A quantitative analysis of ventricular myocardial mass and volume in functional single ventricle using cardiac magnetic resonance imaging

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Introduction: Recently, the Fontan procedure has become feasible in most patients with functional single ventricle. However, postoperative gradual deterioration of ventricular function can occur. Its etiology still remains unclear.

Objectives: To analyze the ventricular volume and mass in patients with functional single ventricle quantitatively by cardiac magnetic resonance imaging (MRI), especially from the point of view of ventricular morphology.

Methods: We analyzed cardiac MRI data from 19 patients with functional single ventricle (RV morphology, 12 patients, LV morphology 7 patients). Ventricular volume and mass were measured by manual tracing of endocardial and epicardial borders on each short-axis cine slice at end-diastole and end-systole. The Simpson method was applied to calculate end-diastolic volume, end-systolic volume, ventricular mass, and volume/ventricular ratio.

Results: Both indexed end-systolic volume (EDVI) and indexed end-systolic volume (ESVI) were significantly higher in the RV group when compared with the LV group (EDVI: 140.2 ± 62.1 mL/m² vs 89.3 ± 20.1 mL/m², p<0.01, and ESVI: 91.9 ± 56.1 mL/m² vs 55.3 ± 16.5 mL/m², p< 0.05, respectively). However, indexed ventricular mass was similar between the two groups (54.5 ± 16.6 g/m² vs 56.3 ± 12.5 g/m², respectively, P=0.34). Consequently, ventricular mass/volume ratio was significantly lower in the RV group when compared with the LV group (0.410 ± 0.072 g/mL vs 0.642 ± 0.125 g/mL, P<0.0005).

Conclusions: In patients with functional single ventricle, RV morphology has the potential risk for decompensation to pressure and/or volume overload in terms of ventricular mass/volume ratio.