

Symposium

Symposium 10 (II-S10)

Novel Simulation Methods in Pediatric Cardiology and Cardiac Surgery: Its Potential and Limitation

Chair:Keiichi Itatani(Department of Cardiovascular Surgery, Kyoto Prefectural University of Medicine, Japan)

Chair:Isao Shiraishi(Department of Pediatric Cardiology, National Cerebral and Cardiovascular Center, Japan)

Co-host:ANSYS Japan K.K.

Co-host:Siemens Healthcare K.K.

Co-host:Materialise Japan K.K.

Sat. Jul 8, 2017 2:00 PM - 3:30 PM ROOM 7 (Seminar and Exchange Center, 2F The Music Studio Hall)

2:00 PM - 3:30 PM

[II-S10-01]Bioengineering contributions to optimize the surgical repair of congenital heart defects

○Kerem Pekkan (Koc University, Turkey)

Objectives: To develop a patient-specific patch reconstruction planning protocol that incorporates vessel deformation, hemodynamics and post-surgery pressure. To evaluate a venous assist device concept intended to reverse the gradually failing Fontan circulation.

Methods: Pre-surgery, intra-operative and post-operative mechanical loading steps of patch reconstruction are simulated in the computer for pulmonary artery stenosis and aortic coarctation. The release of arterial residual stresses after surgical incision and pull produced by the surgeon is represented using time-dependent finite shell elements (Ansys Inc). Model employed the biaxial mechanical properties (Bose Inc) of Dacron, PTFE, porcine pericardium and human pericardium, obtained *in house*. Cubic-wrapped patch at different curvatures are implanted in the computer. The rapid-prototypes of the venous assist device (Siemens NX) is assembled and tested bench-top (ViVitro super-pump) after verifying the single-ventricle physiology as in our earlier mock-up studies.

Results: For selected patch strategies and 3D shapes, stress levels, post-operative pressure drop levels are compared *in silico*. The miniature assist device enabled up to 5mmHg venous recovery by supplying the entire inferior vena cava flow (2LPM).

Conclusion: The pre-surgical patch-planning framework is found to be feasible for patient-specific cases where quantitative performance criteria are defined. A fully implantable version of the novel venous assist system may eliminate the need for external power in assisted Fontan circulation.