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RESEARCH ARTICLE

A STUDY OF COLOUR DOPPLER IN HIGH RISK PREGNANCIES

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ABSTRACT

Introduction: Doppler ultrasound enables a better understanding of the hemodynamic changes and has therefore become one of the most important clinical tools for feto- maternal surveillance in high risk pregnancies. It can be credited with causing a significant decrease in perinatal mortality and morbidity. The objective of the study was to analyse the Doppler flow patterns by ultrasound in high risk pregnancies, and also compare these patterns with that of normal pregnancies. **Material and methods:** It is a randomized control trial study conducted among 100 pregnant women (50 study group and 50 control group) conducted from April, 2017 to November 2019. 50 Women with pregnancies deemed by the investigators to be at high risk namely preeclampsia, IUGR, other hypertensive disorders of pregnancies, gestational DM were selected for the study group whereas 50 women with normal pregnancies were selected in control group and their accurate GA was established by 2nd trimester scan. Patients were assessed for fetal wellbeing colour Doppler flow in umbilical artery and middle cerebral artery and middle cerebral artery. **Results:** In our study A/B ratio, resistance index, pulsatility index values in MCA steadily declined as compared to study group from 28-36 weeks of gestation with slight increase around 34-36 weeks. 90% cases were pre-eclampsia, 6% were gestational DM and 45 cases were PIH with IUGR. Mean birth weight at different gestational period were significantly less compared to study group. At 28-32 weeks of gestation misoprostol was preferred method of induction and after 36 weeks of gestation elective caesarean section was preferred route for delivery. Total 92% live births and 8% of them were still births were recorded. **Conclusion:** Non-invasive methods like color Doppler velocitometery is a valuable tool to assess fetal wellbeing.

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INTRODUCTION

Assessment of fetal well-being in high risk pregnancies is done by a variety of methods which includes NST, biophysical profile, and daily fetal moment. All of which may not carry a high degree of sensitivity and specificity the positive predictive value for assessment of fetal well-being by these tests may not be to the optimum level desirable. Color Doppler flow velocimetry which is receipt advance in ultrasound technology as revolutionized the diagnosis of abnormal blood flow in the foeto-placental bed, and early identification of these abnormal patterns are useful in the determining the optimal time for delivery to reduce the perinatal mortality. One more advantage of color Doppler flow velocimetry blood flow in the umbilical artery and MCA of fetus in the high-risk pregnancies especially those with preeclampsia gestational DM, IUGR. This is a non-invasive technique to study the uteroplacental fetal inoculations and it is simple, safe and reproducible. This technique also offers greater ease is delineating small intracranial vs. resulting in quicker and more accurate examinations.

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Fetal hypoxia can be assessed with the abnormal wave patterns obtained from this vessel. Hence this study was necessitated for the accurate assessment of fetal well-being in all high-risk pregnancies in order to improve the perinatal outcome, and to make this procedure a part of the protocol for the assessment of fetal well-being in these patients.

MATERIAL AND METHODS

This was a randomized control trial and prospective study done in the department of obstetrics and gynecology, from April, 2017 to November 2019. The study was undertaken with the following parameters:

Inclusion criteria

- Women with pregnancies deemed by the investigators to be at high risk namely preeclampsia IUGR other hypertensive disorders of pregnancies gestational DM.
- Women in 2ND / 3RD trimester.
- Singleton pregnancy

Exclusion criteria

- **Multiple pregnancies**

Total 100 were selected with purposive sampling technique, (50 cases) study group of high risk pregnancy taken into the study and compared with an equal number of women with normal pregnancy without complication (control group). The color Doppler wave form of MCA umbilical artery was done for all cases b/w 28 to 37 weeks of gestation in both the groups.

Methods of Examination: Patients were explained the "traumatic and normal invasive nature of the procedures. A brief history was taken and

How to cite this article: This technique studies the a thorough physical examination was carried out which includes weight recording pulse rate, blood pressure in semi recumbent position, heart sounds, lung sounds, pedal edema, height of uterus, presentation, amount of liquor and fetal heart sounds. Basic investigations like Hb%, complete urine examination, blood grouping and Rh typing, random blood sugar, serum uric acid and thyroid profile were performed. Patients were subjected to ultrasonographic examination. Synthetic ultra-gel was applied liberally to get a good acoustic coupling. The equipment used was ALOKA SSD 630 with UGR 38 Doppler unit having a pulsed wave, continuous wave, HPR Doppler with dual sector transducer. Sean was performed using 2D real time ultrasound with 3.5 MHZ convex sector transducer. Gestational age was determined with biparietal diameter, head circumference, femoral length and abdominal circumference and placental grading. Estimated fetal weight and amniotic fluid index were calculated. Congenital anomalies if any were noted.

