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Meeting abstract

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155 Quantification of pulse wave velocity in the pulmonary artery in patients with pulmonary hypertension

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Introduction

Pulmonary artery (PA) stiffness increases in pulmonary hypertension (PH). Pulse wave velocity (PWV) is an index of stiffness that provides prognostic information in systemic arterial disease, but its quantification in the pulmonary circulation is challenging. Harmonic analysis of the oscillatory variations in PA diameters and pressures measured invasively has been used in the past to determine that PWV is on average ~2 m/s in normal individuals and ~4.5 m/s in the presence of PH.

Purpose

To evaluate the feasibility of measuring pulmonary PWV combining information obtained with cardiac magnetic resonance (CMR) and right heart catheterization (RHC).

Methods

CMR and RHC were performed on the same day in 94 patients with known or suspected PH. Systolic, mean and diastolic PA pressures, cardiac index (thermodilution) and pulmonary vascular resistance index (PVRI) were measured invasively. From the RHC results, patients were classified as those with (n = 75) or without PH at rest (n = 19), defined as mean PA pressure >25 mmHg. CMR evaluation included phase-contrast imaging perpendicular to the pulmonary trunk, using a segmented fast gradient echo sequence: TR 7.5 ms, TE 3.1 ms, slice thickness 6 mm, matrix = 256 × 96, 5–7 segments, 20 reconstructed cardiac phases, velocity encoding 100 cm/s. PA areas throughout the cardiac cycle and the cardiac index were measured from the phase-contrast images.

Combining CMR and RHC data, pulmonary elastic modulus (EM) was calculated as:

$$EM\ (mmHg) = pulse\ pressure/pulsatility;$$

where *pulse pressure = systolic - diastolic PA pressures* (in mmHg); and *pulsatility = (maximal PA area - minimal PA area)/minimal PA area* (areas measured in cm^2).

PWV was quantified using the formula:

$$PWV\ (m/s) = (133.28 \times EM/2 \times \rho)^{1/2};$$

where ρ = blood density (assumed to be constant and equal to 1025 kg/m^3).

Data are expressed as median (interquartile range) unless otherwise stated. A p value < 0.05 was considered significant. Statistical analyses were performed with SPSS 12.0©.

Results

The median PWV in the study population was 3.7 m/s (range 1.1–6.3 m/s). CMR-derived pulsatility was inversely correlated with mean and systolic PA pressures (Spearman r = -0.48 and -0.49, respectively, p < 0.0001). PWV was significantly increased in patients with PH in comparison with those without PH at rest: 4.0 (1.4) versus

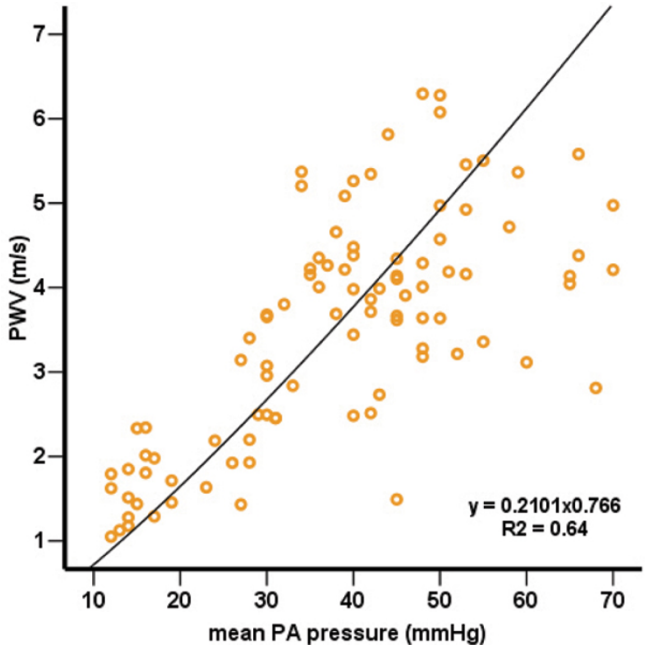

Figure 1
In 94 patients with known or suspected pulmonary hypertension (PH), pulmonary pulse wave velocity (PWV) was calculated from same-day right heart catheterization and phase-contrast imaging. PWV was markedly increased in patients with PH and correlated strongly with PH severity.

1.6 (0.7) m/s ($p < 0.0001$; Mann-Whitney U test). The PWV correlated strongly with pulmonary vascular resistance index ($r = 0.64$), systolic PA pressure ($r = 0.78$) and mean PA pressure ($r = 0.70$, Figure 1); all p-values < 0.0001.

Conclusion

Combined data from RHC and CMR allows for simple quantification of PWV. PWV strongly correlates with the degree of PH severity as evidenced by the levels of both pulmonary pressures and vascular resistance, indicating progressively increased PA stiffness. Quantification of PWV may represent a parameter of interest in the evaluation and follow-up of patients with PH.