

ORAL PRESENTATION

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Evaluation of right ventriculoarterial coupling in pulmonary hypertension: a magnetic resonance study

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Introduction

Inadequate right ventriculo-arterial coupling is an important determinant of heart failure in pulmonary hypertension, in turn the main determinant of outcome in this disease. Coupling can be quantified as the ratio of pulmonary artery effective elastance (E_a , an index of arterial load) to right ventricular maximal end-systolic elastance (E_{max} , an index of contractility).

Objective

To quantify right ventriculo-arterial coupling in pulmonary hypertension combining standard right heart catheterization and cardiac magnetic resonance (CMR), and to noninvasively estimate it with CMR alone.

Methods

We included 139 patients undergoing CMR and right heart catheterization within 2 days ($n=151$ test pairs) for

the evaluation of known or suspected pulmonary hypertension. Right ventricular end-systolic volume index (ESVI) and stroke volume index (SVI) were obtained, respectively, from cardiac cine images and phase-contrast of the pulmonary artery after adjusting for body surface area. Right heart catheterization provided mean pulmonary artery pressure (mPAP) as a surrogate of right ventricular end-systolic pressure, pulmonary capillary wedge pressure (PCWP), and pulmonary vascular resistance index (PVRI). E_a was calculated as $(mPAP-PCWP)/SVI$; and E_{max} as $PAP/ESVI$.

Results

E_a increased linearly with advancing severity (as determined by PVRI quartiles; Figure, 1A), whereas E_{max} increased initially but tended to decrease subsequently (Figure, 1B). Thus, the ratio E_a/E_{max} was maintained in earlier stages but increased markedly (indicating

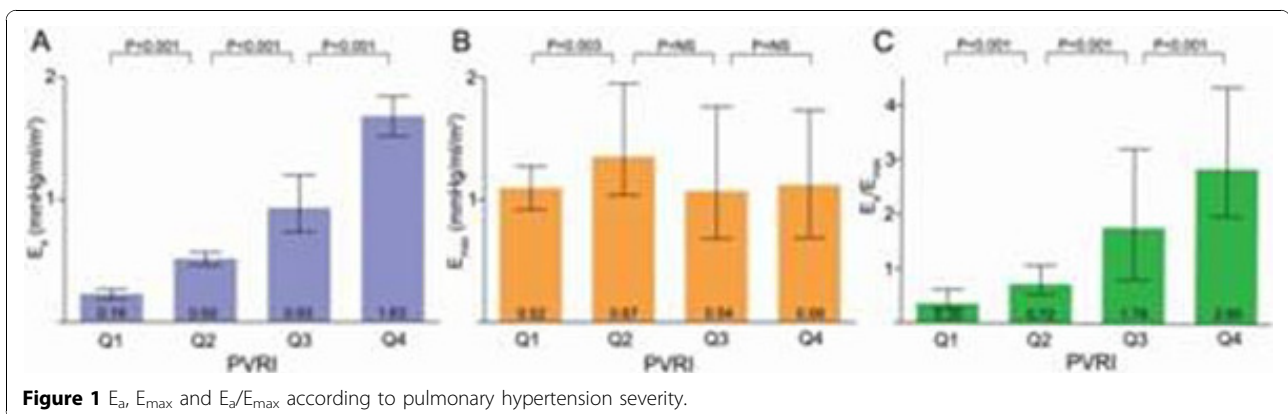


Figure 1 E_a , E_{max} and E_a/E_{max} according to pulmonary hypertension severity.

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uncoupling) with more severe pulmonary hypertension (Figure, 1C). According to underlying etiologies and after adjustment for age, gender and PVRI, there were no significant differences amongst World Health Organization groups in terms of E_a/E_{max} . E_{max} was independently associated with right atrial pressure after adjustment for PVRI ($\beta=-2.81$, $p<0.05$). E_a/E_{max} approximated noninvasively with CMR as $ESVI/SVI$ equaled 0.75, 1.17, 2.28, and 3.51, for PVRI quartile groups (Q1 to Q4) respectively, showing excellent correlation with E_a/E_{max} derived from invasive measurements ($r=0.93$, $p<0.001$) and progressing similarly with disease severity ($p<0.001$).

Conclusions

Right ventriculo-arterial coupling in pulmonary hypertension can be studied combining standard right heart catheterization and CMR indices. In addition, it can be approximated with CMR alone in a completely noninvasive fashion. Arterial load increases with disease severity whereas contractility cannot progress in parallel, leading to severe uncoupling.

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