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Research Article

Role of doppler in fetal growth restriction

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ABSTRACT

Background: Fetal growth restriction is an important and particularly challenging problem for modern obstetricians and paediatricians. The present study is to correlate the importance of Doppler velocimetry and perinatal outcome in cases of growth restricted foetuses by comparing perinatal outcome of control & study groups with normal and abnormal Doppler waveforms.
Methods: A study and a control group comprising of 50 pregnant women having growth restricted foetuses in each group was matched for all other confounding factors except for Doppler changes. These patients were followed up and the perinatal outcomes of FGR foetuses having Doppler changes was compared with those having normal Doppler studies.
Results: In our study, alteration in both MCA and UmbA Doppler was associated with perinatal morbidity and NICU admissions in 64% and mortality in 28%. Doppler changes showing altered CPR less than 1 had adverse outcome with NICU admission in 61% and mortality in 34%. Alteration in DV Doppler was associated with perinatal morbidity and NICU admissions in 17% cases and mortality in 83% cases, with no pregnancies having a healthy outcome. Among high-risk pregnancies with suspected IUGR, the use of Doppler assessment significantly decreases the likelihood of labor induction, caesarean delivery, and perinatal deaths.
Conclusions: Abnormal Doppler waveform changes indicate adverse perinatal outcome of pregnancies with FGR. Doppler study helps to reduce perinatal mortality and morbidity by timely and appropriate interventions.

Keywords: Fetal growth restriction, Umbilical artery Doppler, Middle cerebral artery Doppler, Ductus venosus Doppler, Cerebro placental ratio

INTRODUCTION

The overall incidence of fetal growth restriction (FGR) varies in different studies but is usually between 3% and 10% of all births1. In India the incidence of low birth weight varies from 15 to 25% and more than 50% of them are FGR.[2] The growth restricted foetuses are associated with perinatal complications and need monitoring and evaluation.

FGR refers to deviation and reduction in expected fetal growth pattern. Small for gestational age (SGA) infants are those having birth weights below the 10th percentile for their gestational age. Not all FGR infants are small for gestational age. FGR foetuses are classified as symmetric or asymmetric in term of their body proportion. Symmetrically growth restricted foetuses are usually associated with factors that directly impair the intrauterine growth potential of foetus (i.e. chromosomal abnormalities, viral infections etc.) while asymmetric growth restriction is classically associated with utero-placental insufficiency.[3] The most common cause for uteroplacental insufficiency is pregnancy induced hypertension.

The preferred radiological examination for evaluating FGR is ultrasonographic examination. These include

grayscale assessment of parameters of foetal biometry (BPD, FL, AC, HC and EFW). The foetal surveillance is by Doppler study of the umbilical artery (UmbA), middle cerebral artery (MCA) and ductus venosus (DV). FGR is associated with an inadequate quality and quantity of the maternal vascular response to placentation which is shown by the characteristic pathological findings in the placental bed like atheromatous-like lesions that completely or partially occlude the spiral arteries4. Fetal Doppler studies help in identifying the circulatory changes caused by this pathology.

In the growth-restricted fetus, redistribution of well-oxygenated blood to vital organs, such as the brain, heart and adrenals, represents a compensatory mechanism to prevent fetal damage. When the reserve capacities of the circulatory redistribution reach their limits, fetal deterioration may occur rapidly. The onset of abnormal venous Doppler results indicates deterioration in the fetal condition and iatrogenic delivery should be considered.

In the sequence of deterioration of the condition of the growth-restricted fetus, the first pathological finding is increased impedance to flow in the umbilical artery signified by the increase in the Umbilical Artery Pulsatility Index (UmbA PI). This is usually associated with evidence of arterial redistribution in the fetal circulation, best monitored by examining the PI in the middle cerebral artery (MCA PI), which is decreased. This results in the fall of Cerebro-Placental Ratio (CPR = MCA PI / UmbA PI) and, subsequently, the development of pathological fetal heart rate patterns. On average, the time interval between the onset of abnormal umbilical arterial Doppler results and the onset of late fetal heart rate decelerations is about 2 weeks.[5-7] Hence the most useful diagnostic criteria are umbilical artery PI and cerebro-placental ratio (CPR).[8]

Normal venous flow suggests continuing fetal compensation, whereas abnormal flow indicates the breakdown of hemodynamic compensatory mechanisms.[9] An abrupt increase in pulsatility of ductus venosus (DV) waveforms with loss of forward flow velocity during atrial contraction precede the onset of pathological fetal heart rate patterns and decreased short-term variation. This interval may be as short as a few hours to few days before intrauterine death occurs.

The aim of fetal and maternal surveillance in the case of fetal growth restriction may be summarized as the need to optimize the timing of delivery before death of the fetus in the uterus or before it undergoes permanent damage. The importance of our study is to draw attention of the clinicians to the importance of Doppler study in the management of FGR and its role in decision making regarding the further course of the pregnancy and timing of delivery. Timely intervention can help in the better perinatal outcome of pregnancy.

