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Fully automated quantification of biventricular volumes and function in cardiovascular magnetic resonance: applicability to clinical routine settings

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Background:
Cardiovascular magnetic resonance (CMR) represents the clinical gold standard for the assessment of biventricular morphology and function. Since manual post-processing is time-consuming and prone to observer variability, efforts have been directed towards automated volumetric quantification. In this study, we sought to validate the accuracy of a novel approach providing fully automated quantification of biventricular volumes and function in a "real-world" clinical setting.

Methods:
Three-hundred CMR examinations were randomly selected from the local data base. Fully automatic quantification of left ventricular (LV) mass, LV and right ventricular (RV) end-diastolic and systolic volumes (EDV/ESV), stroke volume (SV) and ejection fraction (EF) were performed overnight using commercially available software. Parameters were compared to manual assessments. Sub-group analyses were further performed according to image quality, scanner field strength, the presence of implanted aortic valves and repaired Tetralogy of Fallot (ToF).

Results:
Biventricular automatic segmentation was feasible in all 300 cases. Overall agreement between fully automated and manually derived LV parameters was good (LV-EF: intra-class correlation coefficient [ICC] 0.95; bias -2.5% [SD 5.9%]), whilst RV agreement was lower (RV-EF: ICC 0.72; bias 5.8% [SD 9.6%]). Lowest agreement was observed in case of severely altered anatomy, e.g. marked RV dilation but normal LV dimensions in repaired ToF (LV parameters ICC 0.73-0.91; RV parameters ICC 0.41-0.94) and/or reduced image quality (LV parameters ICC 0.86-0.95; RV parameters ICC 0.56-0.91), which was more common on 3.0T than on 1.5T.

Conclusions:
Fully automated assessment of biventricular morphology and function is robust and accurate in a clinical routine setting with good image quality and can be performed without any user interaction. However, in case of demanding anatomy (e.g. repaired ToF, severe LV hypertrophy) or reduced image quality, quality check and manual re-contouring is still required.