

## Prognostic significance of late gadolinium enhancement patterns in patients with pulmonary hypertension

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**TARGET AUDIENCE** Cardiac MR Technologists, physicists and cardiologists, radiologists and pulmonologists who care for patients with pulmonary hypertension

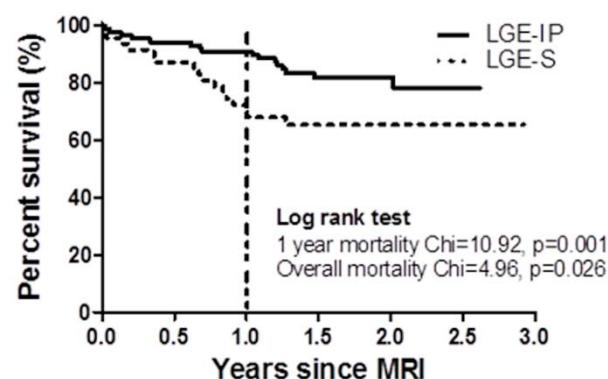
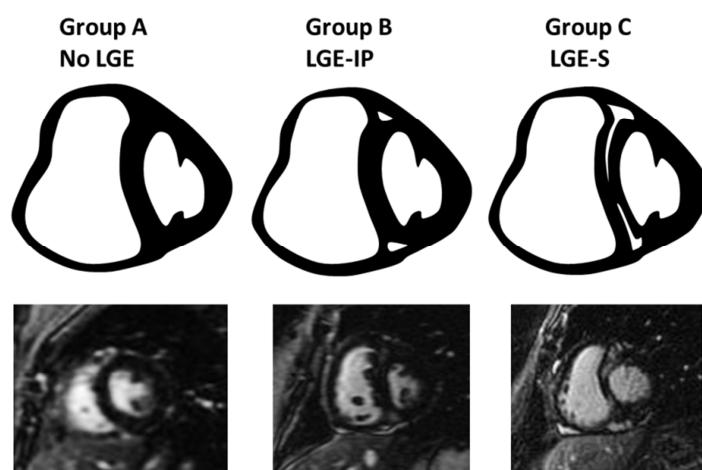
**INTRODUCTION** Late contrast enhancement (LGE) magnetic resonance imaging allows the assessment of changes in the extra cellular compartment of myocardial tissue that may be related to pathophysiological processes of oedema and fibrosis in patients with pulmonary hypertension (PH). However, the prognostic significance of LGE MR imaging in the clinical assessment of patients with PH and associated right heart disease remains uncertain.

To investigate whether physiological and micro-structural changes in the myocardium indicated by LGE MRI relate to morphological and functional changes in the right ventricle in patients with PH. Secondly to determine the added prognostic value of LGE MRI in this subject group.

**METHODS** Consecutive patients with suspected PH underwent right heart catheterisation (RHC) and LGE MRI within 48 hours. LGE MR imaging was performed using a 3D spoiled gradient echo sequence on a 1.5T scanner. Ten minutes following gadolinium contrast injection (0.1 mmol/kg of gadolinium-DTPA; Gadovist, Bayer, Germany followed by 20 ml saline flush), LGE MRI was performed using a retrospective-gated, 2D inversion recovery prepared gradient echo sequence (repetition time 7.1ms, echo time 3.4ms, slice thickness 8mm, FOV 45x40.5, matrix 256x224). A selective 180° inversion pulse triggered to end-diastole was applied in the short axis effectively inverting the signal from 3-5 slices through the ventricles.

LGE images were qualitatively assessed for hyper-intensity at the inter-ventricular septal hinge points or along the septum. Three groups were identified based on a classification scoring system developed as follows: no late enhancement of the myocardium, late enhancement at the hinge insertion points (LGE-IP) and late enhancement involving the hinge insertion points and the interventricular septum (LGE-S), see Figure 1.

**RESULTS** Of 194 patients 162 had PH. LGE was identified in 135 of 162 (83%) patients with PH and 47 (29%) of the patients demonstrated LGE-S. The presence of LGE-S ( $p=0.001$ ) but not LGE-IP alone, RVEF ( $p=0.042$ ), mVo2 ( $p=0.044$ ), male gender ( $p=0.026$ ) and WHO functional class ( $p=0.021$ ), all predicted mortality at one year. At multivariate analysis, LGE-S remained a significant predictor of mortality independent of significant covariate predictors of mortality ( $p=0.018$ ). Patients with LGE-S had significantly higher RV end-diastolic volume ( $p=0.019$ ) and lower Svo2 ( $p=0.045$ ), than patients with LGE-IP alone.



**Figure 1** (above) Subgroups divided according to late gadolinium enhancement (LGE) features. Group A = no LGE, Group B = LGE at the insertion points (IP) and Group C = LGE at the insertion point (LGE-IP) and LGE at the inter-ventricular septum (LGE-S).

**Figure 2** (left) Kaplan-Meier plot analysis: outcome comparison for patients with LGE of the right ventricular insertion points (LGE-IP), versus LGE of the insertion points in addition to the septum (LGE-S).

**CONCLUSIONS** The prevalence of LGE in this study is similar to that previously found by Blyth et al (23 out of 25 patients with PH) [1] and Sanz et al [2] (41 out of 42 patients with PH) supporting the hypothesis that LGE in PH is characteristic. The degree of LGE is related to the severity of PH and has prognostic value. Whilst LGE at the hinge insertion points highly suggestive of the presence of PH, LGE in the septum itself identifies patients with an increased mortality at one year. In patients with suspected PH undergoing MR, grading of the severity of LGE is of added value.

[1] Blyth KG, Groenning BA, Martin TN, Foster JE, Mark PB, Dargie HJ, Peacock AJ. Contrast enhanced-cardiovascular magnetic resonance imaging in patients with pulmonary hypertension. European heart journal. 2005;26:1993-1999

[2] Sanz J, Dellegrottaglie S, Kariisa M, Sulica R, Poon M, O'Donnell TP, Mehta D, Fuster V, Rajagopalan S. Prevalence and correlates of septal delayed contrast enhancement in patients with pulmonary hypertension. The American journal of cardiology. 2007;100:731-735