we set out to guide lead placement by avoiding scar and targeting the region of the LV with the latest mechanical activation.

**Methods** 17 patients underwent cardiac magnetic resonance (CMR) scans. 3D whole heart images were segmented to produce high fidelity anatomical models of the cardiac chambers and coronary veins. 2, 3, 4 chamber and short axis cine images were processed using Tomtec software to give a 16 segment time volume-dyssynchrony map. In patients with myocardial scar the late gadolinium enhancement images were manually segmented and registered to the anatomical model along with the dyssynchrony map. The 3 latest mechanically activated segments with <50% scar were identified and this information was overlaid at CRT implant on to live fluoroscopic images using a prototype version of the Philips EP Navigator software. Subsequently, the x-ray C-arm and table could be moved freely while automatically maintaining a registered roadmap. We used a high fidelity pressure wire to assess the acute haemodynamic response to pacing in different regions of the overlaid 16 segment model. All dP/dt measurements were compared to baseline AAI or VVI (for those patients in AF) pacing at 5–10 beats/min above intrinsic rate.

**Results** 15 of the 17 patients underwent successful placement of a LV pacing lead via the CS with satisfactory pacing parameters and no phrenic nerve stimulation at implant. The mean time from insertion of the CS guide catheter into the venous sheath to successful cannulation of the CS was 1.5±1.0 min. In 2 patients we were unable to place a LV lead successfully in any branch of the CS. We paced in at least one of our 3 target segments in 11 patients. 67% of patients were responders as defined by a 10% increase in +dP/dt over baseline. The mean change in +dP/dt for the best lead position vs baseline +dP/dt was 15.9±11.3% for DDDLV pacing. This compares to a mean change in +dP/dt of 14.9±12.3% when the CMR dyssynchrony-map defined target region was paced DDDLV. The region of best +dP/dt response was postero-lateral, lateral or posterior in all cases.

**Conclusion** We have shown it is feasible to acquire, overlay and accurately register cardiac MR data on to fluoroscopic images at the time of CRT implant. Our data suggest that it is also possible to identify and place the LV lead in at least one target region in most patients. This appears to give close to the best acute haemodynamic response that can be achieved in any branch of the CS. The initial results of this pilot study suggest that a MR dyssynchrony-guided approach to LV lead placement may allow ideal LV lead positioning (Abstract 152 figures 1 and 2).
Patients receiving standard pacemaker generator replacements frequently have impaired left ventricular function and exercise intolerance, related to the percentage of right ventricular pacing

Background Right ventricular (RV) pacing is an accepted treatment for symptomatic bradycardia. However, long-term RV pacing is increasingly recognised to be detrimental to left ventricular (LV) systolic function. We wanted to establish the prevalence, associated features and predictors of LV systolic dysfunction (LVSD) and outcome in a contemporary group of patients with long-term RV pacemakers.

Methods We prospectively recruited consecutive patients listed for pacemaker generator replacement (PGR) between 2008 and 2010 at Leeds General Infirmary. We performed echocardiography, exercise testing and recorded indications for pacing, pacing variables and duration of pacing, comorbidities, current medication and renal function.

Results Of 399 PGR procedures 342 subjects (86%), 184 men, attended. Non-attendees had similar pacing variables and were of similar age as attendees. Mean age (SE) was 76 (1), and mean duration of pacing was 10 (0.3) years. Comorbidities were common: diabetes mellitus in 11%, previous myocardial infarction in 15%, previous cardiac surgery in 26% and atrial fibrillation (AF) in 26%. Medical therapy included β-blockers in 60% and ACE inhibitors in 70%. Dual chamber devices were implanted in 77% (45% of all patients had rate responsive (RR) pacing programmed). Mean percentage of ventricular pacing (%VP) was 61 (2%). Mean left ventricular ejection fraction (LVEF) was 49 (1)%, (44% had an LVEF <50%). Mean peak oxygen uptake (pVo2) (in 107 subjects) was 17 (1) ml/kg/min and mean creatinine was 108 (3) μmol/l. There was an inverse relationship between LVEF and %VP (0.42; p < 0.0001), and years since first implanted (p = 0.09) but there was no effect on LVEF of age, the presence of AF and the pacing mode. In single chamber devices, RR pacing was associated with higher %VP (p = 0.01), and a trend to worse LVEF (p = 0.09). These differences were not seen in RR programmed dual chamber devices. There was a negative relationship between pVo2 and %VP (r = -0.21; p < 0.03). Even with a short follow-up period of 16 (0.5) months, 23 (7%) patients are dead. Patients dead at the censor date were older at the time of the assessment (p < 0.005), had a higher %VP (p < 0.03) and worse renal function (p < 0.001), but did not have significantly worse LVEF or pVo2. The presence of a single chamber device was associated with a poorer outcome (p < 0.002) despite patients with a single chamber device being of similar age as those with a dual chamber device.

Conclusions Patients receiving standard pacemaker generator replacements frequently have cardiovascular comorbidities, left ventricular dysfunction and impaired pVo2 and suffer a high mortality rate. In an unsel ected population of patients with pacemakers, we have established that the amount of RV pacing is related not only to important surrogate measures of outcome such as exercise tolerance and LVEF but also mortality. Whether an aggressive policy of limiting RV pacing in patients at risk reduces mortality is unknown.