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ORIGINAL RESEARCH

Implications of colour doppler ultrasound in determining detrimental perinatal consequences and IUGR in cases of high-risk pregnancies

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ABSTRACT

Introduction: The colour flow Doppler imaging is already being used to analyse abnormal vascular flow patterns in intrauterine growth restriction and high-risk pregnancies. The study used middle cerebral artery and umbilical artery blood flow to link Doppler findings with perinatal outcome and IUGR in high-risk pregnancies.

Methods: Fortwo years, 100 women with singleton pregnancies with vertex presentation between 28 and 40 weeks of gestation complicated by preeclampsia and IUGR were examined for umbilical artery and middle cerebral artery Doppler waveforms at Jagannath Gupta Institute of Medical Science and Hospital, Kolkata, West Bengal, India. Perinatal outcome data were captured and statistically analysed using the percentage and Chi-square test.

Results: In our investigation, 57% of the umbilical artery wave shapes had the highest LSCS for foetal distress. The umbilical artery PI offers the highest sensitivity for detecting IUGR (82.2%). Umbilical RI also predicted APGAR<48 hours with 100% sensitivity. Perinatal mortality was highest with abnormal PI (41.8%), followed by abnormal RI (34%), and abnormal S/D (31%). The aberrant PI group had the highest LSCS for foetal distress, at 30.2%. Perinatal death was 31.5% in those with a CPR of 48 hours and 100% sensitivity in predicting foetuses with APGAR.

Conclusion: Non-invasive techniques such as colour Doppler velocimetry is a useful method for assessing foetal well-being.

INTRODUCTION

A range of measures are used to assess foetal well-being in high-risk pregnancies, including NST, biophysical profile, and daily foetal moment. All of these tests may not have a high degree of sensitivity and specificity, and their positive predictive value for assessing foetal well-being may not be as high as desired [1, 2]. Color Doppler flow velocimetry, a breakthrough in ultrasound technology, has revolutionised the diagnosis of abnormal blood flow patterns in the foeto-placental bed, and early identification of these abnormal patterns is useful in determining the optimal time for delivery to reduce perinatal mortality [2].

Intrauterine growth restriction (IUGR) is defined as foetal weight measured by sonography to be less than the 10th percentile for gestational age [3]. The present clinical care of IUGR has challenges such as accurate diagnosis of the genuinely growth restricted foetus, selection of adequate foetal surveillance, and optimization of birth schedule. Color Doppler flow velocimetry has the advantage of detecting preeclampsia and IUGR early, which can reduce

foetal morbidity and death [2, 3]. This procedure examines blood flow in the umbilical artery and MCA of the foetus in high-risk pregnancies, particularly those with preeclampsia, gestational diabetes, and IUGR. The aberrant wave patterns obtained from this artery can be used to assess foetal hypoxia [4, 5, 6].

As a result, the goal of this study is to identify early high-risk foetuses using variations in doppler flow velocity waveforms. It also seeks to assess the importance of several indicators in predicting pregnancy-induced hypertension and intrauterine growth retardation.

METHODS

The study included 100 women referred to Jagannath Gupta Institute of Medical Science and Hospital, Kolkata, West Bengal, Indiawith singleton pregnancies with vertex presentation between 28 and 40 weeks of gestation complicated by preeclampsia and IUGR.

Inclusion criteria: Singleton pregnancies with vertex presentation between 28-40 weeks of gestation complicated by preeclampsia and IUGR were eligible. Preeclampsia is defined as (1) blood pressure of 140/90 mm Hg after 20 weeks of pregnancy and (2) proteinuria of 300 mg/24 hours or 1+ dipstick. Intrauterine growth restriction criteria are defined as a lag of more than 4 cms in the symphysiofundalheight than expected for the gestation time (as measured by Naegele's technique).

Exclusion criteria-Patients with medical and obstetric complications, Intrauterine fetal demise, Multiple gestation, Anomalous fetus, unreliable LMP details and not confirmed by 1st trimester scans.

All patients gave their informed consent. A thorough examination and detailed history were performed. All necessary investigations were conducted. The pertinent data was recorded in the usual supplied proforma.

