

COLOR AND PULSE WAVE DOPPLER ASSESSMENT OF CEREBRAL, UMBILICAL AND UTERINE ARTERIES AND ITS USEFULNESS IN PREDICTION OF PERINATAL OUTCOME

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Abstract

Background: The aim of our study was to evaluate the usefulness of the doppler parameters of the umbilical artery (UA), middle cerebral artery (MCA) and uterine arteries in the prediction of adverse perinatal outcome. **Materials and Methods:** The study population comprised of 92 pregnancies of 28 -40 weeks gestation of whom 64 cases had been diagnosed clinically as intrauterine growth retardation (IUGR). The UA, MCA and uterine arteries doppler parameters such as PSV, RI, PI, S/D Ratio were calculated. **Result:** Totally the sample includes 92 antenatal cases. 64 cases are in experimental (IUGR) group. 28 cases are in control group. In this, 55/92 Cases are delivered by LSCS and 31/92 cases are associated with abnormal perinatal morbidity. 9 cases died during neonatal period. 50/92 cases were low birth weight. Absent diastolic flow in Umbilical artery is seen in 1 case and reversed diastolic flow is seen in 2 cases. The results were correlated with parameters of fetal outcome. **Conclusion:** Inferences drawn from the study were: (1) The Umbilical artery RI and PI are better predictor adverse perinatal outcome. (2) The umbilical artery RI, PI and SD Ratio (Systolic diastolic ratio) shows significant role in the diagnosis of the Intra uterine growth retardation.

INTRODUCTION

Utero placental circulation is essential for the normal growth of the fetus. Intra uterine growth restriction (IUGR) is diagnosed when the growth parameters of the fetus is less than 10th percentile. USG biometry is used to evaluate heterogenous group of small for gestational age fetuses. The common duplex Doppler parameters studied include Umbilical artery [UA], Middle Cerebral arteries [MCA] and Uterine arteries. The values studied include peak systolic velocity [PSV], Resistive index [RI], S/D ratio, Pulsatility index [PI] and ratios of Resistive (RI) and Pulsatility indices(PI) of Middle Cerebral artery and Umbilical artery. Doppler USG identifies the hemodynamic changes associated with Placental insufficiency. In this study, we study the usefulness of the doppler parameters of the umbilical artery (UA), middle cerebral artery (MCA) and uterine arteries and compare the various Doppler parameters in prediction of abnormal perinatal outcome in fetuses diagnosed as intra uterine growth retardation.

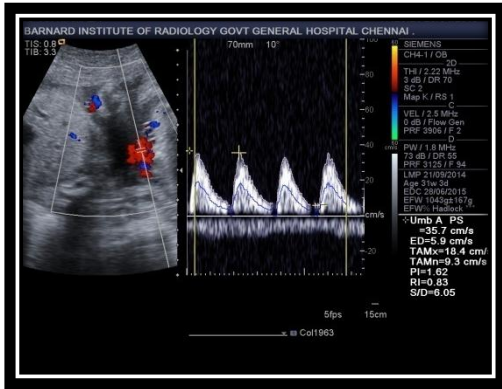
MATERIALS AND METHODS

Growth Assessment

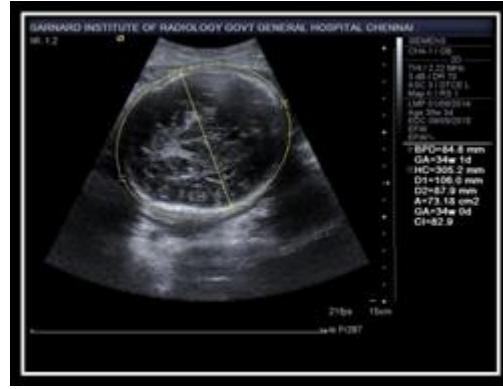
Antenatal cases with Singleton pregnancy in the gestational weeks of 28-40 weeks who had been diagnosed clinically as IUGR and were referred for USG assessment underwent USG duplex Doppler after obtaining consent. Initially fetal biometry was measured and the parameters were plotted in the growth chart. The diagnosis of IUGR was confirmed based on estimated fetal weight. When the fetus biometric measurement are less than 10 th percentile, the cases were considered IUGR.

