Comparison between Ex-vivo HREM and In-vivo 4DHRTV Ultrasound of the First Trimester Fetal Heart

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Purpose: To compare 3D reconstructed images processed by High Resolution Episcopic Microscopy (HREM) with in-vivo 4D High Resolution Trans Vaginal ultrasound (4DHRTV) in the ability to discern morphological features of the normal human fetal heart at the first trimester.

Methods: Prospective collaborative study on fetal hearts between 9 to 14 weeks. For ex-vivo 3D analysis, 30 human fetal hearts (9w0d-14w6d) retrieved from surgical termination of pregnancy were processed by HREM and high resolution virtual 3D model was created in each case. 4DHRTV ultrasound uses 28 in vivo fetal heart (10w2d-14w0d) obtained using high resolution transvaginal ultrasound. A feasibility comparison between various fetal heart structures was performed using classical (standard) axial planes and surface planes.

Results: All 3D models by HREM demonstrate normal cardiac structures although abdominal situs was undetectable. The 4DHRTV ultrasound able demonstrates the different cardiac structures in the five short axis transverse sections at 32-85% of the fetuses. HREM shows four characteristic features in the first compared to second trimester: prominent atrial appendages, spiral ventricular arrangement, prominent coronary arteries and thickened arterial walls. 4DHRTV also shows the first two, but ultrasound resolution does not yet permit quantification of wall thickness and demonstration of coronary arteries at this resolution of 3-5 mm diameter of the heart.

Conclusions: First trimester 4DHRTV shows similar morphological features to HREM. HREM provides a gold standard of imaging, against which developments in ultrasound resolution can be compared.

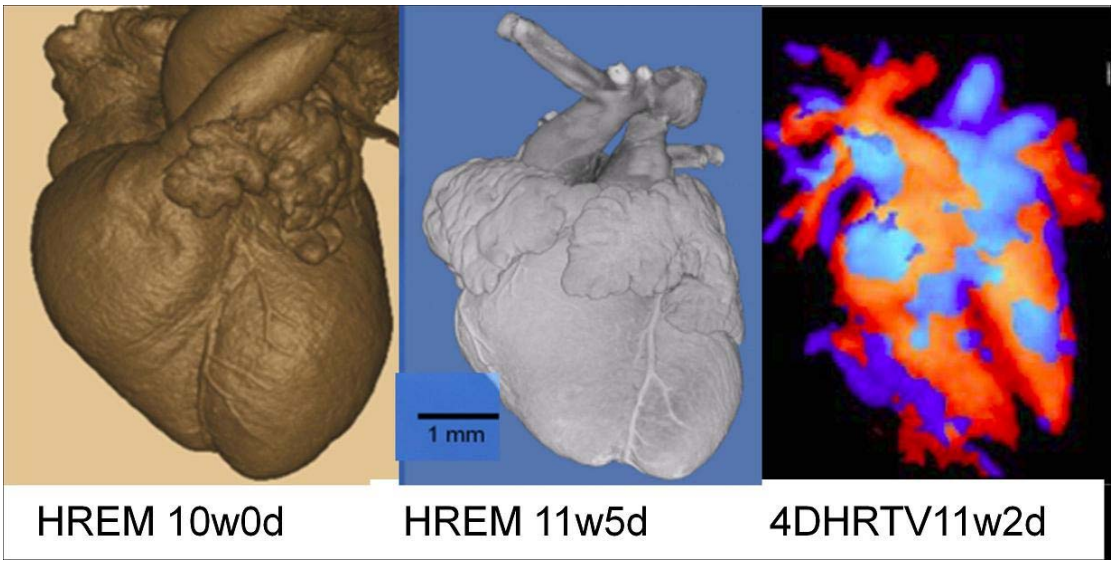

Table 1: Comparison between HREM and 4DHRTV ultrasound in their ability to demonstrate the cardiac structures in the five short axis transverse sections.

	HREM N=30	4DHRTV Demonstrated N=28	Mean gestational age (range)- 4DHRTV Demonstrated	Mean gestational age (range)- 4DHRTV Not Demonstrated
Situs	0	17 (60.7%)	12w (10w3d-13w4d)	Not included in volume
4 chamber views	30	24 (85.7%)	12w (10w2d-14w)	11w (10w2d-12w1d)
Left ventricle outflow	30	14 (50%)	12w1d (10w2d-14w)	11w5d (10w2d-12w3d)
Right ventricle outflow	30	18 (64.3%)	12w1d (10w2d-14w)	11w4d (10w2d-12w3d)
3 vessel trachea	30	21 (71.4%)	12w2d (10w3d-14w)	11w2d (10w2d-12w3d)
Pulmonary Veins	30	9 (32.1%)	12w1d (11w2d-14w)	11w4d (10w2d-12w6d)

Table 3: The 4DHRTV ultrasound ability to demonstrate the specific features of the human first trimester fetal heart, as were detected by HREM.