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Novel polycaprolactone/multi wall carbon nanotubes nanocomposite scaffolds for cardiac tissue engineering

Mehdi Mehdikhani-Nahrkhalaji[1] and **ShararehGhaziof**[2]
[1]University of Isfahan, Iran
[2]Islamic Azad University, Iran

Myocardial infarction, commonly known as a heart attack, is caused by the blockage of blood flow to heart, resulting in the death of cardiomyocytes, or heart muscle cells. Scar tissue formation occurs in the area of the damage due to the heart's inability to regenerate myocardial tissue. Cardiac tissue engineering promises to revolutionize the treatment of patients with end-stage heart failure and provide new solutions to the serious problem of heart donor shortage. The purpose of this study was to evaluate the micro-structural, mechanical properties and degradation of polycaprolactone (PCL) / multi wall carbon nanotubes (MWCNTs) nanocomposite scaffolds for cardiac tissue engineering. Nanocomposite scaffolds composed of PCL and 1 wt% MWCNTs were prepared via solvent casting and vacuum drying (SC/VD) technique. Characterization techniques such as Fourier transform infrared microscopy (FT-IR), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and X-ray diffraction (XRD) were performed. Furthermore, mechanical properties of the PCL and nanocomposite scaffolds were determined. Also we compared the degradation rate of the samples after 30 and 60 days. Contact angle measurements were taken to determine the wettability of the prepared nanocomposite scaffolds. The results indicated that the scaffolds contain sufficient porosity with highly interconnected pore morphology. Multi wall carbon nanotubes were used as doping material to develop highly conductive nanocomposite scaffolds. Desired distribution of MWCNTs with a few agglomerates was observed in the nanocomposite scaffolds by SEM. PCL/MWCNTs nanocomposite scaffolds showed good mechanical behavior. In conclusion, the electrically conductive and nanofibrous networks formed by MWCNTs within a porous PCL scaffold could be used as an appropriate construct for myocardium regeneration.

sh_gh_256@yahoo.com

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