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Meeting abstract

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2073 Novel quantitative measures of pulmonary arterial hypertension using MRI – a study in patients with early-stage systemic sclerosis

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Introduction

Systemic Sclerosis (SSc) is a progressive systemic disease which can involve the pulmonary arteries and patients suffering from it can develop pulmonary arterial hypertension (PAH). Currently, we lack quantitative and non-invasive methods to adequately assess PAH.

Purpose

To evaluate the feasibility of using novel magnetic resonance imaging (MRI) methods to identify physiological involvement of the pulmonary circulation in early-stage SSc patients.

Methods

Ten patients (7 with established SSc, 3 with suspected SSc, 7 women, 3 men, 38–64 years, mean 55 years) and 10 healthy volunteers (3 women and 7 men, 21–30 years, mean 24 years) were studied using MRI. Both patients and healthy volunteers underwent velocity encoded MRI measurement of the blood flow in the pulmonary trunk and all pulmonary veins. The difference in arterial and venous pulmonary flow over the cardiac cycle was integrated to determine the pulmonary blood volume variation (PBVV). Also, in patients but not in healthy volunteers, the pulmonary blood volume (PBV) was measured. PBV was determined as the product of the cardiac output and the pulmonary transit time, determined as the transit time for a 1 ml intravenously administrated contrast bolus (gadopentate dimeglumine, 0.5 mmol/ml) to pass from the pulmonary trunk to the left atrium. The pulmonary volume including lung tissue and the functional residual capacity was measured in all patients using planimetry in axial MRI images covering the entire lung field. The pulmonary blood density (PBD) was defined as the PBV divided by the pulmonary volume.

Results

Stroke volume (SV) and PBVV/SV were (mean ± SEM) 75 ± 4 ml and 45 ± 2% in patients, and 103 ± 6 ml and 43 ± 3% in healthy volunteers, ($p = 0.002$ for SV, and $p = 0.912$ for PBVV/SV). PBVV correlated to SV ($n = 20$, $R^2 = 0.65$, $p < 0.001$). Patients had a PBV of 469 ± 26 ml and a PBD of 16 ± 1% (range 9–23%). One additional patient (female, 80 years old) with SSc and established pulmonary arterial hypertension (mean pulmonary arterial pressure 49 mmHg by right heart catheterization) had the following results: PBVV/SV = 54%, PBD = 8%.

Conclusion

We have, for the first time, demonstrated the feasibility of using novel methods to quantify the pulmonary blood volume, pulmonary blood density, and the pulmonary blood volume variation using MRI. Early-stage SSc patients do not differ from healthy volunteers with regards to PBVV/SV. SSc is a progressive disease with a 10–15% life time risk of developing PAH due to increasing rigidity of the pulmonary vessels. Future studies are motivated to assess other patient groups and follow up these

patients over time in order to evaluate the utility of PBVV and/or PBD as measures of pulmonary arterial hypertension.

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