Ultrasound marker for detecting isolated congenital heart diseases in the first trimester

Tudorache S, Iliescu DG, Dragusin R, Florea M, Patru LC, Ceausescu A, Cara ML
University of Medicine and Pharmacy Craiova, Craiova, Romania

Objective
The aim of this research is to evaluate the modeled predictive value of a volumetric ultrasound marker, the subjective normal spatial arrangement between the inflows and the outflows, in the detection of major congenital heart diseases (MCHDs) at late first-trimester scan.

Methods
We assessed a single volumetric US marker in screening for MCHDs: the subjective normal spatial arrangement between the inflows and the outflows. This marker was quantified by measuring the angle between two lines, traced along the interventricular septum and the main pulmonary trunk (the septal-truncal angle – the STA). We measured the STA prospectively in 100 normal cases. We subsequently applied this measurement in 26 MCHDs (12 isolated) first trimester diagnosed cases. Effects were quantified using multiple logistic regression analysis to develop a mathematical model. The performance of screening was determined by Receiver Operating Characteristics (ROC) curve analysis.

Results
The STA angle’s variation is very low (median 140.43°, range 136.68°–146.02°; SD = 1.52°) in normal cases. Its value has a standard deviation >3 in all MCHDs cases. We found significant differences between the two groups.

Conclusion
The main advantage of performing first-trimester fetal cardiac assessment (using conventional 2D-US or 4D STIC datasets), is, at least for the moment, raising the early second trimester detection rates. The main disadvantage is the dependency on the operator. Using a standardized technique, assessing a single marker (subjective/measurable) has the potential to raise detection rates, by lowering the operator-dependency and by eliminating the fetal position-dependency, the two main reasons for delayed diagnosis of MCHDs. The major drawback of the described method is the cost of the equipment involved.

The STA angle in normal cases

Left: Spatial temporal image correlation (STIC) dataset, displayed in the surface rendering mode (high definition flow mapping applied), in a normal heart case. The measurement of the septal-truncal angle (the STA) is demonstrated. Right: Graphic representation of the variation of STA in normal case series.
Spatial temporal image correlation (STIC) dataset, displayed in the surface rendering mode (high definition flow mapping applied), in a normal heart case. The described parameter 'normal spatial arrangement between inflows and outflows' seen: normal inflows (in red), normal outflows (in blue). The STIC dataset was acquired in an oblique lateral sonation from the right shoulder (with the interventricular septum at approximately 45° to the ultrasound beam).

Spatial temporal image correlation (STIC) datasets, displayed in the surface rendering mode (high definition flow mapping applied), in abnormal cases. The measurement of the septal-truncal angle (the STA) is demonstrated. In the listed order, the isolated MCHDs were: complete atio-ventricular septal defect and tetralogy of Fallot associated, isolated dextrocardia with normal heart, right aortic arch and tetralogy of Fallot associated, and respectively uncorrected great arteries transposition.