

The New Challenge of Prenatal Diagnosis: The Assessment of Fetal Heart Function

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ABSTRACT

Advances in prenatal imaging techniques have allowed a more comprehensive assessment of fetal anatomy, improving the detection rate of congenital anomalies. Evaluation of the fetal heart during the anomaly scan is very important. In particular, detailed fetal echocardiography is necessary in case of suspect cardiac structural abnormality at the time of screening, suspected or confirmed extracardiac abnormalities or increased nuchal translucency.

The new challenge of prenatal diagnosis is to understand the adaptation mechanism of the fetus to pathological conditions, like Fetal Growth Restriction (FGR), preeclampsia, diabetes, infections or malformations, and to study outcomes in the short and long time. For a long time we investigated peripheral vascular structures using Doppler velocimetry to better understand different maternal fetal pathologies. Today we are trying to understand "HOW" the fetal cardiovascular system "adapts" to pathogenic noxa.

Keywords: Fetal heart; Fetal echocardiography; Fetal cardiac remodeling; Myocardial fibers

DESCRIPTION

During the fetal cardiac adaptation to the "noxa", changes in the function, shape or size of the heart can be assessed. The process of heart changes is known as "cardiac remodeling". We tried to understand fetal heart adaptation mechanism and cardiac changes using methodological and technological suggestions arise from postnatal cardiology [1]. But fetal is different from adult circulation because right and left circulation work in parallel. Furthermore, fetal heart development during intrauterine life will depend on the physiological or pathogen-modified fetal-maternal hemodynamic.

Histological and anatomical structure of the fetal heart with three different orientations of the myocardial fibers [2] play an important role in this physiological and pathological development.

Different techniques [3] have been purpose to investigate cardiac morphological and functional changes (Table 1), such as evaluation of the spherical index, atrio-ventricular annular plane displacement or "strain rate"; based on the use of B-mode, M-mode, cardiac doppler and, also, new generation technologies, like Tissue Doppler (TDI) or Speckle Tracking (STE) using dedicated software.

Technique	Parameters	Objective
2D conventional ultrasound	Fetal cardiac biometry and Sphericity Index (SI)	Cardiac remodelling evaluation
M-mode	Fractional shortening and ejection fraction	Evaluation of the systolic valvular plane excursion

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Conventional doppler	Aortic and pulmonary arteries PI and relative stroke volume	Functional cardiac evaluation
	E/A ratio	
	Myocardial Performance Index (MPI)	
Tissue Doppler Imaging (TDI)	Myocardial motion velocity	Evaluation of the longitudinal velocity of the mitral or tricuspid annular plane systolic excursion
Tissue doppler offline of speckle tracking	Strain (ϵ) strain rate	Regional function
4D-STIC	-	Cardiac volume evaluation

Table 1: Techniques for functional evaluation of the fetal heart.

New evidences from International Literature suggest that cardiovascular changes occurring in fetal life may produce unfavorable perinatal outcomes in the short term [4,5], which may persist into childhood and adolescence, increasing cardiovascular morbidity in adulthood. So, prenatal evaluation of fetal cardiac dysfunctions could be useful to prevent and improve cardiovascular outcome in adulthood [6]. But the data in our possession do not yet allow us to be certain that echocardiographic evaluation of fetal cardiac morphometry and function can improve the management and outcome of complicated pregnancies. At the moment the limits are fundamentally determined by the variability of the parameters described and taken into consideration in the evaluation of fetal cardiac function as well as by the variability in the evaluation of these parameters as there are no nomograms, references to fetal and doppler parameters other than those of small studies.

CONCLUSION

The functional study of the fetal heart will be the future of prenatal diagnosis. It will be useful to understand the mechanism in utero will change morphological and functional fetal heart and its implications in short and long term life for human beings. Prospective randomized multicenter studies are needed to develop multiparametric predictive models that integrate echocardiographic, Doppler, clinical data in order to identify fetuses at higher risk of cardiovascular impairment and improve long time cardiovascular risk with appropriate postnatal strategies.

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