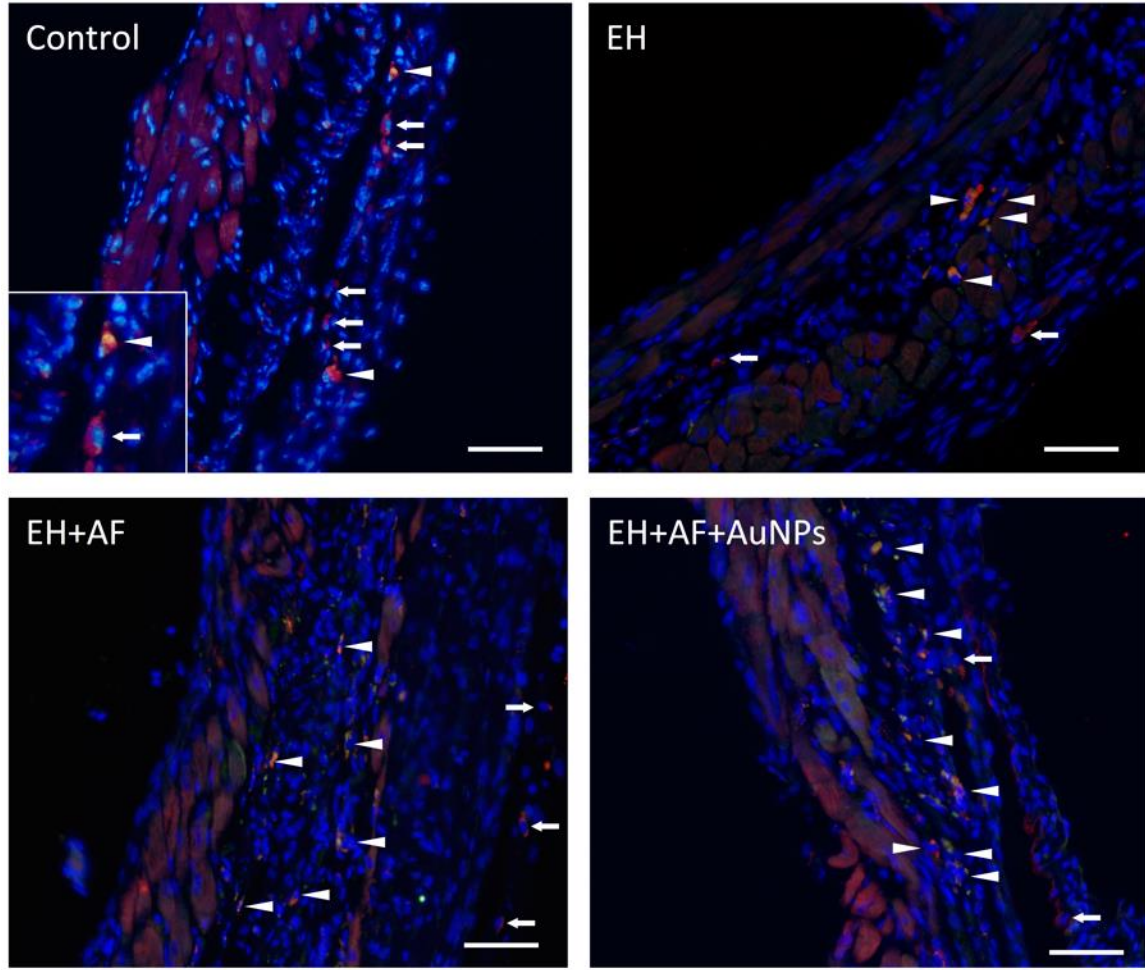
Figure S10. Representative images of CD68 (red) and CD206 (green) immunostaining of the murine heart at day 28 post-implantation. Arrows indicate CD68$^+$/CD206$^-$ cells and arrowheads indicate CD68$^+$/CD206$^+$ cells. Scale bar = 50 μm. EH, elastic hydrogel; AF, aligned fiber. Scale bar = 50 μm. EH, elastic hydrogel; AF, aligned fiber.
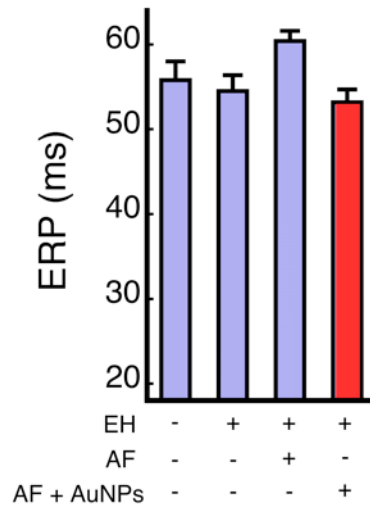
Figure S11. Effective refractory period (ERP) measured by electrophysiological study in 35 day post-MI animals implanted with the different experimental groups (n=5). P-values were calculated from Tukey-Kramer test. EH, elastic hydrogel; AF, aligned fiber.