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Fucoidan/VEGF-Based Surface Modification of Decellularized Pulmonary Heart Valve Improves the Antithrombotic and Re-endothelialization Potential of Bioprostheses

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Supplementary materials: 1**; and supplementary figures**: **1-4.**

Abstract

Decellularized porcine heart valves offer promising potential as biocompatible prostheses. However, this procedure alter matrix fibres and glycans, leading to lower biomechanical resistance and increased their thrombotic potential. Therefore, their durability is limited due to calcification and weak regeneration *in vivo*. Surface modifications are highly requested to improve the scaffolds re-endothelialization required to restore functional and haemocompatible heart valve. Fucoidan, a natural sulphated polysaccharide, carries antithrombotic and anti-inflammatory properties and is known to enhance endothelial adhesion and proliferation when associated with vascular endothelial growth factor (VEGF). Based on these features, we constructed fucoidan/VEGF polyelectrolyte multilayer film (PEM) coated valve scaffold in an attempt to develop functional heart valve bioprosthesis. We investigated the haemocompatibility of the PEM coated valve scaffolds, the adhesion and growth potential of endothelial cells (HUVECs) in flow, as well as long term culture with stem cells. Fucoidan/VEGF PEM coated scaffolds demonstrated antithrombotic and non-calcifying properties. The PEM application increased HUVECs adhesion in flow (6 h) and HUVECs viability over time (72 h). HUVECs were well spread and aligned in flow direction. Interestingly, stem cells infiltration was improved by the PEM coating at 21 days. Thus, the fucoidan/VEGF PEM is a promising surface modification to obtain valve bioprostheses for clinical applications with increased antithrombotic and re-endothelialization potential.