Bioengineering of a semiautologous arterial vessels with reconstructed media and intima, longtime tested in vivo

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Abstract

Objective:

Goal was to engineer biological, arterial grafts with antithrombotic, autologous endothelial luminal surface combined with extraluminal smooth vascular muscle layer (VSMC) and to test invivo.

Methods:

1. Different decellularisation methods described in literature were compared to identify the most suitable one with focus on the preservation of extracellular fibre matrix.

2. Endothelial precursor cells (EPC), isolated from bone marrow and VSMC from small venous segments of donor animals were cultivated. Cells were seeded sandwich-like on homologous decellularized venous scaffolds and conditioned under pulsatile circulation in a bioreactor.

3. The semiautologous grafts were implanted in carotidal position on both sides in five Beagle dogs (n=10; group 2) as interposition.

Results:

Comparison of four in literature described decellularisation methods showed different preservation of elastic and collagen fibres compared with native veins, whereas decellularity was similar in all methods. This forced us to choose a decellularization protocol with the best preservation of the extracellular matrix. The invivo experiments showed in group 1 (control) already after one week a complete thrombotic occlusion of the decellularized implants, whereas in group 2 9/10 semiautologous grafts were patent after 98±4 days in ultrasound, angiography and histology (p=0.0001).

Conclusion:

A complete incorporation of semiautologous grafts in the surrounding tissue could be shown. The seeding with two different cell types preserved an aneurysmatic degeneration under arterial conditions with patency without anticoagulation.