

Poster presentation

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Clinical application of 3D velocity-encoded magnetic resonance imaging: a new tool for the assessment of tricuspid and pulmonary valve flow and diastolic function of the right ventricle in patients after correction of Tetralogy of Fallot

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Objective

Evaluation of three directional three-dimensional velocity-encoded MRI (3D VE-MRI) with retrospective valve tracking to assess forward and backward flow over the pulmonary valve (PV) and tricuspid valve (TV), and to assess diastolic function in corrected Tetralogy of Fallot (cToF) patients.

Background

Echocardiographic assessment of diastolic function of the right ventricle (RV) is inaccurate in the presence of pulmonary regurgitation (PR). With two-dimensional one-directional velocity-encoded MRI (2D VE-MRI), diastolic flow through the tricuspid valve (TV) and pulmonary valve (PV) can be summated, rendering time-volume curves reflecting RV relaxation. However, 2D VE-MRI of the TV is hampered by heart motion and heart rate variability. 3D VE-MRI overcomes these problems with retrospective valve tracking and the assessment of all valves during one acquisition.

Methods

22 cToF patients with PR (12.8 ± 2.4 y) and 15 controls (13.8 ± 2.5 y) underwent MRI for the assessment of forward and backward flow through the PV and TV including planimetry, 2D VE-MRI and 3D VE-MRI. RV time-volume

curves were reconstructed for the evaluation of diastolic function.

Results

3D VE-MRI pulmonary forward flow showed a strong correlation and agreement with planimetry ($r = 0.88$, difference -2.7 ± 12 mL, not significant) and was significantly different from 2D VE-MRI ($r = 0.88$, difference 5.9 ± 11.8 mL, $p = 0.006$). Compared to planimetry, 3D VE-MRI was more accurate than 2D VE-MRI to assess PV backward flow (difference 2D VE-MRI - planimetry 10.3 ± 15.3 mL, $p = 0.009$, difference 3D VE-MRI - planimetry 3.2 ± 13.9 mL, not significant). With 3D VE-MRI, an excellent correlation was found between effective TV and effective PV flow ($r = 0.97$, $p < 0.0001$) with no significant difference. 3D VE-MRI assessment of diastolic function was able to detect an increased peak early filling rate in patients with a restrictive RV.

Conclusion

3D VE-MRI is more accurate than 2D VE-MRI for the assessment of PR and TV flow. The assessment of diastolic function with 3D VE-MRI can facilitate ongoing research on the implications of diastolic dysfunction in cToF patients.