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Spontaneous Cell Repopulation of Valved Aortic Conduits after Decellularization and Allogeneic Transplantation

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Objectives:

This work is aimed to the production of acellular valve substitutes which can acquire post-implantation autograft-like characters.

Method:

Valved aortic conduits were excised from 3-month-old minipigs. Decellularization was performed with defined procedure using Triton X-100 and Cholate detergents and then unspecific endonuclease Benzonase®. Surgical replacements were performed at pulmonary position in 3 12-month-old minipigs. The conduits were excised together with adjacent recipient tissue after 6 months and processed for immunohistochemical detection of cell phenotypes (markers for vWF, CD31, vimentin, CD34, alpha-SMA) and (ii) electron microscopy.

Results:

Favorable postoperative outcomes were achieved. Proper compensatory growth of implants occurred (30-35% increase in diameters). Both aortic wall and valve leaflet surfaces were completely coated by an adhering monolayer of cuboidal endothelium-like cells engaged in prominent ECM production and showing weak basal laminae. Many cells populated valve interstitium with most of them showing ultrastructural features consistent with marked collagen fibrillogenesis, elastogenesis and fibrillin microfibrillogenesis, including patterns reminiscent of embryonal ECM production, and vimentin+ and alpha-SMA+. Several cells were CD34+.

Conclusions:

In conclusion, the procedure used allows to achieve glutaraldehyde-free valved vascular conduits that are permissive of spontaneous cell repopulation "in vivo" and tissue growth/remodelling, with the involvement of cells expressing phenotypes mimicking those in native conditions, possibly supported by CD34+ so called circulating fibrocytes.