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Optimization of oxygen transport within a tissue engineered vascular graft model using embedded micro-channels inspired by vasa vasorum

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1 **Optimization of oxygen transport within a tissue engineered vascular graft**
2 **model using embedded micro-channels inspired by vasa vasorum**

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11 **Abstract**

12 Tissue Engineered Vascular Graft (TEVG) is a promising treatment for cardiovascular diseases because
13 of its potential for repair and long-term patency. However, the quality and preparation time to achieve a
14 mature TEVG has limited its use in clinical settings. Both of these factors can be improved by effectively
15 growing TEVGs with a uniform and high cell density, which is currently limited due to the diffusion limit
16 of oxygen and nutrients. In this paper we propose a novel optimized microchannel geometry in TEVG
17 wall model that facilitates uniform oxygen transport within a simulated TEVG with high cell density. In
18 order to model the oxygen mass transport incompressible Navier-Stokes, convection, and diffusion
19 equations were solved numerically. Furthermore, to model oxygen consumption in the graft domain,
20 Michaelis-Menten kinetics were coupled with the oxygen diffusion equation. Finally, an optimized model
21 was yielded such that nearly four times the cell density can be sustained by using the proposed
22 microchannels design compared to a simulated TEVGs with a solid wall. In addition, to minimize the
23 oxygen gradient along the graft, multiple segments are added to microchannels and their locations along

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