Doppler Study

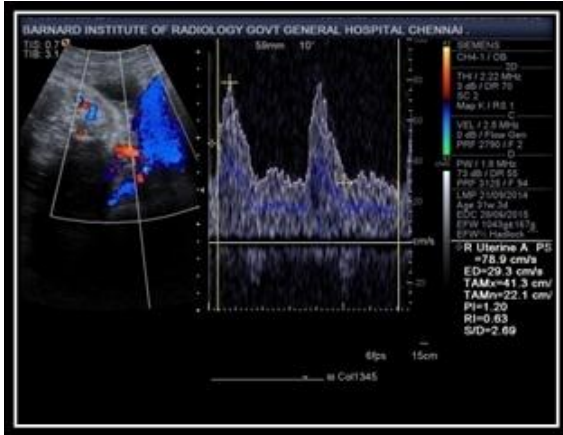
Umbilical artery [UA], Middle Cerebral arteries [MCA] and Uterine arteries were assessed by USG Doppler. The values studied include peak systolic velocity [PSV], Resistive index [RI], S/D ratio, Pulsatility index [PI] and the ratios of Resistive (RI) and Pulsatility indices (PI) of Middle Cerebral artery and Umbilical artery. All the patients were subjected to a repeat USG colour Doppler examination by second radiologist [blinded to the previous findings]. The findings of the initial study were reconfirmed after 15 days. The pregnancies were



UMBILICAL ARTERY



Head Circumference



RIGHT UTERINE ARTERY



ABD Circumference

Doppler shows uterine notch and abnormal PI ratio and RI ratio.

This patient antenatal case was sonographically diagnosed as IUGR. Doppler study shows uterine notch and abnormal Doppler studies.

FOLLOW UP

LSCS was done on the next day of Doppler studies for oligohydromnios. Newborn baby needed NICU care for 5 days for observation.



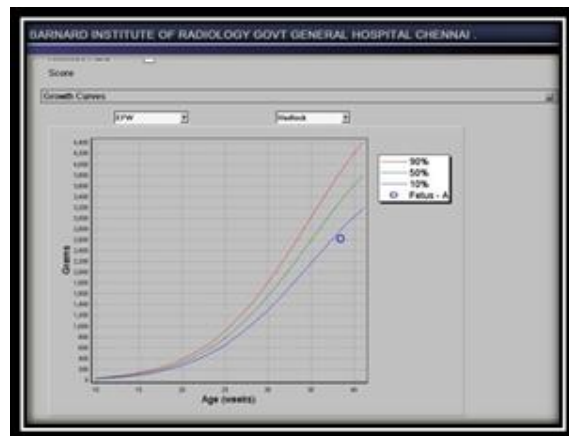
Femoral Length

Case 2

29-year Female ANC LMP GA- 38 weeks 4 days, USG GA – 34 Weeks.



