Biodegradable Synthetic Small-calibre Vascular Grafts: 1-Year Results after Replacement of the Rat Aorta

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Introduction:
Shelf-ready synthetic small calibre grafts are needed for coronary artery bypass grafting. Biodegradable scaffolds resistant to degradation-induced aneurysm formation in the systemic arterial circulation have been developed for in vivo vascular tissue engineering¹,². Our aim is to assess the long-term results of synthetic, biodegradable small-calibre vascular grafts compared to ePTFE for aortic replacement in the rat model.

Materials and Methods:
Ten anaesthetised Sprague Dawley rats (male, 275g), received an infrarenal aortic graft (5 biodegradable; 5 ePTFE) replacement (end-to-end; 2mm ID; 20mm long) and 5 rats served as sham controls. Biodegradable grafts (polycaprolactone = PCL) were produced by random nano-fibre (porosity 80%) electro-spinning. After 1-year survival in vivo high resolution ultra-sonography (Visualsonics; see figure 1) and angiography were performed to assess patency, stenosis, aneurysm formation, intimal hyperplasia and compliance. After explantation micro CT calcification quantification, histology, immuno-histology, scanning electron microscopy (SEM) and morphometry were carried out.

Results:
Patency at one year was 100% for PCL and 80% for ePTFE grafts. No aneurysmal dilation or stenoses were found in the PCL group by angiography. Ultra-sonography showed minimal peri-anastomotic intimal hyperplasia in PCL compared to ePTFE grafts. In vivo compliance revealed a marked reduction between the native abdominal aorta (7-9%) and PCL (3-5%) or ePTFE grafts (1-2%). Micro-pet calcifications were present in both grafts (2-6% of total graft volume) and absent in the native aorta (see figure 2). Histologically low cellular ingrowth was found in ePTFE grafts, whereas PCL grafts showed good homogenous cellularity producing collagen and extra-cellular matrix replacing the PCL scaffold. SEM revealed a confluent neendothelialisation of the PCL grafts, unlike ePTFE.

Discussions and Conclusions:
Synthetic biodegradable small calibre nano-fibre polycaprolactone grafts show excellent results after 1-year of aortic replacement and compare favourably with the clinically used ePTFE grafts. Thus, such novel in situ tissue engineered grafts could become a future option for clinical applications such as coronary artery bypass grafting.

References

Disclosures
The authors have nothing to disclose.