

Research Article

A clinical study of role of colour Doppler imaging in pregnancies at risk

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Abstract

Aim: To determine the role of colour Doppler sonography in evaluation of fetal outcome in high risk pregnancies and in normal patients.

Methods: Study carried out in 23 high risk cases and 10 normal antenatal cases in their third trimester. Studies of various arteries performed using colour Doppler ultrasound {ESOATE BIOMEDICAL 3 AU TRIPLEX DOPPLER MACHCINE} with 3.5 MHz curvilinear transducer. The umbilical artery and fetal middle cerebral artery studied. The required measurements taken in form of peak systolic velocity and end diastolic velocity and calculation of Systolic/Diastolic(S/D) ratio and Resistive Index(RI) sone and results compared with fetal outcome.

Results: The mean weight of the baby 2.13(0.62)kg. 6 babies had respiratory distress and 7 babies had APGAR score at 5'≤7. 9 babies stayed in NICU>24 hours. We had 1 intrauterine death Umbilical artery S/D ratio >3 for the prediction of IUGR had a sensitivity of 69.2% and specificity of 60%, and for the prediction of adverse perinatal outcome had a sensitivity of 76.5% and specificity 100%. RI ratio <1 for the prediction of IUGR had a sensitivity of 46.15% and specificity of 70% and for the prediction of adverse perinatal outcome has a sensitivity of 47.4% and specificity of 100%.

Conclusion: Doppler can be considered as one of the important non invasive technique to assess fetomaternal and uteroplacental circulation. Due to it feasibility and safety it can be used in antepartum surveillance in high risk cases to know pregnancy outcome and also formulate plan of management for optimum fetal and maternal outcome.

Keywords: colour Doppler, Doppler indices , high risk pregnancy

1. Introduction

The application of Doppler velocimetry has been well established regarding intrauterine growth restriction, fetal hypoxia, hypertension, fetal anaemia and cardiac malformations.^{1,2,3,4} Doppler deterioration was observed 24 hours before biophysical profile score declined. The combination of longitudinal multivessel monitoring and biophysical profile score together with the gestational age could help in optimising management of fetus with IUGR.⁵

Doppler investigation of the fetal venous circulation may play an important role in monitoring growth retarded fetus and optimising time of delivery.⁶ Cerebral/umbilical ratio found to be the best parameter to diagnose small for

gestational age fetus and also adverse perinatal outcome.^{2,7} The hypoxic events which happen before labour is much more important than what happens during and after labour.⁸

We have designed our study to emphasize the importance of Doppler ultrasound in high risk pregnancies in regard to maternal and fetal outcome.

The primary objective of the study was to know the Doppler middle cerebral S/D ratio, Umbilical artery S/D ratio in the prediction of perinatal outcome in pregnancies at risk and also to determine the accuracy of the middle cerebral to umbilical artery resistance index ratio in the prediction of fetal outcome in pregnancies at risk.

2. Materials and methods

The present study of evaluation of fetal well being by blood flow studies was performed on antenatal patients (with known LMP) in Karnataka Institute of Medical Sciences, Hubli. All the subjects underwent detailed clinical examination and relevant laboratory investigations. We had 23 study patients and 10 patients of same characteristics with low risk taken as control. In our study pregnancy at risk meant any obstetrical/clinical condition which affect fetoplacental circulation and influences the outcome of pregnancy.

Patients whose LMP was not known, who were admitted with less than 28 weeks of gestation were not recruited in our study. Informed written consent taken from all the patients.

Studies of various arteries performed using colour Doppler ultrasound {ESOATE BIOMEDICAL 3 AU TRIPLEX DOPPLER MACHINE} with 3.5 MHz curvilinear transducer. The recording of images done with sony thermal printer. Doppler measurements were taken with the mother in recumbent position during fetal inactivity and apnea.

The umbilical artery was interrogated at its middle portion where the umbilical cord was freely floating in the liquor. Three frames of waveforms were obtained. The middle cerebral artery was located after identifying the circle of Willis. The middle cerebral artery was traced upto its portion in the vicinity of the middle cerebral peduncles and interrogated.

The required measurement taken in the form of

- Peak systolic velocity
- End diastolic velocity

Calculation of indices : Following indices were calculated using the measurements from arterial waveforms.

1. S/D ratio

2. Resistive index: $RI = \frac{S - D}{S}$

Where S = max. Systolic Doppler shift frequency

D = minimum Doppler shift frequency

Doppler indices were considered abnormal when S/D ratio, RI of each artery > 2SD for the gestational age according to the standard reference values.

The inbuilt software of the machine used to give all the values of indices after tracing the waveforms.

3. Results

Most of our patients belonged to 21-30 years. 13 patients had to be induced ; severe PIH(7), IUGR with mild PIH(4), oligoamnios(2). 12 patients delivered vaginally and 11 underwent caesarean section. The mean weight of the baby 2.13(0.62)kg. 6 babies had respiratory distress and 7 babies had APGAR score at 5' \leq 7. 9 babies stayed in NICU > 24 hours. We had 1 intrauterine death Umbilical artery S/D ratio > 3 for the prediction of IUGR had a sensitivity of 69.2% and specificity of 60%, and for the prediction of adverse perinatal outcome had a sensitivity of 76.5% and specificity 100%. RI ratio < 1 for the prediction of IUGR had a sensitivity of 46.15% and specificity of 70% and for the prediction of adverse perinatal outcome has a sensitivity of 47.4% and specificity of 100%. Doppler indices shown in tables 11-V.