Doppler studies were done on umbilical artery, arcuate artery and middle artery by B- mode real time scanner. BPP scoring was done and cases were followed till the time of delivery, mode of delivery, Apgar score at birth, birth weight of baby, any meconium staining of liquor, perinatal outcome was noted baby was examined for any external congenital anomalies.

Identification of umbilical artery: The umbilical artery was identified within the amniotic fluid by the appearance of parallel line echoes. Which display pulsatility activity, pulsed Doppler was used to get Doppler signals after localizing the vessel. The maximum Doppler shift frequencies were obtained and various ratios were calculated i.e., SID RI, PI. The Doppler examination was done when the fetus was in apneic state to avoid the influence of fetal respiration on Doppler signals. These ratios were tabulated for various periods of gestations, their mean values and standard deviations were calculated and tabulated. These ratios were compared with those of normal pregnant women. Identification of middle cerebral artery:

Visual axial plane at the level of brain stem shows the circle of Willis which is clearly visualized especially with color Doppler, then the three branches on side (anterior, middle and poste cerebral and pulse wave Doppler is recorded.

The following criteria was considered for decision regarding delivery.

- Abnormal umbilical artery Doppler with MCA abnormality
- Absent end diastolic flow I reverse EDF in umbilical
- artery
- Worsening maternal condition with preeclampsia or eclampsia.
- Sever oligoamnios AFI<5.
- Absence of growth for 2 weeks period with abnormal umbilical artery Doppler.

Management protocols for labor: Induction of labor with PGE2 gel was done if liquor was adequate and only mild increase resistance of umbilical artery without MCA abnormality. For severe oligoamnios IUGR, AEDF/MCA abnormal LSCS was decided. Antenatal steroids were given b/w 28-34 weeks to enhance fetal lung maturity. Various parameters studies include mean gestational age, scan to delivery interval, mode of delivery, birth weight, Apgar, admission to nursery and perinatal outcome in IUGR with abnormal and normal doppler groups and comparison to normal fetuses without IUGR.

Perinatal outcome: Preterm delivery: Obstetric interventions: Electives .C.S, SPVD, outlet forceps. Neonatal outcome: Acute neonatal problems, neonatal morbidity.

RESULTS

A group of 100 cases were studied. Half of then (50 cases) comprised the study i.e. cases with high risk pregnancy, i.e. preeclampsia gestation and IUGR. Table-1 shows that, there was a slight decrease in resistance index as gestation increase in both control and study group. In control group, there is a slight decrease of A/B ratio with increase in gestation period. In control group, up to 32-34 weeks of gestation there was fall of A/B ratio suggesting decrease in resistance and thereafter it increased up to 38 weeks suggesting that - increase in placental assistance. Control group pulsatility index decreased with increase in gestational period indicating decrease in placental resistance. In the study, there NTS a variable pattern was observed i.e. PI value decreased up to 34 weeks in a steady manner and there after b/w 34-36 weeks there was a marginal rise followed up to 40 weeks.

In our study 90% of all risk patients were diagnosed as preeclampsia 6% were gestational diabetes and 4% were PIH with IUGR. The peak changes were observed in the umbilical artery. MCA were seen at 34-36 weeks of gestation. Therefore, in the study group the mean A/B ratio 2.27, RI- 0.54, PI-1.03 when intervention was more likely to improve the maternal and fetal outcome. The control group also demonstrated the normal values. Table-3 shows that there was a slight decrease in resistance index also as gestational period increases in the control and study group. In Control group there was a slight decrease of A/B ratio with increase in gestational period. In the control group, up to 32-34 weeks of gestation there was fall of A/B ratio suggesting decrease in

Table-1: Umbilical indices at different periods of gestation in control cases and study cases

