Assessment of Pressure-Volume Relations in Univentricular Hearts – Comparison of Obtainment by Real-time 3D Echocardiography and Mini Pressure-Wire with Conductance Technology

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Objectives
Pressure-volume relations (PVR) of the heart allow assessment of systolic as well as diastolic function which may be of particular importance in single ventricle physiology. The gold standard to acquire PVR, the conductance technology (PVRCond), is rarely used in children and restricted to older age due to its catheter size and invasiveness. PVR can also be obtained by three-dimensional-echocardiography (3DE) volume data in combination with simultaneously measured pressure data by a mini pressure-wire (PVR3DE).

Aim: To compare 3DE in combination with pressure wire and conductance technology in patients with univentricular hearts.

Methods
- 19 patients (age 2–29 years)
- 12 with single right, 7 with single left ventricle
- PVRCond: Conductance Catheter, 4F (CD Leycom)
- PVR3DE: 3DE (iE33, Philips), analysis with TomTec Imaging Systems and simultaneous recording of ventricular pressure by a mini pressure-wire (Radi, St. Jude Medical)
- PVR3DE and PVRCond under baseline conditions followed by dobutamine 10µg/kg/min

Results
Both methods showed the following changes under dobutamine (Fig. 2):
- End-systolic elastance (Ees) as a measure for contractility increased
- The isovolumic relaxation time constant Tau, reflecting the early active relaxation process, decreased expressing the positive lusitropic effect of dobutamine
- Effective arterial elastance (Ea) increased
- The indexed EDV at an end-diastolic pressure of 10mmHg (EDV10) an assessment of diastolic function did not change
- Bland-Altman-analyses (bias ± standard deviation): Ees: 1.6±2.9 mmHg/ml, Tau: -4.6±7.8 ms, Ea: 0.5±3.0 mmHg/ml, EDV10: 8.4±27.1 ml

Conclusion
- Both methods reflected changes under dobutamine stimulation in the same way
- Bland-Altman analysis showed that absolute values could vary between the methods, though. Thus, methods are not interchangeable.
- Obtaining PVR using 3DE and mini pressure-wire in a single ventricle was feasible in all patients in a short time while obtaining PVR using conductance technology can be very demanding especially in a single right ventricle with increased time of intervention and potentially more radiation
- PVR obtained by 3DE and mini pressure-wire can serve as a promising and needed alternative to the conductance technology

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