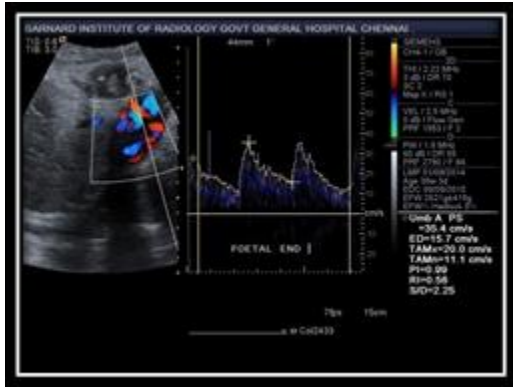
Biparietal Diameter



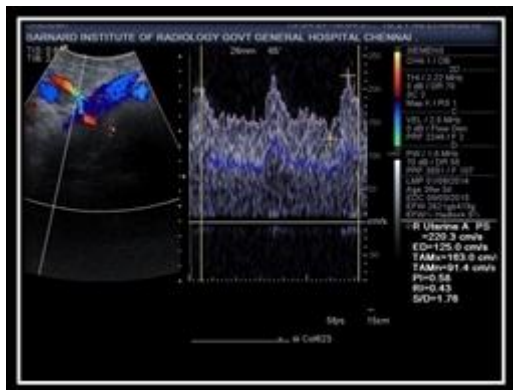
Growth Chart

The fetal biometry shows growth parameters < 10 th percentile for the age of the fetus. This is indicative of IUGR.

DOPPLER STUDY



Umbilical Artery



Uterine Artery- Notch

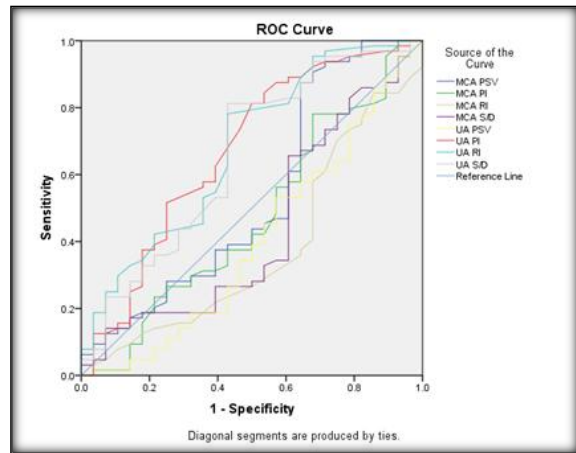
BARNARD INSTITUTE OF RADIOLOGY GOVT GENERAL HOSPITAL CHENNAI							
Fetal Heart Rate Measurement							
Fetal HR: 139 bpm							
OB Fetal Doppler Measurements							
	PS	ED	S/D	TAV	PI	RI	Angle
R MCA	15.3	20.4	2.6	35.5	0.92	0.62	1
Umb A	35.4	15.7	2.95	70	0.99	0.56	1
OB Maternal Doppler Measurements							
	PS	ED	S/D	TAV	PI	RI	Angle
R Uterine A	220.3	125	1.78	163	0.58	0.43	85
OB Biophysical Profile							
Fetal Tone	<input type="checkbox"/>						
Fetal Breathing	<input type="checkbox"/>						
Fetal Movements	<input type="checkbox"/>						
Amniotic Fluid	<input type="checkbox"/>						
Score							
Growth Curves							

IMPRESSION

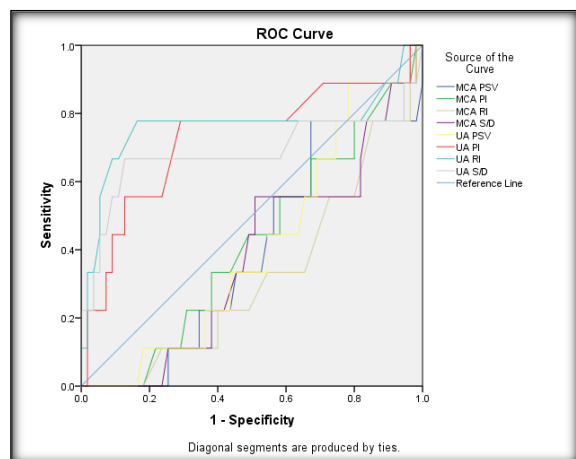
A case of IUGR with abnormal doppler indices. Uterine artery doppler shows uterine notch.

