



DOPPLER ULTRASOUND IN HIGH RISK PREGNANCY WITH ITS PERINATAL OUTCOME: A HOSPITAL BASED PROSPECTIVE STUDY.

Obstetrics And Gynaecology

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ABSTRACT

OBJECTIVES: This study was to evaluate the diagnostic value of various abnormal waveform of Doppler ultrasound of triple vessels (uterine artery, middle cerebral artery and umbilical artery) in high-risk pregnancies with its perinatal outcome.

METHODS: Doppler ultrasonography was performed to all cases of high risk pregnancy in every week. And diagnostic value of waveforms were obtained for umbilical artery, uterine artery and middle cerebral artery. And various indices were calculated viz. Pulsatility Index (PI) (difference between peak systolic and diastolic flow over the mean flow velocities). Resistance Index (RI), (difference between peak systolic and diastolic flow over systolic flow and S/D ratio done). Flow velocimetry waveform of uterine artery, umbilical and middle cerebral artery were obtained. Neonatal follow up was obtained.

RESULTS: Data was analyzed by using simple statistical methods with the help of MS-office software. All the data were tabulated and percentages were calculated.

CONCLUSIONS: Maternal age 20-25 years had commonly associated with high risk pregnancy with spontaneous vaginal delivery. Most of the cases had second gravida and adverse MCA/UA pulsatility index. Abnormal Doppler was found in all the cases of PIH with IUGR. Most of the cases of high risk pregnancy had UmbA S/D >3, abnormal C/U PI and low birth weight babies. And highest sensitivity and specificity of pulsatility index to predict perinatal outcome were seen in MCA/UmbA PI and MCA PI respectively. Hence Doppler ultrasonography is one of the best investigating modalities to predict high risk pregnancy and perinatal and neonatal management.

KEYWORDS

Doppler Ultrasonography, High Risk Pregnancy, Perinatal Outcome, Pulsatility Index.

INTRODUCTION

Doppler assessment of the placental circulation plays an important role in screening for impaired placentation and its complications of pre-eclampsia, intrauterine growth restriction and perinatal death. Assessment of the fetal circulation is essential in the better understanding of the patho-physiology of a wide range of pathological pregnancies and their clinical management [1].

Doppler velocimetry is a rapid non-invasive test that provides valuable information about hemodynamic situation of the fetus and is an efficient diagnostic test of fetal jeopardy that helps in management of high risk pregnancy. The development of Doppler ultrasound evaluation of uteroplacental and fetoplacental circulation is one of the most important achievements of modern obstetrics [2].

Placental insufficiency is the primary cause (60%) of intrauterine growth restriction in normally formed fetuses and can be identified using umbilical artery Doppler velocimetry [3]. Umbilical artery Doppler waveforms provide an estimate of downstream placental vascular resistance and placental blood flow. There is a strong association between reduced end-diastolic umbilical artery blood flow velocity and increased vascular resistance in the umbilical placental microcirculation. As well, abnormal umbilical artery Doppler waveforms have been associated with an increased risk of fetal acidosis [4].

The association between abnormal umbilical artery Doppler velocimetry and adverse pregnancy outcomes has been investigated widely [5,6]. Many reports have shown a statistically significant relation between increased fetoplacental resistance, as estimated by either the resistance index or systolic-diastolic ratio (S/D), and the later development of either preeclampsia or fetal growth retardation (FGR) [7,8]. Objectives of our study was to evaluate the diagnostic value of various abnormal waveform of Doppler ultrasound of triple vessels (uterine artery, middle cerebral artery and umbilical artery) waveforms in high-risk pregnancies and also evaluate the perinatal outcome of high-risk pregnancies with abnormal triple vessel waveform.

MATERIALS & METHODS

This present study was conducted in Department of Obstetrics & Gynaecology, with collaboration of Department of Radio-diagnosis, Anugrah Narayan Magadh Medical College, Gaya, Bihar, India. A total of 50 high risk pregnancies with age group < 20 to > 30 years

were enrolled in this study. Attendants/patients signed an informed consent approved by institutional ethical committee of Anugrah Narayan Magadh Medical College, Gaya, Bihar was sought. Data was collected during a period from November 2018 to March 2019.

METHODS:

A detail history, clinical examination and relevant investigations were performed to all high risk cases. Doppler Ultrasonography was performed. And all cases were on regular follow up.

