

## Peripheral venous pressure measurement can replace central venous pressure measurement in pre- and post-Fontan patients undergoing hemodynamic MRI evaluation

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**Objectives:** Cardiac catheterization has been used to evaluate patients for potential risk factors before and following a Fontan operation. However, catheterization has a low diagnostic yield of outcome in this patient population, and alternative diagnostic strategies have been suggested. Ideal imaging modality should be non-invasive and include high-resolution imaging, flow measurements, and pressure measurements.

**Methods:** Simultaneous peripheral venous pressure (PVP) and superior caval vein pressure (CVP) were measured in 32 pre- and post-Fontan patients undergoing cardiac catheterization. The measurements were compared using Bland-Altman method. Four patients who underwent both MRI and cardiac catheterization were included in the study. Anatomical and flow measurements in MRI and catheterization were compared. PVRI results derived from combined MRI and catheterization data were compared to the catheterization data alone. Predicted oxygen consumption and Fick principle were used for flow calculations at catheterization.

**Results:** The median (range) PVP was 14 mmHg (10-23 mmHg) and CVP 13 mmHg (8-21 mmHg). Limits of agreement between these two methods were narrow (Figure).

In four patients who underwent combined MRI and catheterization study there was excellent correlation with anatomic measurements. QPi was overestimated in catheterization. In MRI CI and QPi were  $3.3 \pm 1.0$  l/min/m<sup>2</sup> and  $2.0 \pm 1.2$  l/min/m<sup>2</sup>, whereas in catheterization CI and QPi were  $5.0 \pm 2.5$  l/min/m<sup>2</sup> and  $2.7 \pm 0.4$  l/min/m<sup>2</sup>, respectively.

Overestimation of QPi was observed in patients with significant collateral flow resulting in underestimation of PVRI ( $2.1 \pm 1.0$  U\*m<sup>2</sup> when calculated from catheterization data and  $4.7 \pm 4.9$  U\*m<sup>2</sup> when combined MRI and catheterization data were used). In patients with high collateral flow, overestimation of Qpi was observed if the MRI measurements were done from pulmonary veins rather than from pulmonary arteries.

**Conclusions:** 1) PVP can be used instead of CVP for screening of high CVP and PVRI. Use of PVP is non-invasive and can be done without general anesthesia. 2) In patients with significant collateral flow only combined MRI/catheterization may be used to estimate PVRI.

MRI combined with PVP is suitable for initial screening of pre- and post-Fontan patients. However, we believe that high-risk patients should be evaluated by using combined MRI and catheterization data.

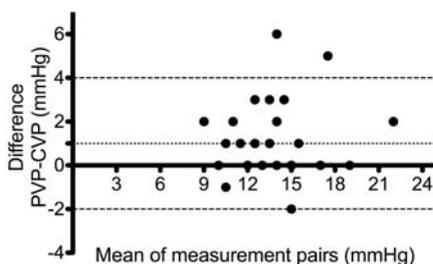


Figure: Bland-Altman analysis of peripheral venous pressure (PVP) and central venous pressure. X-axis: mean of measurement pairs, y-axis: difference of PVP and CVP. Bias 1 mmHg, SD of bias 2 mmHg (95% limits of agreement from -2 to 4 mmHg).