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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 ( $PVR_{Cond}$ ), 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 ( $PVR_{3DE}$ ).

**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
- $PVR_{Cond}$ : Conductance Catheter, 4F (CD Leycom)
- $PVR_{3DE}$ : 3DE (iE33, Philips), analysis with TomTec Imaging Systems and simultaneous recording of ventricular pressure by a mini pressure-wire (Radi, St. Jude Medical)
- $PVR_{3DE}$  and  $PVR_{Cond}$  under baseline conditions followed by dobutamine  $10\mu\text{g}/\text{kg}/\text{min}$

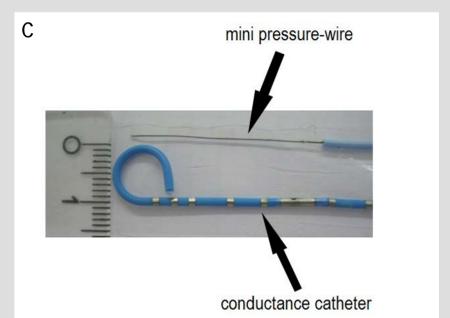
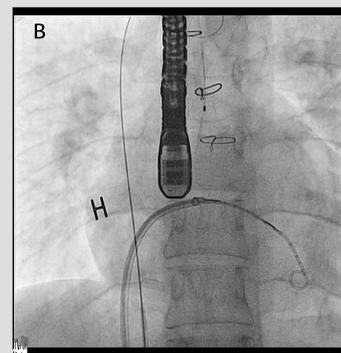
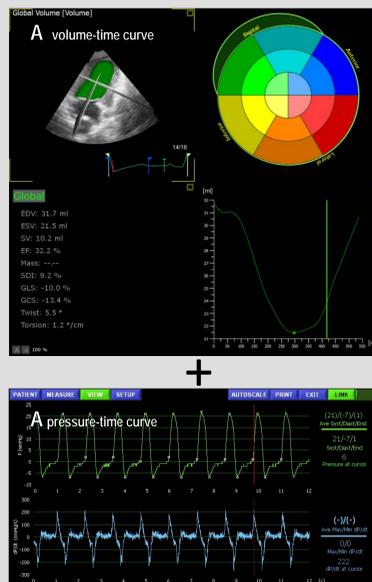


Fig.1. A: 3DE analysis and pressure curve by mini pressure-wire  
B: Conductance catheter in place during examination  
C: Mini pressure-wire and conductance catheter in comparison

## 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 ( $EDV_{10}$ ) an assessment of diastolic function did not change
- Bland-Altman-analyses (bias  $\pm$  standard deviation): Ees:  $1.6 \pm 2.9$  mmHg/ml, Tau:  $-4.6 \pm 7.8$  ms, Ea:  $0.5 \pm 3.0$  mmHg/ml,  $EDV_{10}$ :  $8.4 \pm 27.1$  ml

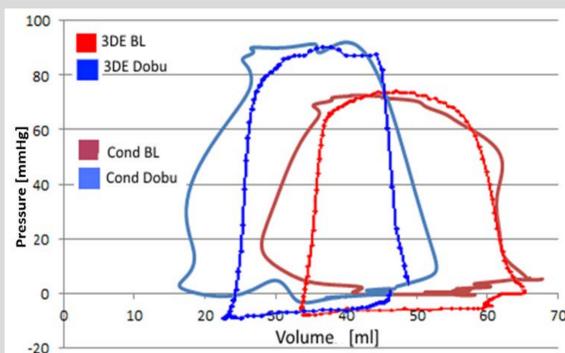


Fig. 3. Example of pressure-volume loops of a single right ventricle assessed by 3D-echocardiography combined with mini pressure-wire (3DE; dotted line) and conductance technology (Cond; solid line) under baseline conditions (BL) and stimulation with dobutamine (Dobu).

- Obtaining  $PVR_{3DE}$  successful in all 19 patients, correct placement and signal quality for  $PVR_{Cond}$  successful in only 15/19 (79%) patients under baseline conditions and in 12/19 (63%) patients under dobutamine

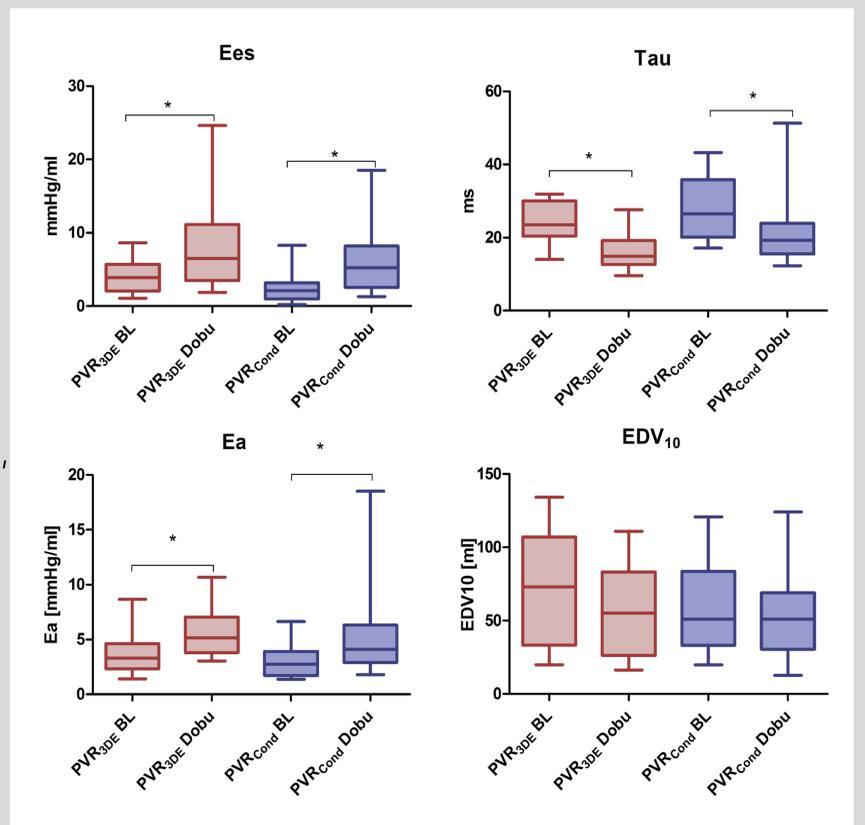


Fig. 2. PVR-specific parameters under baseline conditions (BL) and stimulation with dobutamine (Dobu).  $PVR_{3DE}$  = 3D-echocardiography combined with mini pressure-wire;  $PVR_{Cond}$  = conductance technology; \* =  $p < 0.05$  BL compared to Dobu.

## 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

## Acknowledgements

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