This study was consisted of 50 cases of high-risk pregnancies after fulfilling inclusion and exclusion criteria. The inclusion criteria was included clinical suspicion of IUGR (based on fundal height discrepancy and poor maternal weight gain), well-documented date (reliable menstrual history with and early clinical examination or dating by USG in early weeks), PIH, singleton pregnancies, gestational age ranging from 28-38 weeks. The exclusion criteria were patient with congenital anomaly of the foetus, multiple gestation, chronic hypertension and renal and cardiac disease.

Waveforms were obtained for umbilical, uterine and middle cerebral artery and various indices were calculated viz. Pulsatility Index (PI) (difference between peak systolic and diastolic flow over the mean flow velocities). Resistance Index (RI), (difference between peak systolic and diastolic flow over systolic flow and S/D ratio done). Flow velocimetry waveform of uterine artery, umbilical and middle cerebral artery were obtained for all 50 cases of high risk pregnancies. Doppler USG was performed every week with abnormal Doppler indices. Last Doppler USG results were used for analysis of perinatal outcome. Detailed delivery and neonatal follow up information were gathered for all cases of high risk pregnancies. And regular neonatal follow up were known.

OBSERVATIONS

In this study of 50 antenatal mothers, the gestational age at the time of Doppler examination was ranges between 28-38 weeks. Out of them, 19(38%) cases were primi, 25(50%) were 2nd and 6(12%) were 3rd gravida. 25(50%) cases were delivered Spontaneous Vaginal Delivery, 20(40%) cases had emergency LSCS and 5(10%) forceps delivery were done. The mean birth weight of these babies was 2.45±0.84.

Table.1. Age wise distribution in high risk pregnancy cases.

Age group (Years)	Primi gravid	2nd gravid	3rd gravida	No	%
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<20 years	2(66.67%)	1(33.33%)	0	3	6%
20-25	12(44.44%)	13(48.15%)	2(7.41%)	27	54%
26-30	5(27.78%)	10(55.55%)	3(16.67%)	18	36%
>30	0	1(50%)	1(50%)	2	4%
Total	19(38%)	25(50%)	6(12%)	50	100%

3(6%) cases were in age group <20 years, 27(54%) cases between 20-25 years and 18(36%) were in age group 26-30 years and only 2 (4%) cases were in >30 years.

Table.3. Doppler finding of High-Risk Cases.

High Risk	Number (n)	Abnormal doppler	UmbA S/D >3	Abn C/Umb PI	Appgar <7	LBW	NICU	Neonatal Death
PIH	12(24%)	9	6	9	2	5	2	1
IUGR	8(16%)	6	6	8	2	6	2	0
PIH+IUGR	8(16%)	8	8	8	4	8	7	1
PIH + BOH	4(8%)	4	3	3	1	0	1	0
IUGR+DM	3(6%)	2	2	2	0	0	0	0
PIH + IUGR +BOH	1(2%)	1	1	1	1	1	1	1
IUGR+BOH	1(2%)	1	1	0	0	0	0	0
IUGR + Anaemia	3(6%)	2	1	1	1	2	1	0
BOH	8(16%)	0	0	1	0	3	0	0
RH-	2(4%)	0	0	0	0	1	1	0
Total	50(100%)	33(66%)	28(56%)	33(66%)	11(22%)	26(52%)	15(30%)	3(6%)

APGAR score <7 is found in 11 cases and 15 baby were admitted in NICU. Neonatal Death was occurred in 3 cases. This implied poor perinatal outcome in high-risk cases in the presence of abnormal Doppler indices and hence the presence of foetal anoxia.

Doppler finding was most abnormal in the group with concomitant PIH and IUGR (8 cases). All the 8 cases had DN in the UA, UmbA S/D >3 and abnormal C/U PI. Also, the perinatal outcome was worst in the

Table.4. Comparison of Doppler Indices and Adverse Perinatal Outcome

Index	TP	TN	FP	FN	Sensitivity	Specificity	PPV	NPV	DA
UA DN	16	5	1	4	80	83.33	94.11	55.55	80.76
UARI	16	3	4	3	84.21	42.85	80	50	73.07
UmbA PI	15	7	4	5	75	63.63	79	58.33	71
UmbA S/D	8	3	4	7	53.33	42.85	67	30	50
MCA PI	15	6	1	5	75	86	94	54.54	78
MCA/UmbA PI	17	6	3	3	85	66.66	85	66.66	79.31

Table 4 shows sensitivity, specificity, PPV, NPV of the individual vessels studied in predicting neonatal morbidity. Here all emergency LSCS, IUD, NICU admission and APGAR <7 were taken as positive cases.