METHODOLOGY

The Doppler effect is the observed shift in frequency of energy wave transmission caused by relative motion between the source of wave transmission and the observer. The frequency change is referred to as the doppler effect. When an ultrasound beam collides with blood flow, the doppler effect is also noticed. Millions of RBCs in the blood act as moving scatterers of the event ultrasonography. In this case, the erythrocytes serve as both a moving receiver and a moving source, establishing the basis for the Doppler equation.

A free-floating umbilical cord loop was identified using Doppler. The signals were then collected after optimising the angle of insonation. When the umbilical artery S/D ratio exceeded 3, it was considered abnormal. When the RI and PI of the umbilical artery exceeded the 95th percentile, it was declared high. The middle cerebral artery is the internal carotid artery's greatest terminal branch. It was sonated at the level of the sphenoid's larger wing. For this vessel, the angle of in sonation can easily be controlled at zero. The systolic flow (A) and diastolic flow (B) of the aforementioned arteries were measured.

The Doppler indices were computed. A/B = Systolic/Diastolic (S/D) ratio A-B/A resistance index A-B/mean pulsatality index the cases were managed further based on the clinical status of the patients and the Doppler findings, and pregnancies were terminated as needed. The mode of pregnancy termination was determined based on the clinical condition of the patients and the indications. Details such as baby weight, APGAR score, meconium staining of liquor, and neonatal intensive care unit admissions were recorded at the time of birth.

STATISTICAL METHODS

The Descriptives technique computes standardised values and displays univariate summary statistics for several variables in a single table (z scores). Variables can be arranged alphabetically, by the magnitude of their means (in ascending or descending order), or by the

order in which they are selected (the default). (Contingency table analysis) Crosstabs: The crosstabs technique creates two-way and multiway tables and offers a number of association tests and measurements for two-way tables.
The structure of the table and arrangement of the categories affect which test or measure to utilise. The Chi-Square Test technique categorises a variable and computes a Chi-Square statistic. This test compares observed and expected frequencies in each category to see whether all categories contain the same proportion of values or a user-specified proportion of values. If the p value is less than 0.05, the results are considered statistically significant. The sensitivity and specificity of positive tests are also determined whenever doppler is required.

RESULTS

Table 1: Characteristics

Age in Years	Number	Percentage
< 20	35	35
21-25	42	42
26-30	21	21
30-36	2	2
Total	100	100
Distribution of cases		
Cases	**Number**	**Percentage**
IUGR	7	7
PE	47	47
PE+IUGR	46	46

Table 2: Doppler Analysis of LSCS, APGAR<7 and NICU admission

	LSCS		APGAR<7		NICU	
Index	**Abnormal cases**	**LSCS total[16]**	**Sensitivity %**	**Specificity %**	**Sensitivity %**	**Specificity %**
UAPI	63	16	96.9	61	86.7	63.8
UAS/D	52	13	96.5	57.6	83.6	74.4
UARI	58	16	100	71.1	84.9	72.3
MCAPI	43	13	66.6	76.2	62.2	78.7
MCAS/D	58	15	93.9	67.7	83.0	70.2
MCARI	47	12	69.6	72.8	67.9	76.5
CPR	57	1	100	72.8	90	86.0

Although none of the indices correlated, we did have a considerably better sensitivity of the UA PI than Smitha k et al study, most likely because it directly represents resistance in the placental vascular bed [9,10]. Thus, in suspected IUGR instances, UA PI may be sufficient to detect IUGR, as advised by Smitha k et al.

DISCUSSION

Perinatal doppler velocimetry can identify Fetus at risk in PIH and IUGR complicating pregnancies before with the worst perinatal outcome, but a meta-analysis of nine randomised trials found that when UA Doppler velocimetry was used as an adjuvant to FHR monitoring, length of stay and perinatal mortality were significantly reduced, as by the time FHR tracing become abnormal, up to 77% of foetuses Fetal hypoxia causes a variety of biophysical, cardiovascular, endocrine, and metabolic reactions [7, 8, 9].
The most essential adaptive reactions responsible for preserving embryonic homeostasis are probably the foetal cardiovascular responses to hypoxia, which include variations in heart

rate, an increase in blood pressure, and redistribution of cardiac output towards crucial organs [10, 11]. The 'brain-sparing effect' refers to the redistribution of blood flow towards the foetal brain [12]. Doppler analysis of the foetal cerebral and umbilicoplacental circulations can identify and quantify foetal blood flow redistribution during hypoxia [13]. Although the brain-sparing effect attempts to compensate for decreased oxygen delivery to the embryonic brain, it has recently been demonstrated that this phenomenon cannot always avoid the development of brain lesions [13, 14, 15].

