Superiority of Tissue Engineered Heart Valves to Stentless Porcine Aortic Bioprostheses

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Background
The presence of viable endothelial cells may support longer durability and the absence of calcification in valve prostheses. Our objective was to investigate the superiority of tissue engineered (TE) heart valves constructed by viable autologous endothelial cells and an acellular porcine matrix to stentless porcine aortic bioprostheses.

Methods
In 3 months old sheep (n=6) a piece of vein was harvested to culture autologous endothelial cells. The acellular matrix was reendothelialized and implanted in juvenile sheep as pulmonary interposition. Six Freestyle valves and 6 Toronto SPV valves were implanted in juvenile sheep in the same way. In each series, three valves were explanted after 3 months and three after 6 months. Valves were analyzed by gross inspection, X-ray, light microscopy, electron microscopy and immunohistochemistry. Quantitative determination of calcium content was made with atomic absorption spectrometry.

Results
X-ray showed one nodule calcification in 6 months Toronto SPV explant and no cusp calcification in Freestyle and TE-heart valves. These results were confirmed by light microscopy. Immunostaining for Factor VIII demonstrated the colonisation of viable mature autologous endothelial cells on the TE-heart valve after the seeding process. At 6 months after implantation the cusps of auto-xenograft explants contained significantly less calcium than those of stentless porcine aortic bioprostheses (TE-heart valve; 0.3 ± 0.2 µg/mg, Freestyle; 0.8 ± 0.7, TorontoSPV; 2.3 ± 1.7: P=0.0016). Especially in the free edge of the cusp, calcium content of TE-heart valve was significantly lower than those of stentless bioprostheses (TE-heart valve; 0.2 ± 0.03 µg/mg, Freestyle; 0.8 ± 0.6, TorontoSPV; 2.5 ± 1.1: P=0.02).

Conclusion
No cusp calcification in TE-heart valves occurred in the juvenile sheep after 3 and 6 months. These data suggest the superiority of TE-heart valves to stentless porcine aortic bioprostheses.

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