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An In Vitro Hydrodynamic Comparison of Aortic Porcine Valves Before and After Decellularization Procedure

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Objectives:

Research in cardiovascular tissue engineering constantly explores valve bioprosthesis that simulates the hydrodynamic, durability and easy post-surgery management features of the native valves. Our aim involves investigation of acellular valve scaffold tested in a “pulse duplicator”.

Methods:

Aortic native porcine valves were tested in a “pulse duplicator” machine immediately after animal sacrifice in order to reproduce the appropriate physiologic hemodynamic condition. Then they were treated with the TRI-COL decellularization process. This treatment uses Triton X-100 and Sodium Cholate in association. We investigated in other study that this method completely removes cell components. The same valves were then retested in the pulse duplicator under unchanged conditions.

Results:

Heterogeneous functional modifications were present in the decellularized valve as related to cardiac output changes in terms of stenosis and regurgitation compared to the same valve immediately after explant. Decellularized porcine aortic roots showed significantly lower transvalvular-gradients, effective-orifice-area, stroke-work-loss, valvular-resistance and global-left-ventricle-afterload than fresh intact porcine roots. On the contrary, the leaflet coaptation time during diastolic-phase was longer with the decellularized aortic roots, although the difference did not reach a statistical significance.

Conclusions:

Observed changes are very likely due to the effect of the decellularization procedure. These particular testing conditions as used for the first time in this investigation are likely to provide in the future valuable comparative information if applied to scaffold prepared with different decellularization procedures as they allow to clearly distinguish between influence of testing conditions per se and experimental treatment of the sample.