

## Platelet adhesion on functionalized nonwoven fiber vascular grafts

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**Introduction:** After decades of use, vascular grafts made of woven polyethylene terephthalate (PET) fibers (Dacron™) or expanded polytetrafluoroethylene (ePTFE) have shown to perform well for larger vessels ( $\geq 6$  mm). However, for small-diameter ( $< 4$  mm) applications neither material has been suitable until now due to their low patency. Moreover autologous grafts (*e.g.*, saphenous veins) only present a 5-10 year patency of 50%<sup>1</sup>. An urgent need exists for small-diameter (2-6 mm) vascular grafts, demanding materials that are far less thrombogenic. In this study, the blood compatibility of novel nonwoven PET fiber structures for vascular scaffolds is investigated by means of platelet reactions. Our aim is to increase the blood compatibility of these high compliance, nonwoven PET fiber structures using polyethylene glycol (PEG) functionalization.

**Materials and Methods:** The surface treatment consisted of reacting the PET fiber surface with polyvinylamine (PVA) in the presence of a base. The amino-modified PET surfaces were functionalized with different concentrations of PEG ( $M_w=5000$ ). Human platelets isolated from blood donors were labelled with <sup>51</sup>Cr. The samples were incubated in 1 ml of a labelled platelet suspension ( $250 \times 10^6$  platelets/ml) for 1 h under agitation. They were then rinsed and platelet adhesion was quantified by radioactivity emissions from the samples using a gamma counter. Platelet adhesion on unmodified PET structures was compared with PVA and PVA-PEG functionalized structures as well as with commercial vascular grafts made of ePTFE (Bard's Impra Carboflo® ePTFE Vascular Grafts) and Dacron (Boston Scientific's Hemashield Platinum™). Platelet adhesion was also visualised using a mepacrine dye. In this case, the samples were fixed with tissue fix solution (during 45 min) and dyed with 10 mM of mepacrine solution (during 90 min). They were then rinsed and observed with a confocal microscope (Zeiss lsm 510) at 488 nm.

**Results and discussion:** Results of platelet adhesion are shown in Fig. 1. Commercial ePTFE and Dacron grafts were used as controls. Results shown in Fig. 1 indicate that platelet adhesion on our unmodified nonwoven fiber structure was slightly higher than on Dacron, which was considerably higher than on ePTFE ( $p < 0.05$ ). Results in Fig. 1 also show that the PVA surface treatment led to an increase in platelet adhesion compared to the unmodified structure, while PEG functionalization led to an important reduction in platelet. In fact, platelet adhesion decreased with increasing PEG concentration ( $p < 0.05$  for 7.5, 10 and 15% PEG). Platelet adhesion of nonwoven PET fiber structure functionalized with PVA-15%PEG was almost as low as that of carbon coated ePTFE, known for its low platelet adhesion<sup>2</sup>.

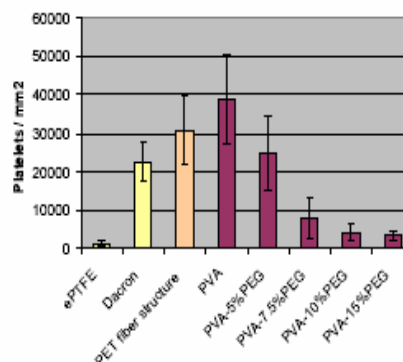


Fig.1 Platelet adhesion on samples: ePTFE, Dacron, unmodified PET fiber structure, then modified with PVA and PVA-5%, -7.5%, -10% and -15% of PEG.

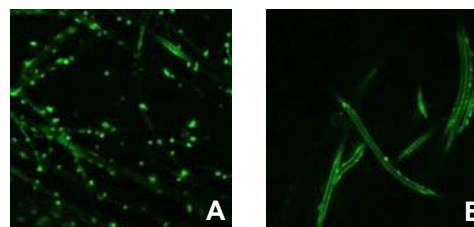


Fig.2 Fluorescence images of platelet adhesion on nonwoven PET fiber structures: (A) without surface modification and (B) with PVA-10%PEG functionalization.

Micrographs of mepacrine dyed-platelets onto the nonwoven PET fiber structures, shown in Fig. 2, reveal that the platelets adhered onto the PET fibers, validating <sup>51</sup>Cr-labeled platelet quantification. Fig. 2 clearly illustrates the reduction in number of platelets on the PET fiber structure following PVA-PEG functionalization. Also shown in Fig. 2B is the fact that PVA-PEG modified fibers are also dyed by mepacrine, and therefore fluoresce.

**Conclusions:** PEG functionalization of nonwoven PET fiber structures led to a significant reduction in platelet adhesion, as observed by platelet labelling and dying, which for PVA-15%PEG functionalized structures, was close to levels observed on carbon coated ePTFE.

**References:** 1. Taylor et al. J Vasc Surg 1990;10:220-5.  
2. Akers DL et al.. J Vasc Surg 1993;18:10-15.