Umbilical blood flow is greatly reduced in PIH and IUGR, owing to alterations in placental vascular resistance. Giles et al. [16] discovered that a decrease in the number of resistance capillaries in the placenta's tertiary stem villi increases resistance, resulting in slower flow through the UA and an increase in the UA PI. Umbilical placental insufficiency is the medical term for this.

Fleischer and Schulman [5] discovered that in IUGR complicated by pregnancy-induced hypertension, there is insufficient trophoblastic invasion of the spiral arteries, resulting in increased resistance and decreased blood flow in the placental vascular bed and in the UA, resulting in an increase in the UA PI. This condition is known as uteroplacental insufficiency. Hofer et al [17] defined many blood flow classifications (0IIIb) to represent anomalous UA waveform patterns. Diastolic flow decline (class II), absence of diastolic flow (class IIIa), and diastolic flow reversal all have increasing clinical relevance (class IIIb). All of these patterns were linked to higher UA PI.

The most serious consequence occurs in patients with reverse end diastolic volume (REDV) and absent end diastolic volume (AEDV). Fetuses with AEDV require close monitoring since their health can worsen quickly [18]. Fetuses with REDV are especially vulnerable. REDV denotes a premature foetal condition. Fetal MCA Doppler flow velocimetry may aid in the diagnosis and management of problematic pregnancies. A poor pulsatility index in the middle cerebral artery has been linked to foetal deterioration [18, 19, 20, 21]. Because the MCA/UA ratio takes into account not just placental condition but also foetal responsiveness, it may be more useful in predicting perinatal outcome [21]. Doppler data combining umbilical and cerebral velocimetry adds to the picture of the foetal effects of the placental anomaly [22].

In our investigation, 57% of the umbilical artery waveforms had the highest LSCS for foetal distress. Umbilical RI was also 100% sensitive in predicting APGAR<48hrs and 100% sensitive in predicting foetuses with APGAR<7 at 5 minutes. Five out of 100 patients had AEDF and three had REDF. Perinatal mortality was highest in the AEDF/REDF group, where the S/D ratio could not be measured for all delivered stillborn foetuses. The umbilical artery PI C has a significant sensitivity for IUGR (82.25%). Perinatal mortality was highest with abnormal PI (41.8%), followed by abnormal RI (34%), and abnormal S/D (31%).

The aberrant PI group had the highest LSCS for foetal distress, at 30.2%. CPR was <1.08 in all foetuses with a brain sparing effect (57 cases). The perinatal mortality rate in individuals with a CPR of <1.08 was 31.5%. CPR exhibited 100% specificity in predicting NICU stays of more than 48 hours and 100% sensitivity in predicting foetuses with APGAR<7 at 5mins. CPR has a 90% specificity in determining NICU admissions. Overall, the highest CPR had the highest sensitivity for foetal outcome (90%), while the UA PI has a high sensitivity for IUGR (82.2%).

CONCLUSION

The current investigation discovered a negative foetal outcome in cases of Preeclampsia and/or IUGR with incorrect Doppler results. The discovery of REDF is concerning, and AEDF was also linked to a poor foetal outcome, with a perinatal mortality rate of 60%. CPR showed the best sensitivity of 100% in predicting unfavourable neonatal outcomes in our investigation. CPR is potentially more advantageous because it integrates data not only from

the placental side but also from the foetal reaction. Doppler patterns show a longitudinal trend, with changes in the umbilical artery leading to alterations in the middle cerebral artery.Doppler examination of the foetal circulation is vital in monitoring the growing foetus and may aid with determining the best time for delivery. When dealing with pregnancies complicated by preeclampsia and growth limitation, obstetricians rely heavily on Doppler.

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