Statistical analysis shows MCA/UmbA PI had the highest sensitivity (85%) in predicting perinatal outcome. MCA PI had the highest specificity (86%).

DISCUSSIONS

Doppler evaluation of blood flow through cerebral vessels might be used to detect altered cerebral circulation before there is hypoxemia significant enough to alter the fetal heart rate pattern. Fong et al [9] compared the diagnostic performances of fetal (MCA) middle cerebral artery, umbilical artery and renal artery Doppler ultrasound for prediction of adverse perinatal outcome in high risk pregnancies. Zha [10] studied P.I. of fetal MCA and umbilical artery in 84 normal late pregnancies and 31 IUGR (intrauterine growth restriction) cases by Doppler ultrasonography. The uterine artery Doppler waveform is unique and increased resistance to flow and development of a diastolic notch has been associated with pregnancy induced hypertension [2].

The relation between adverse perinatal outcome and intrauterine growth restriction, oligohydramnios and adverse outcome is well known and lots of research found that uterine artery Doppler very useful in the prediction of uteroplacental insufficiency from early and late gestation [11,12].

Maternal age and gravida of most of the cases in this present study were

Table.2. Ratio to Determine Foetal Blood Flow Redistribution in high risk cases.

MCA/UA Pulsatility Index	Number (n)	Adverse outcome	
		No	%
<1.08	37(74%)	33	89.18
Normal	13(26%)	2	15.38
Total	50(100%)	35	70.00

In this present study, out of 50 cases, 37 cases had <1.08 MCA/UA pulsatility index. And 35(70%) cases had adverse outcome.

group with low APGAR, LBW babies in all 8 cases and all 8 cases admitted in NICU, out of which 1 deaths. In PIH group, Doppler findings were abnormal in 9 cases and low APGAR in 2 cases. LBW in 5 cases and 2 admitted in NICU out of which 1 neonatal deaths occurs. 8 cases were in IUGR, all cases had Abn C/Umb PI. among them 6 had abnormal Doppler and UmbA S/D >3. 2 cases had low Appgar <7. 6 cases had low birth weight. 2 were admitted in NICU and all were survived.

20-25 years and 2nd gravida respectively. These findings are consistent with the similar study done by Wald RM et al, Garcia et al and Rai L et al [13,14].

In this present study, caesarean section was reportedly less in number in comparison with vaginal delivery. And fetal distress was the main indication for caesarean section. These findings are comparable with the findings of study done by Rai L et al and Garcia B et al [15,14]. Mean birth weight in present study was 2.45±0.84 kgs but these findings were not comparable with similar study done by Wald RM et al, Garcia B et al, Peixoto et al and Li H et al [16,13,15,17].

In this study of 50 antenatal mothers, the gestational age at the time of Doppler examination ranges between 28-38 weeks. In this group of 50 cases, uterine artery indices shows significant increased pulsatility index, resistance index and S/D ratio in high-risk group whereas in umbilical artery Doppler indices also shows a significant increase in high-risk group. In middle cerebral artery, Doppler indices shows a significant decrease in high-risk group of pulsatility index, resistance index and S/D ratio. 37 cases had <1.08 MCA/UA pulsatility index. 13 cases had normal. Among total 50 cases, 35(70%) cases had adverse MCA/UA pulsatility index outcome.

In this study placenta and its blood vessels i.e., umbilical artery by colour doppler are correlated with histology of placenta. In this study, the diameter of placenta in high risk group was significantly reduced which mostly includes cases of preeclampsia. Kishwara S et al, [18] Teasdale F et al, [19] found significant reduction of transverse diameter

in preeclampsia group; this reduction seems to be due to the small size of placenta in preeclampsia group. Cibils LA, [20] reported that the placentae from hypertensive patients were significantly smaller than the normal suggesting that the pathologic process interferes with the normal placental growth.

In 1994, RH Merchant et al [21] conducted a study on Colour Doppler evaluation of uteroplacental circulation in management of high-risk pregnancies, in which 75 high-risk pregnancies in whom colour Doppler evaluation of the uteroplacental circulation was determined and correlated with perinatal outcome. Out of the 75 fetuses studied 33(44%) had abnormal Flow Velocity Waveforms and only 30.3% of these had an uncomplicated outcome as compared to 81% of those with normal flows.

