

A visible antithrombogenic biosurface for synthetic vascular grafts

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INTRODUCTION: Synthetic vascular grafts are used with moderate success for the replacement of large diameter blood vessels. Small diameter (<6mm) synthetic vascular grafts are highly prone to thrombotic failure and are not suitable for clinical applications. In native blood vessels the luminal surface is lined by a monolayer of endothelial cells which secrete a variety of antithrombogenic and fibrinolytic factors. In this work we present a new strategy to obtain an antithrombogenic endothelial coating on the luminal surface of synthetic vascular grafts. The cellular coating can be additionally assessed non-invasively on a clinical MRI scanner thus providing a valuable pre- and postoperative diagnostic control[1].

METHODS: Human umbilical vein endothelial cells (HUVECs) were prelabeled with clinically approved superparamagnetic nanoparticles (Resovist®, Schering, Germany). Magnetically labelled cells were delivered with a customised solenoid onto the lumen of a tubular collagen coated graft. The solenoid provides a radial magnetic force which impels the cells towards the luminal surface of the scaffold, fostering a homogenous luminal cell distribution[2]. Upon completion of the seeding process, samples were examined in a clinical 1.5T magnetic resonance imaging (MRI) scanner to demonstrate the integrity of the cellular coating on the graft surface. Constructs were incubated with non-anticoagulated human whole blood for 8 minutes and characterised for blood clots via SEM. Markers of activated coagulation and complement system F1+2 and C3a were analysed by ELISA .

RESULTS: MRI inspection through a T2* sequence using a transversal gradient echo sequence reveals circumferential integrity of the endothelium as a bright layer covering the entire luminal surface of the scaffold. SEM inspection of unseeded samples shows platelet activation and fibrin formation over the entire surface. In contrast endothelialised scaffolds showed no evidence of thrombogenicity after contact with whole blood corroborated by lower levels of the activation markers F1+2 and C3a.

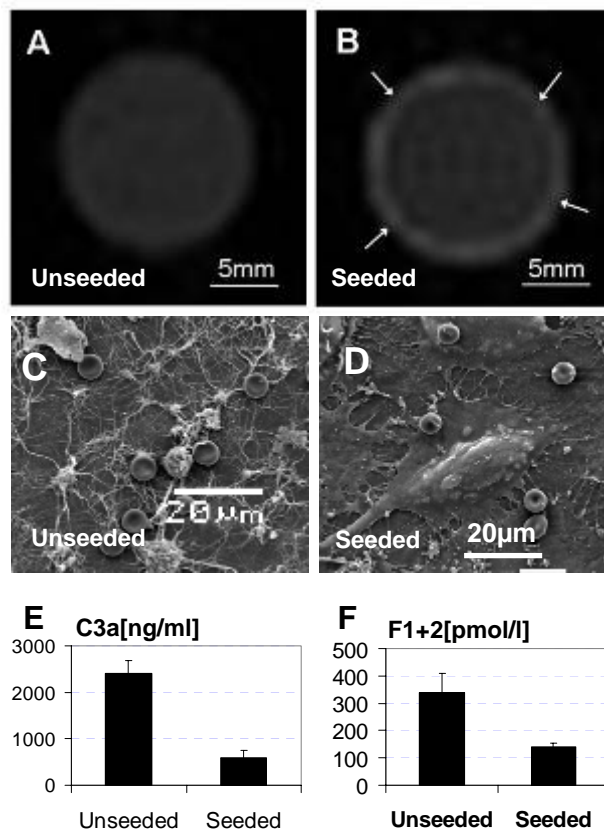


Fig. 1: MRI inspection of unseeded (A) and seeded (B) vascular grafts. The endothelium appears as a bright layer on the lumen of the graft (arrows). Unseeded grafts trigger platelet activation and fibrin formation (C). Endothelialised grafts inhibit coagulation (D). Endothelial cells inhibit the thrombogenic properties of synthetic grafts (E, F).

DISCUSSION & CONCLUSIONS: Magnetic endothelial cell seeding provides an intact antithrombogenic interface which can be assessed non-invasively in a clinical MRI scanner. This technology provides a visible antithrombogenic biosurface for synthetic vascular grafts.

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