FOLLOW UP

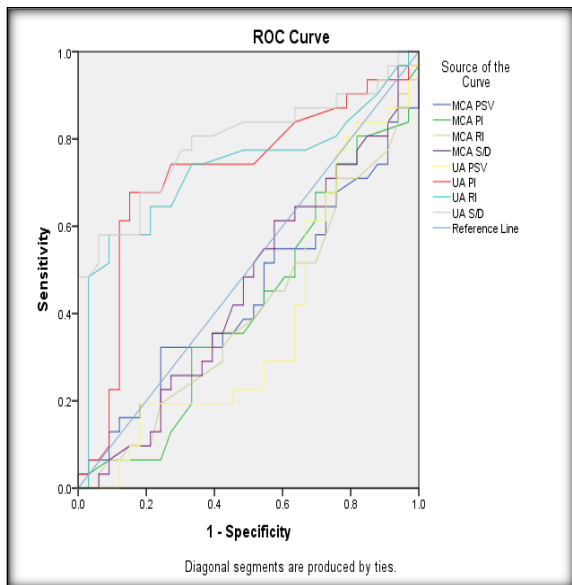
Baby delivered by LSCS for fetal respiratory distress. Baby New Born required NICU Care for 10 days. New Born developed respiratory distress and intra ventricular haemorrhage.



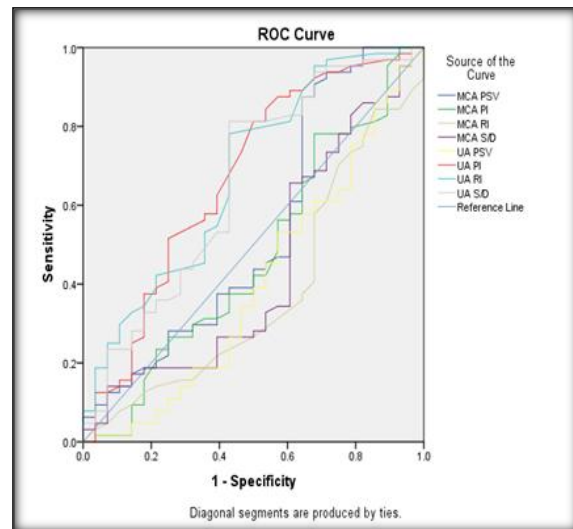
ROC Curve					
Case Processing Summary					
IUGR %	Valid N (listwise)				
Positive ^a	64				
Negative	28				
Larger values of the test result variable(s) indicate stronger evidence for a positive actual state.					
a. The positive actual state is IUGR.					
Area Under the Curve					
Test Result Variable(s)	Area	Std. Error ^a	p-value	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
MCA PSV	.532	.072	.623	.392	.673
MCA PI	.471	.069	.662	.337	.606
MCA RI	.379	.065	.065	.251	.506
MCA S/D	.441	.069	.366	.306	.575
UA PSV	.400	.068	.130	.267	.533
UA PI	.670	.065	.010	.542	.798
UA RI	.678	.063	.007	.555	.801
UA S/D	.655	.066	.019	.526	.783
The test result variable(s): MCA PSV, MCA PI, MCA RI, MCA S/D, UA PSV, UA PI, UA RI, UA S/D has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.					
a. Under the nonparametric assumption					
b. Null hypothesis: true area = 0.5					



Case Processing Summary					
MORTALITY	Valid N (listwise)				
Positive ^a	9				
Negative	55				
Larger values of the test result variable(s) indicate stronger evidence for a positive actual state.					
a. The positive actual state is Dead.					
Area Under the Curve					
Test Result Variable(s)	Area	Std. Error ^a	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
MCA PSV	.391	.093	.297	.209	.573
MCA PI	.417	.095	.428	.231	.603
MCA RI	.323	.091	.091	.145	.501
MCA S/D	.380	.094	.251	.196	.563
UA PSV	.404	.090	.359	.228	.580
UA PI	.725	.107	.031	.516	.935
UA RI	.763	.120	.012	.528	.998
UA S/D	.685	.132	.077	.426	.944
The test result variable(s): MCA PSV, MCA PI, MCA RI, MCA S/D, UA PSV, UA PI, UA RI, UA S/D has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.					
a. Under the nonparametric assumption					
b. Null hypothesis: true area = 0.5					



