A new semi-automatic cell seeding device and technique for tissue heart valves

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Background:
So far tissue heart valve prostheses are of biological dead porcine or bovine origin. Their durability is limited because of tissue degeneration and calcification. Surface seeding with vital human endothelial cells (EC) could improve valve durability and biocompatibility. A new seeding technique including a new developed special seeding device is presented.

Methods:
The aortic valve including a cylinder of the aortic root was prepared from a fresh porcine heart taken from the slaughterhouse. Porcine EC were removed by surface treatment with chemical detergent solutions. A new developed seeding device with an integrated CO2-incubator was designed. The device is composed of: The Seeding Chamber (SC), the Rotation Unit (RU), the Control Unit (CU). The porcine aortic root cylinder with the valve leaflets is placed into the SC. A matrix of fibronectin is applied to the acellular valve. Then the SC is filled with the ECs suspended in modified Dulbecco’s Eagle Medium (DMEM). Under cell culture conditions the EC seeding of the tissue valve is established rotating the valve around two orthogonal axes simultaneously and independently following the software controlled preset parameters.

Results:
Using initial EC seeding concentrations of $6 \times 10^6$ ECs/ml DMEM a seeding efficiency of 80-85% could be achieved within 3-4 hrs. Cell viability tests proved that 90-95% of the seeded ECs are vital after the seeding procedure.

Conclusions:
This new seeding technique allows to cover the complex cubic surface of a tissue heart valve with vital ECs to form a confluent EC monolayer.

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