METHODS

The study was conducted at Obstetrics department of Sheth V.S. General Hospital, Ahmedabad, Gujarat, India between 1st July 2014 and 1st July 2015. Cases were sampled according to the inclusion and exclusion criteria from all the third trimester singleton pregnancies with FGR attended to at our department and their Doppler examination was done. Analysis of spectral waveforms and pulsatility (PI) of umbilical artery, middle cerebral artery and ductus venosus was done. Total sample was split in to 2 groups of 50 each depending on their Doppler findings. Group A (n=50) included patients with FGR having altered Doppler. Group B (n=50) comprised of patients with FGR and normal Doppler indices. Data was collected which included diagnosis to delivery interval, gestational age at birth, admission to neonatal intensive care, morbidity and mortality if any. Pregnancy with diabetes, pregnancies with other associated chronic maternal conditions and foetuses having congenital anomalies were excluded.

Informed consent was taken from all the pregnant patients included in the study. The pregnancies were dated by a combination of last menstrual period and the first trimester dating scan. The diagnosis of FGR was made clinically and confirmed subsequently on ultrasound, when foetal abdominal circumference and estimated foetal weight was below 10th centile for the gestational age.

RESULTS

Table 1: Relationship of altered Doppler and perinatal outcome.

	Morbidity (requiring NICU Admission)	Mortality even after NICU admission	Healthy
Altered UmbA PI (n=47)	26 (55%)	09 (19%)	12 (26%)
Altered MCA PI (n=40)	23 (58%)	09 (22%)	08 (20%)
Both UmbA and MCA PI (n=42)	27 (64%)	12 (28%)	03 (08%)
Altered DV Doppler (n=12)	02 (17%)	10 (83%)	00 (00%)

DISCUSSION

Altered UmbA Doppler is associated with perinatal morbidity and NICU admissions in 55% cases and mortality in 19% cases. Altered MCA Doppler is associated with perinatal morbidity and NICU admissions

in 58% cases and mortality in 22% cases. Alteration in both MCA and UmbA Doppler is associated with perinatal morbidity and NICU admissions in 64% cases and mortality in 28% cases. These results are comparable with other studies which have mortality rate of about 22% and morbidity rate of 62%.[9]

Table 2: CPR and perinatal outcome.

	Morbidity (requiring NICU Admission)	Mortality even after NICU admission	Healthy
CPR >1 (n=64)	27 (42%)	05 (08%)	32 (50%)
CPR <1 (n=36)	22 (61%)	12 (34%)	02 (05%)
Total	49	17	34

Table 3: Time of delivery.

	<33 weeks	33-37 weeks	>37 weeks
Group A	34(68%)	12(24%)	4(8%)
Group B	22(44%)	19(38%)	9(18%)

Table 4: Mode of delivery.

	LSCS	Normal Delivery
Group A	41(82%)	9(18%)
Group B	29(58%)	21(42%)
Total	70	30

Table 5: Perinatal morbidity and mortality.

	Neonatal Intensive Care admission	Perinatal Mortality
Group A	30(60 %)	14(28%)
Group B	19(38%)	3(6%)
Total	49	17

According to Gramellini et al, the cerebral-placental Doppler ratio provided a better predictor of adverse perinatal outcome for FGR new-borns than either the MCA or UmbA alone. In our study, the Doppler changes showing altered CPR less than 1 had adverse outcome with NICU admission in 61% and mortality in 34% cases, which correlated well with other studies.[10]

Alteration in DV Doppler is associated with perinatal morbidity and NICU admissions in 17% cases and mortality in 83% cases, with no pregnancies having a healthy outcome. These results are congruent with the study by Gudmundsson et al, where they have noted 80% mortality in foetuses with altered DV Doppler.[11]
In our present study, in 82% of the cases, delivery was conducted by LSCS as compared to 58% in the control group. Normal delivery was conducted in 18% of the cases compared to 42% in the control group. These results are comparable with Lakhakar et al, showing 62% of caesarean rate in abnormal Doppler and 38% vaginal birth in their study.[9]

In accordance with the results of our study, a systematic review of other Doppler studies indicates that among high-risk pregnancies with suspected IUGR, the use of Doppler assessment significantly decreases the likelihood of labor induction, caesarean delivery, and perinatal deaths. Antepartum surveillance with Doppler should be started when the fetus is viable and IUGR is suspected, which can help improve the perinatal outcome of the fetus.[12-14]

CONCLUSIONS

Doppler velocimetry is the key for early detection, prompt follow up, and timely decision making in management of FGR. Doppler allows better understanding of hemodynamic changes in fetoplacental and uteroplacental circulation associated with growth restricted foetuses. As changes in umbilical and middle cerebral artery circulation strongly correlate with pregnancy outcome, Doppler is a primary tool for feto-maternal surveillance in these pregnancies.

Study of middle cerebral artery is as important as umbilical artery in term of neonatal outcome. The cerebro-placental ratio (CPR), which measures the proportion of flow supplying the brain and placenta, is one of the most powerful parameters for assessment of FGR and hypoxia as it takes into account the cause and consequences of placental insufficiency. If CPR is less than 1, there is not only a high rate of perinatal loss, but the surviving fetus demonstrates signs of profound compromise. If umbilical and middle cerebral artery Doppler indices are positive then the study should be extended to other fetal vessels like ductus venosus. Abnormal ductus venosus Doppler signifies impending fetal compromise and imminent fetal distress and such pregnancies should be considered for urgent iatrogenic termination.

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