

Super-resolution MultiVane Technique for 3D-Visualization of Large Vessel Anomalies in fetal MRI

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Objective

To assess the feasibility of super-resolution-aided three-dimensional reconstruction of the heart and large vessels in fetal MRI of normal fetuses and fetuses with vascular malformation using MultiVane technique.

Patients and Methods

The study cohort (n=30) consisted of 15 cases (nine male) with echocardiographically confirmed malformation of the large vessels, and 15 normal cases (eight male). The malformation group included the following entities: tetralogy of Fallot (n=4), aortic coarctation with and without venous malformation (3), right descending aorta (2) common arterial trunk (2), persistent left superior vena cava (1), unilateral pulmonary agenesis (1), hypoplastic left heart (1), heterotaxy syndrome (1). Fetal MRI scans were performed at a mean gestational age of 28+1 gestation weeks (GW) (malformation group) and 29+5 GW (normal group). T2-weighted sequences in three orthogonal planes acquired using MultiVane technique on one 1.5 T scanner (Philips Ingenia) were used to calculate super-resolution datasets. Manual segmentation using free ITK-Snap software was performed to obtain three-dimensional models of the fetal heart and large vessels (aorta, pulmonary arteries, superior and inferior vena cava). T2-weighted images in three orthogonal planes, axial super-resolution images, and three-dimensional models were reviewed for anomalies of the great vessels.

Results

Super-resolution reconstruction based on T2-weighted MultiVane sequences and three-dimensional reconstruction of fetal heart and large vessels was feasible in all (30 of 30) cases. Review of T2-weighted MultiVane sequences in three orthogonal planes identified large vessel malformations in 13 of 15 cases. If super-resolution images and three-dimensional models were available all (15 of 15) malformation cases were correctly classified. Vessel malformations were found in none of the fetuses in the normal group.

Conclusion

Fetal MRI-based visualization of large vessel structures using MultiVane technique and super-resolution is feasible and helpful in the identification of fetuses with cardiovascular malformations. Fetal MRI has the potential to improve early detection and prenatal treatment planning in cases with large vessel anomalies.

