



Early detection of IUGR using conventional doppler fetal cardiac function in 2nd and 3rd Trimester

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Abstract

Introduction: Fetal echocardiography is the ultrasonic evaluation of the human fetal cardiovascular system

Aim: The study was conducted with the aim of evaluating the role of AV valve flow pattern in early detection of IUGR pregnancy

Material and Methods: Using Ultrasonography A comparative study of E/A value was done in normal and IUGR fetuses in different gestational age group from 15th to 37th gestational weeks. At term cases were categorized as normal and IUGR on the basis of fetal weight. Correlation of E/A value with gestational age was calculated and compared in both group to find any statistically significant difference.

Result: A positive correlation was observed between E/A value and gestational age in both groups. Low E/A values of mitral and tricuspid valves show significant correlation with low birth weight (IUGR). As ventricular stiffness decreases with advancing gestation, E/A ratio increases from 0.53 ± 0.05 in the first trimester to about 0.70 ± 0.02 in the second half of pregnancy. Indeed E/A ratios around 0.82 ± 0.04 are noted at term. The rise in E/A ratio with advancing gestation suggests a shift of blood flow from late to early diastole

Discussion: By our study, B-Mode & Spectral wave analysis of flow of Atrio-ventricular valve for early detection of IUGR with good accuracy, sensitivity, specificity, positive predictive value & negative predictive value.

Conclusion: We concluded that we can use B-Mode & Spectral wave analysis of flow of Atrio-ventricular valve for early detection of IUGR with strong positive linear correlation with gestational age.

Introduction

Fetal echocardiography is the ultrasonic evaluation of the fetal cardiovascular system. General obstetrical ultrasound has become a standard part of gestational care and is used for the determination of fetal age, size, well being and for the detection of congenital anomalies. A number of maternal or fetal disorders may result in abnormality of the cardiovascular system.

Ultrasound (USG) morphological cardiac examination is now part of routine fetal surveillance, methods of fetal cardiac function measurement is considered difficult, poorly reproducible, and challenging. Analysis of fetal cardiac function may provide information on the hemodynamic status and cardiovascular compensation to different perinatal complications. Such information may be helpful for the clinical

management of pregnancies affected by IUGR, complicated twin pregnancy, fetal hydrops, diabetes, and fetal arrhythmias. Improvements in US imaging technology are now making such evaluation possible. A broad range of techniques have been applied for evaluation of fetal cardiac function including: fundamental image, M-mode, Doppler modes: directional color, power, spectral conventional, and tissue Doppler, and recently 3D and 4D US variants tomographic US imaging (TUI) and spatiotemporal image correlation (STIC). Each of these has its advantages and limitations.^[1]

With early diagnosis, good intranatal and postnatal care can be offered to a baby with a cardiac anomaly and the family can be prepared emotionally and financially to accept such a baby. With improvement in operator skills and the availability of high-end machines the pick-up rate for cardiac anomalies has increased significantly.

Material and Methods

The study was conducted in Department of Radiodiagnosis in collaboration with the Department of Obstetrics and Gynaecology, G.S.V.M. Medical College, Kanpur from January 2018 to October 2019.

The cases coming to the Department of Radiodiagnosis for ultrasound fulfilling the inclusion and exclusion criteria were selected and enrolled in the study after taking informed consent.

In this study pulse Doppler assessment of E/A value was done across both AV valve in different gestational ages was done. A comparative study of E/A value was done in normal and IUGR fetuses in different gestational age group from 15th to 37th gestational weeks.

Study was conducted using SAMSUNG RS-80A USG machine with convex array probe (2-6MHZ). Pregnant woman was examined in supine position with transducer placed on abdomen after applying the coupling agent (gel). Assessment of fetal positions & gestational age was performed. Examinations of situs, cardiac

positions, cardiac axis & cardiothoracic ratio was performed. Any fetal pathological condition was characterized. E/A value were calculated as described below after excluding any cardiac morphological malformation.

