A new pulsatile bioreactor for in vitro seeding and conditioning of endothelial cells in tissue-engineered heart valves

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Background
To improve the durability of allografts and xenografts a tissue-engineered heart valve was developed covered with an autologous endothelial cell (EC) layer. A new pulsatile bioreactor was created for seeding and conditioning EC.

Methods
To create a tissue-engineered heart valve a fresh pulmonary porcine valve (ischemic time < 6 hours) had been chemically decellularized. This acellular matrix was used to be coated with EC. The seeding device consists of a bioreactor which provides pulsatile flow over a wide range of physiologic conditions (0.3-8.8 L/min). The bioreactor is placed into a humidified incubator at 37°C and 5% CO₂, while the driver-unit is placed outside. During the conditioning phase the pulsatile flow was progressively increased. The pH value of the circulating medium was continuously measured, and adjusted to maintain optimum viability of the EC.

Results
The mean effective EC seeding was 89%, with 100,000 cells/cm³. The performed viability test showed a mean value of 98.2%. The produced tissue engineered valve was conditioned for another 7 days in the humidified incubator (37°C, 5% CO₂ and 98% air saturation). A confluent shear stress resistant EC layer covers the surfaces of the heart after the incubation.

Conclusions
With this seeding device it is possible to condition EC for in vivo circulation shear stress and to investigate long-term in vitro behavior of EC.

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