Table 1: Maternal characteristics of patients

Variables	Number
Parity	
Primipara	12
Multipara	11
Delivery	
Vaginal	12
Caesarean section	11
Indication for caesarean section	
Fetal distress	06
Severe PIH	02
Transverse lie	01
Others	02
Perinatal outcome	
AGA	10
SGA	13
IUD	01

Table 11: Umbilical artery indices

	Control	Study
Indices	Mean(SD)	Mean(SD)
S/D	2.166(0.6171)	3.1534(1.3779)
RI	0.5666(0.068)	0.7191(0.1095)
‘t’ =2.02 at p=0.05; Here ‘t’ value 2.8431, significant		

Comparison of umbilical artery S/D ratio.

Table III: Middle cerebral artery indices.

	Control	Study
Indices	Mean (SD)	Mean (SD)
S/D	4.73(0.7184)	5.4573(2.740)
RI	0.773(0.0425)	0.767(0.1121)

Table IV: RI Ratio(MCA/UA)

RI Ratio(MCA/UA):	Mean (SD)
Study	1.0891(0.2185)
Control	1.391(0.2344)

Table V: Comparison of umbilical artery S/D ratio

Umbilical artery S/D ratio		
	Mean	SD
Study	3.1534	1.3779
Control	2.166	0.6171
t=2.02 at p=0.05; here ‘t’ value 3.4622, significant		

4. Discussion

The results of this study have confirmed importance of Doppler evaluation in high risk pregnancy. Vast majority of cases of IUGR, poor trophoblastic invasion of maternal spiral arteries and reduced uteroplacental flow is underlying defect. Progressive reduction in intervillous flow will result in increased placental flow resistance and abnormal umbilical artery Doppler indices.⁹

Messawa and co-workers in their cohort study subjected 100 patients to colour Doppler and 100 controls and showed the Doppler studies to be more beneficial in the perinatal as well as neonatal management.¹⁰ Khalid M and co workers on the study of colour Doppler on hypertensive patients in third trimester showed values of S/D, RI and PI above 2 SD in 61.1% of cases, of which 50% patients had SGA babies.¹¹

Middle cerebral artery (MCA Doppler time-averaged mean velocity (TAMV) for the prediction of fetal anaemia done on 35 fetuses without ultrasound features of hydrops showed a strong negative correlation between the MCA Doppler TAMV and the Hb values (correlation coefficient $r=-0.65$, $p<0.0001$). The sensitivity of the increased MCA Doppler TAMV to predict fetal anaemia in these cases was 96.4% and the specificity was 71.4%. It can be a reliable non invasive test to detect fetal anaemia and invasive procedure can be delayed until treatment is planned.¹² In our study mean middle cerebral artery S/D ratio of 5.5 in study group and 4.7 in control group which was not very significant because of the brain sparing effect which results in an increased diastolic flow during fetal asphyxia.

In a study on 50 preeclamptic patients, the cut off levels for MCA, MCA/UA was found to be 3 and 1 respectively and when MCA/UA ratio was <1 foetal prognosis was poor.¹³ In our study mean middle cerebral to umbilical artery RI ratio was 1.0891 and 1.391 respectively for the study and control group. Sensitivity was 46.15% and specificity 70% for IUGR and sensitivity of 47.4% and specificity of 100% for adverse perinatal outcome with MCA/UA RI ≤ 1 .

Prospective study of 139 high risk cases, early evaluation of arterial uterine RI and presence of notches predicted low birth weight and intra uterine growth retardation in a high risk population between 12-14th weeks.¹⁴ In our study, mean umbilical artery S/D ratio of study group and control group was >3 and <3 respectively. We had a sensitivity of 69.2% and specificity of 60% for IUGR and a sensitivity of 76.5% and specificity of 100% for other adverse perinatal outcome.

Pooled results from sixteen studies have shown that Doppler velocimetry in umbilical and fetal arteries in high risk pregnancies, coupled with appropriate intervention can reduce perinatal mortality by 29% [RR 0.71, 95% CI 0.52-0.98] and reduce still birth by 35% [RR 0.65, 95% CI 0.41-1.04]. The results were not of statistical significance. Nevertheless it can be recommended for high income and middle income countries to improve the standards of facility based care.¹⁵

Fifty preeclamptic pregnant women selected randomly in the last three weeks of the third trimester were stratified into two groups based on the MCA/UA ratio. The MCA/UA was valuable for predicting the outcome of preeclamptic and hypertensive pregnancies. When the ratio was <1 , foetal prognosis was poor.¹³ Prospective study of 100 high risk patients cerebral/umbilical pulsatility ratio (C/U ratio) was 100% specific in diagnosing intrauterine growth retardation in third trimester.²

In conclusion, doppler can be considered as one of the important non invasive technique to assess fetomaternal and uteroplacental circulation. Due to its feasibility and safety it can be used in antepartum surveillance in high risk cases to know pregnancy outcome and also formulate plan of management for optimum fetal and maternal outcome.

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