E/A Estimation

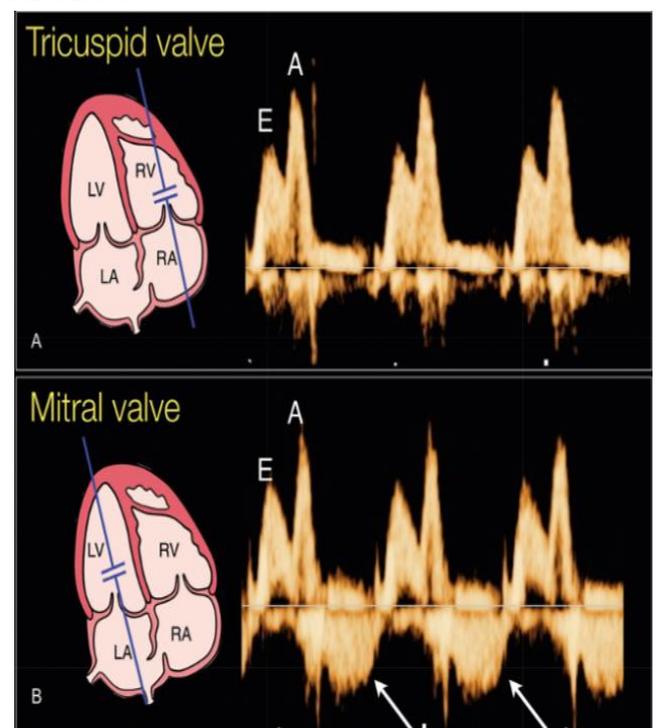
Assessment of the fetal diastolic component of the cardiac cycle was performed with spectral Doppler through the both right and left atrioventricular (AV) valves. The Doppler sample gate was located just below the AV valves where a biphasic waveform is usually displayed in normal fetus. The ratio was obtained by the division of the peak velocities of the E over the A waveforms.

Pregnant women were followed till delivery for fetal outcome and they were divided in two groups according to fetal weight-

Group A- fetal weight >2500 grams (normal)

Group B- fetal weight <2500 grams (IUGR)

Mean E/A value was calculated for each gestational age group range in both normal and IUGR pregnancies. Any statistical significant difference between mean of both groups were calculated.



Doppler waveforms across the tricuspid (A) and mitral (B) valves.

Observations

To study all cases of pregnancy coming in second and third trimester fulfilling the inclusion and exclusion criteria were subjected to ultrasound and doppler evaluation in order to assess the accuracy of ratio of Early passive ventricular filling (E) / Late ventricular filling due to atrial contraction (A). Aforementioned techniques are able to early detect IUGR in second and third trimester with the help of value of E/A in different obstetric age. Our study comprises of 231 patients.

