

Tissue engineered heart valve leaflet substitute in orthotopic aortic position in a sheep model – preliminary results

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Objectives. Currently used patch materials are associated with limited longevity of aortic valve repair. To overcome this limitation, we try to create a living replacement material with regeneration and growth capacity made of homologous cells.

Methods. Myofibroblasts harvested from umbilical cord of a lamb are isolated, cultivated and expanded at 37°C for 14 days. Then the cells are seeded in two steps at 24 hour interval on the scaffold. Seven days static cultures are followed by cultivation in a bioreactor for another 14 days. Then the tissue engineered patch (TEP) is implanted in the adult swiss white mountain sheep (59-70 kg). After median sternotomy or lateral thoracotomy extracorporeal circulation (ECC) is established. The aortic valve is exposed. The aortic leaflet is explanted and the TEP tailored to implant it as leaflet substitute. 6 hours later the animal is sacrificed. Post mortem analyses including histology are done.

Results. So far, we operated on seven sheep (median sternotomy [n:6], right lateral thoracotomy [n:1]). One sheep developed ventricular fibrillation (VF) due to unknown reason right after sternotomy; after ending of ECC VF recurred and the sheep died. Nevertheless, the operation was finished in all seven attempts. One sheep developed VF refractory to medical or electrical treatment after weaning from ECC and died also before planned scarification. Mean follow-up time after chest closure was 3.2 hours. Postoperative transthoracic, epicardial or transesophageal 2 D colour Doppler echocardiography revealed excellent function of leaflet substitute with good coadaptation of the aortic valve leaflets without signs of relevant aortic valve stenosis (none) or regurgitation (none or trivial).. In one case an angiogram was done demonstrating a sufficient valve. CT scan was done in 3 cases (2 to 3 hours post.op) demonstrating none to trivial aortic valve regurgitation. Obtained histologic samples at sacrifice showed cell migration (red blood cells as well as lymphocytes) into the scaffold

Conclusions. Tissue engineered heart valve leaflet substitute in orthotopic aortic position in a sheep model shows excellent acute hemodynamic results regarding aortic valve function. Chronic animal model testing is needed to test longevity of this new approach.