Area Under the Curve					
Test Result Variable(s)	Area	Std. Error ^a	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
MCA PSV	.441	.073	.416	.298	.584
MCA PI	.417	.072	.256	.277	.558
MCA RI	.404	.071	.186	.264	.543
MCA S/D	.457	.073	.554	.315	.599
UA PSV	.381	.072	.103	.241	.522
UA PI	.718	.068	.003	.584	.852
UA RI	.729	.068	.002	.597	.862
UA S/D	.793	.059	.0001	.677	.909
The test result variable(s): MCA PSV, MCA PI, MCA RI, MCA S/D, UA PI, UA RI, UA S/D has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.					
a. Under the nonparametric assumption					
b. Null hypothesis: true area = 0.5					



DISCUSSION

Intrauterine growth restriction (IUGR) is a failure of the fetus to achieve its optimal growth potential.^[1] IUGR is defined as effective fetal weight (EFW) of less than 10th percentile for gestational age during pregnancy.^[1]

Intra uterine growth retardation can be diagnosed with routine USG examination with fetal biometric measurements.

Fetal growth assessment in second and third trimesters include biparietal diameter (BPD), head circumference (HC), femur length (FL), abdominal circumference (AC).

The Placental insufficiency is the most common cause of intrauterine growth retardation.^[3] Entire Placental blood flow, thereby fetal blood flow depends on bilateral uterine arteries. Assessment of uterine artery indirectly reflects the placental flow.

Case Processing Summary					
ICU	Valid N (listwise)				
Positive ^a	31				
Negative	33				
Larger values of the test result variable(s) indicate stronger evidence for a					

Doppler studies of the uterine artery, Umbilical artery and MCA provides the important information about the distribution of fetal blood flow. In IUGR, the distribution of fetal blood flow is altered. There is more redistribution of blood to the brain. This redistribution is assessed by doppler study of umbilical artery and MCA. So it is used to identify the severity of Intrauterine growth retardation and thereby the fetuses at risk for an adverse outcome.^[4,5]

Various studies test the significance of changes in these parameters in diagnosis of IUGR and in prediction of adverse perinatal events so that the obstetrician can decide about the management.

Arduini and Rizzo et al.^[4] studied the characteristics of MCA, Umbilical artery, renal artery PI indices in prediction of adverse perinatal outcome. After the diagnosis of IUGR, the PI ratio was best test than PI indices of MCA, Umbilical artery. The results in that study were specificity of 94% (91%, 88%, 91%) .98 and sensitivity 89% , (vs 68%, 64%,43%)

In another study chan et al.^[2] studied 71 high risk cases . He followed up the cases with weekly Doppler until delivery. There was 15% perinatal mortality and morbidity. They found RI ratio is more sensitive but less specific than Umbilical artery SD Ratio.

Dangolo Gramellini et al.^[1] studied cerebro umbilical ratio as a predictor of adverse perinatal event. According to his study, specificity and positive predictive value is higher for MCA PI and sensitivity is higher in PI ratio.

In our study, the sensitivity to predict the outcome is higher for umbilical RI, specificity is higher for

umbilical artery PI. Positive predictive value are also higher for umbilical PI. In our study Umbilical artery absent diastolic flow is seen in 1 case and reversed diastolic flow is seen in 2 cases. Umbilical artery RI, PI and SD Ratio showed good correlation with fetal outcome.

CONCLUSION

1. The Umbilical artery RI and PI are better predictor of adverse perinatal outcome.
2. The umbilical artery RI, PI and SD Ratio (Systolic diastolic ratio) shows significant role in the diagnosis of the Intra uterine growth retardation.

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