Table 01 Age Distribution of Pregnant Females

AGE	No. OF PREGNANT FEMALES
< 20	1
20-25	84
26-30	104
31-35	39
36-40	3

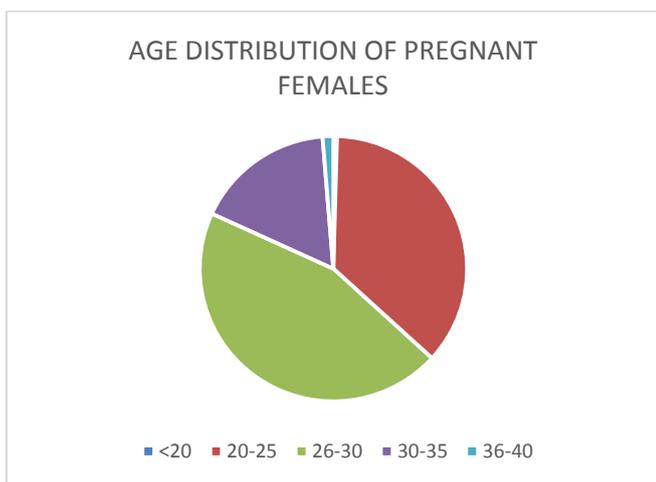


Table 02 Variations in E/A values

E/A VALUES	No. OF CASES
NORMAL	202
RAISED	3
DECREASED	26

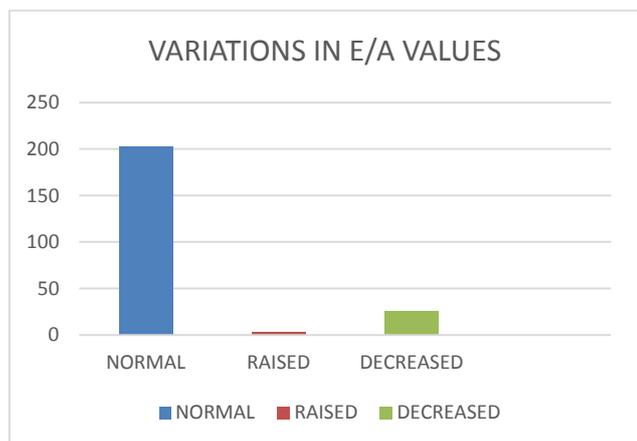


Table 03 Correlation of Fetal E/A values with IUGR Outcome

IUGR OUTCOME	No. OF CASES	% OF CASES WITH IUGR OUTCOME
WITH NORMAL FETAL E/A VALUES	2/202	0.99
WITH RAISED FETAL E/A VALUES	1/3	33.33
WITH DECREASED FETAL E/A VALUES	19/26	73.07

Table 04 Correlation of Fetal E/A values with Normal Outcome

NORMAL OUTCOME	No. OF CASES	% OF CASES
WITH NORMAL FETAL E/A VALUES	200/202	99.00
WITH RAISED FETAL E/A VALUES	2/3	66.66
WITH DECREASED FETAL E/A VALUES	7/26	26.92

Table 05 Correlation between Predicted IUGR and Final Outcome

	IUGR OUTCOME		
	+	-	
PREDICTED IUGR FINAL OUTCOME	+	19	7
	-	18	187

Discussion

Our study demonstrates the normal values and the gestational age-related changes in the tissue Doppler-derived myocardial velocities and other parameters of ventricular function assessment in the fetus. All the tissue Doppler myocardial velocities (systolic S', early E', and late A' diastolic velocities) increased with gestational age at all the three sites, namely, lateral mitral and tricuspid annulus and the medial mitral annulus (interventricular septum). However, the absolute value of the velocities at interventricular septum was much lower than that of the lateral wall which is probably because the septum is coupled with right ventricular while the lateral wall is free. Although both the early (E') and late (A') diastolic velocities increased, simultaneous increase in the E'/A' ratio indicates a greater rise of early diastolic velocity (E') with age and supports the fact that it is an important index of myocardial maturation and ventricular diastolic function. The E'/E' ratio

showed a decrease with increasing gestational age due to improved myocardial relaxation and elastic recoil with myocardial maturation. This observation was similar to that of other studies. The inflow velocities are markedly dependent on loading conditions which can get altered by changes in placental vascular resistance and therefore not necessarily reflect fetal myocardial dysfunction. Tissue Doppler has a major advantage over the inflow velocities as it measures the myocardial velocities which are more accurate and less load dependent. In addition, TDI also evaluates the systolic function. Larsen *et al.* has demonstrated that a decrease in the peak systolic myocardial velocity (S') is a predictor of perinatal mortality in fetuses with growth restriction and reversed umbilical artery flow.

In our study pulse doppler & B-mode Ultrasound alone is not sufficient to diagnose IUGR however we can earlier predict the IUGR with the help of E/A values in pregnant females.

SENSITIVITY	51.3%
SPECIFICITY	96.3%
POSITIVE PREDICTIVE VALUE	73.0%
NEGATIVE PREDICTIVE VALUE	91.2%
ACCURACY	89.1%

Mert Ozan Bahtiyar (2008) et al also found that Cardiac Changes in the Intrauterine Growth-Restricted Fetus. IUGR, which complicates 3% to 10% of all pregnancies leads to hemodynamic changes in affected fetuses. Advanced ultrasound modalities allow reliable and reproducible assessment of the intrauterine fetal cardiac function. Combined cardiac output, individual ventricular ejection forces, E/A ratio, and Tei index can be utilized to quantify fetal heart function.

Conclusions

By our study, we concluded that we can use B-Mode & Spectral wave analysis of flow of Atrio-ventricular valve for early detection of IUGR with good accuracy, sensitivity, specificity, positive predictive value & negative predictive value.

Low E/A values of mitral and tricuspid valves show significant correlation with low birth weight (IUGR). In the fetus, a reduction in both mitral and tricuspid E/A ratio has been reported in recipient twins in twin-to-twin transfusion syndrome (TTTS), along with other markers of diastolic dysfunction.

Increased E/A ratio is seen in situations of cardiac compromise, including intrauterine growth restriction (IUGR) and hydrops due to congenital cystic adenomatoid malformation.

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