Peri- od of gesta- tion in weeks	Control cases		Study cases		P-Value	Result
	Resistance index		Resistance index			
	Mean	SD	Mean	SD		
Umbilical artery-resistance index at different periods of gesta-tion						
28	0.65	0.06	No flow	No flow	<0.001	S
30	0.63	0.05	0.64	0.14	>0.05	NS
32	0.59	0.07	0.65	0.069	>0.05	NS
34	0.61	0.04	0.59	0.106	>0.05	NS
36	0.58	0.07	0.61	0.08	<0.05	S
38-40	0.58	0.05	0.59	0.09	>0.05	NS
Umbilical artery A/Bratio at different gestation periods						
28	2.93	0.62	No flow	No flow	>0.05	NS
30	2.78	0.44	3.26	0.63	>0.05	NS
32	2.51	0.43	2.17	0.89	>0.05	NS
34	2.61	0.34	2.27	0.405	>0.05	NS
36	2.47	0.53	2.45	0.379	>0.05	NS
38-40	2.43	0.33	2.39	0.289	>0.05	NS
Umbilical artery-pulsatility index at different period of gesta-tion						
28	1.03	0.17	No flow	No flow	>0.05	NS
30	0.98	0.20	1.50	0.81	>0.05	NS
32	0.96	0.18	1.65	0.105	>0.05	NS
34	1.03	0.25	1.006	0.418	>0.05	NS
36	0.92	0.22	1.14	0.52	<0.01	S
38-40	0.94	0.18	0.96	0.192	>0.05	NS

S-Significant: NS-Non-significant

Table-2: Umbilical artery- The mean indices at around 34-35 weeks gestation in high risk pregnancies and controls

Mean	Pre-eclampsia (90%)	Diabetes (6%)	PIH with IUGR	Control
A/B ratio	2.27	1.56	No IUGR cases at 34-35 weeks	2.47
RI	0.54	0.54	No IUGR cases at 34-35 weeks	0.58
PI	1.03	0.68	No IUGR cases at 34-35 weeks	0.92

Table 3. Middle cerebral artery indices at different period of gestation in control cases and study cases

Period of gestation in weeks	Control cases		Study cases		P-Value	Result
	Resistance index mean	SD	Resistance index Mean	mean		
Middle cerebral artery –Resistance index at different period of gestation						
28	-	-	-	-	-	-
30	0.57	0.018	0.47	0.021	>0.05	NS
32	0.59	0.019	0.64	0.023	>0.05	NS
34	0.61	0.041	0.59	0.061	<0.05	S
36	0.70	0.13	0.62	0.167	<0.01	S
38-40	0.60	0.049	0.57	0.064	>0.05	NS
Middle cerebral artery-A/B ratio at different period of gestation in control cases and study cases						
28	2.7	1.392	4.3	1.41	>0.05	NS
30	2.9	0.135	3.13	0.152	>0.05	NS
32	2.8	0.59	2.72	0.62	>0.05	NS
34	2.4	0.46	2.64	0.572	>0.05	NS
36	2.2	0.3	2.66	0.49	<0.01	S
38-40	2.32	0.32	2.51	0.49	>0.05	NS
Middle cerebral artery-pulsatility index at different gestational periods						
28	1.12	0.14	1.37	0.14	>0.05	NS
30	1.00	0.091	1.22	0.118	>0.05	NS
32	1.2	0.27	1.02	0.401	>0.05	NS
34	1	0.25	1.007	0.38	>0.05	NS
36	0.98	0.21	1.27	0.395	<0.01	S
38-40	0.84	0.19	0.95	0.27	>0.05	NS

S-Significant: NS-Nonsignificant

Table-4: Middle cerebral artery-the mean indices at around 34-35 weeks of gestation in high risk pregnancies and controls

Mean	Preeclampsia (90%)	Diabetes (6%)	PIH with IUGR (4%)	control
A/B ratio	2.64	1.98	No IUGR cases at 34-35 weeks	3.2
RI	0.59	0.54	No IUGR cases at 34-35 weeks	0.75
PI	1.0	0.71	No IUGR cases at 34-35 weeks	1.2

Table-5: Mode of delivery termination at various gestational periods

Gestational period in weeks	Misoprostol (%)	Extra amniotic Emecredyl (%)	Dinoprostol gel (%)	Elective caesarean section (%)
28-30	6%	4%	-	4%
30-32	4%	-	-	2%
32-34	6%	-	4%	8%
34-36	-	-	4%	8%
36-40	-	-	-	10%

