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Successful creation of an ovine pulmonary stenosis-regurgitation model simulating a Tetralogy of Fallot

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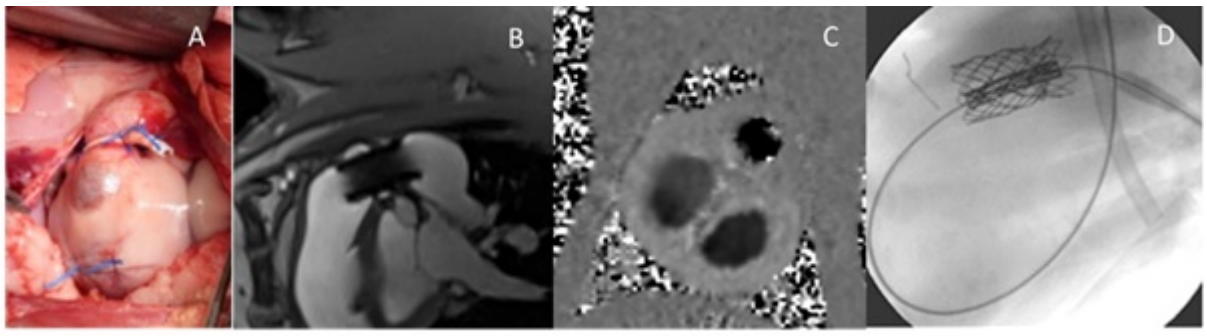
Introduction Patients with surgically corrected tetralogy of Fallot (TF) often develop severe pulmonary regurgitation (PR) with chronic right ventricular volume overload, leading to adverse outcomes. We created an ovine survival model simulating the pathophysiology of TF to study the effects of right ventricular remodeling due to stenosis and regurgitation.

Methods: In lambs (weight 27.4±5.3 kg), a pulmonary valve stenosis (PS) was created by placing a PTFE strip around the pulmonary artery through a right thoracotomy (Figure A). Four months later a bare metal stent was anchored across the pulmonary valve in the PTFE strip (Figure B) thereby relieving the stenosis and creating pulmonary valve insufficiency (Figure C). Melody valve implantations into this bare metal stent at different time intervals (5 months to 10 months) are ongoing (Figure D). Follow up by means of MRI was performed to assess remodeling and reversed remodeling of the RV.

Results: All animals survived the initial surgical phase (n=9). Two animals died during bare metal stent implantation (ventricular fibrillation n=1; PA rupture by balloon dilation n=1). MRI showed signs of RV hypertrophy prior to relief of stenosis compared to healthy controls. Total RV cardiac output (CO) was 2.2±0.7 L/min after PS, 5.0 ±0.8 L/min immediately after bare stent implantation and 3.5±0.1 L/min SD after 5 months of PR. Animals had an important PR 5 months after bare metal stent implantation (32±2.3%). The RV-LV EDV ratio was 1.6±0.3 significantly higher compared to 0.9±0.0 in healthy controls (n=3) (p 0.06).



Conclusions: The creation of an ovine survival TF model with initial pulmonary valve stenosis and secondary regurgitation (mimicking the effect of surgical repair) is feasible. All hallmarks of the TF physiology (ventricular hypertrophy after stenosis – ventricular dilatation due to PR) were realized. This model forms good basis to study the timing of pulmonary valve replacement in TF.

Legend figure : A/ PTFE strip supra-annular and marker infundibular B/ MRI showing bare metal stent across the native pulmonary valve C/ MRI phase short axis showing massive PR D/ Deployment of Melody valve in bare stent