In this present study, out of total 50 cases on Doppler findings. 33(66%) cases had abnormal Doppler. 28(56%) cases had UmbA S/D >3. 33(66%) cases had Abn C/Umb PI. 11(22%) cases had Apgar <7. 26(52%) cases had low birth weight. 15(30%) neonates were admitted in NICU. Among them neonatal death was occurred in 3(6%).

In this study mean birth weight of babies born to high risk group were low. This is attributed to uteroplacental insufficiency and same finding has previously been reported by Udaina et al [22]. In this study, perinatal mortality and neonatal morbidity and incidence of caesarean section are significantly higher in groups with abnormal Doppler flow which is correlated with Seyam YS et al [23].

Sharma Urmila et al [24] conducted a study in 2010 on triple vessel wave pattern by Doppler studies in normal and high-risk pregnancies and perinatal outcome and concluded that there was a high incidence of LSCS and NICU admissions in study group as compared to control group, which is similar to findings of our study.

In this present study, Doppler indices for sensitivity, specificity, PPV, NPV of the individual vessels were studied to predict neonatal morbidity. Sensitivity and specificity of UA DN was 80% and 83.33% respectively. UARI was 84.21% and 42.85% respectively. UmbA PI was 75% and 63.63% respectively. Sensitivity and specificity of UmbA S/D was 53.33% and 42.85% respectively. MCA PI was 86% and 94% respectively. Similarly sensitivity and specificity of MCA/UmbA PI was 85% and 66.66% respectively. It was shown that MCA/UmbA PI had the highest sensitivity (85%) in predicting perinatal outcome. And MCA PI had the highest specificity (86%). Lowest sensitivity (53.33%) was seen in UmbA S/D. And lowest specificity (42.85%) was seen in UARI and UmbA S/D.

This maybe because of the included women was with bilateral notch in Farrell T et al [25] study whereas in present study present of diastolic notch either left or right nor both were included. However, the analysis done by Colemann et al [26] for reliability of early diastolic notch of uterine artery as predictor for uteroplacental insufficiency reveals a sensitivity of 76%. The sensitivity of RI in our study in comparison to that of Benson and Doubilet [27] was 67% and Colemann et al [26] (2000) was 83%. This discrepancy maybe contributed to different cut off level of RI varying between 0.5-0.62. Best screening test is measuring placental site UA RI. If the placenta is situated in the midline, the highest RI is the best predictor. Our study may also correlated with the study of Zimmermann et al [28] who found a combination of several Doppler parameters to be superior than single parameter. According to D Grammelini et al, [29] the sensitivity of PI in the UmbA in predicting perinatal outcome was 64%. UmbA was the main artery used for monitoring high-risk pregnancies. This is because UmbA represent foetoplacental system and primarily reflect placental resistance. In present study as there is highest no. of PIH cases probably this can be attributed for difference in the studies. Another study by K. W. Fong et al [30] showed the sensitivity of PI in the UmbA as 58.3%. In Arduini D, Rizzo G [31] study, the sensitivity of MCA in predicting perinatal outcome was 68%.

Madazli R et al, [32] showed that placenta from IUGR cases with abnormal umbilical artery doppler velocimetry had a significantly increased number of villous infarcts, cytotrophoblastic proliferation and thickening of villous trophoblastic basement membrane. Abnormal placental pathology was significantly associated with abnormal umbilical artery doppler velocimetry. The patients with abnormal doppler velocimetry had lower mean birth weight. And perinatal mortality, low Apgar Score, IUGR are higher in cases with abnormal histology of placenta [33].

CONCLUSIONS

This present study concluded that the maternal age 20-25 years had commonly associated with high risk pregnancy with spontaneous vaginal delivery. Most of the cases had second gravida and adverse MCA/UA pulsatility index. Abnormal Doppler was found in all the cases of PIH with IUGR. Most of the cases of high risk pregnancy had UmbA S/D >3, abnormal C/U PI and low birth weight babies. And highest sensitivity and specificity of pulsatility index to predict perinatal outcome were seen in MCA/UmbA PI and MCA PI respectively. Hence Doppler ultrasonography is one of the best investigating modalities to predict high risk pregnancy and perinatal and neonatal management.

ABBREVIATIONS:

UmbA: Umbilical artery, MCA: Middle cerebral artery, UA: Uterine artery, RI: Resistive index, PI: Pulsatility index, S/D: Systolic/Diastolic ratio, IUGR: Intrauterine growth restriction, PIH- Pregnancy-induced hypertension, IUFD-Intrauterine fetal demise, LSCS-Lower segment caesarean section.

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