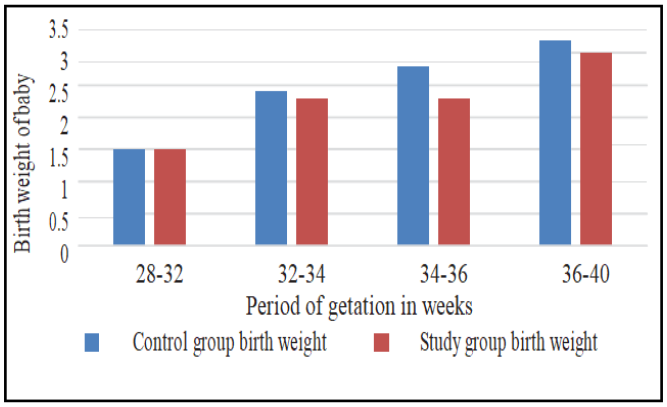

Figure 1. Period outcome in relation to birth weight in control and study group

resistance and thereafter there was increase in A/B ratio up to 38 weeks suggesting increase. A/B ratio becomes decrease due to (an increase in diastolic flow in the presence of chronic hypoxic state which in brain sparing effect and is demonstrated by low pulsatility index which indicates a greater risk of adverse perinatal outcome. Recent randomized control trial suggest that incorporation of umbilical or Doppler wave from analysis, management protocols for high risk pregnancies significantly decreases perinatal mortality. In our study, it has conclusively proved that the resistance in placental resistance. Control group PI decreased with increase in gestational period indicating decrease in placental resistance. In the study group, there was a variable pattern observed i.e. PI values were decreased up to 34 weeks in a steady manner and there after b/w 34-36 weeks there was a marginal rise followed up to 40 weeks.

Table-4 showed that the mean A/B ratio was more than the upper limit 2.64 around 34-36 weeks in preeclampsia i.e. any intervention should be undertaken at this time to improve the maternal and fetal outcome. There will be brain sparing effect in the middle cerebral artery, which explains this decreased value. Fugure-5 reveals that mean birth weight at different gestational period are significantly less than of study group which was clinically significant and proved that low birth weight was consequence of decrease in foeto-placental circulation. The charts show that the mean the birth weight in the study group was 2.3 kg less than control group which is clinically significant. At 28-32 weeks of gestation misoprostol was preferred method of induction. After 36 weeks of gestation elective caesarean section is preferred route for delivery (table-5). In our study we could ensure that we had 92% live births and 8% of them were still births.

DISCUSSION

Maternal hypertensive disorders are associated with inadequate blood supply through placenta and when the fetus is hypoxic. The cerebral arteries tend to become dilated in order to pressure the blood flow to the brain and therefore the A/B ratio decrease due to increase in diastolic flow. 40% of combined ventricular output is directed to the placenta by the two umbilical arteries. The assessment of umbilical outflow provides information on blood and perfusion of the foetal placental unit. The relationship b/w abnormal uterine artery Doppler velocimetry and preeclampsia, IUGR and adverse pregnancy outcome is well established.

The pulsatility index and RI are used for arteries the abnormal umbilical artery Doppler flow velocimetry is defined as pulsatility index of more than 2SD above the mean for gestational age and are reversal of end diastolic flow. When the blood flow in umbilical artery becomes abnormal information about MCA is important because it is easy to identify and the MCA's trend to become dilated in order to pressure the brain supply. On the MCA, the index in the MCA steadily declined as compared to the study group from 28-36 weeks. When the maximum incidence of IUD is reported. Our study also shows that the A/B ratio in the MCA was highest around 28 weeks of gestation and fall of A/B ratio is present up to term to facilitate increase blood flow. But this fall is statistically less than that of control group. The MCA pulsatility index also showed a high at around 28 weeks with a study decline up to term which is significantly less than that of controls. The umbilical artery blood flow studies show that the peak. PI levels are at 30 weeks of gestation with a study decline and at 36 weeks there is a rise showing that there is resistance to blood flow as compared to control group and there is steady decline at term. The pulsatility index in the high-risk group as showed study decline up to 6 weeks and rise nearing term. The A/B ratio in study group peak at round 30 weeks and study decline at 36 weeks and an abrupt ripe at term. In the control group the mean A/B ratio steady decline in with minimum values at term. An analysis of this pattern shows that in the high risk cases the abnormal Doppler flow patterns are observed b/w 36-38 weeks and there is an increase in chance of an adverse prenatal outcome at this stage and therefore an early intervention in the form of elective caesarean sections indicated.

The perinatal outcome in the study group revealed that we could salvage 92% of fetuses which were live births and 8% were still births, as compared to control groups in which there were 100% live births. The mean birth weight was around 2.3 kgs in our study group and except for preterm cases more than 90% of the women delivered by caesarean section. In our high-risk group 90% women had preeclampsia 6%, diabetes and 4% PIH with IUGR. The peak changes observed in the high-risk group in Doppler study were at 34/36 weeks and therefore all obstetric interventions should ideally be done at that period of gestation and Doppler flow velocimetry is valuable tool for the same ensuring for a better perinatal outcome. Harrod Shulmal et al3 studied umbilical artery wave from ration in 130 pregnant women and found that A/B ratio gradually decrease as gestation advances, which result in small for gestational age (SGA) fetus, the ratio is significantly higher. Abnormal umbilical velocity wave values are seen in a SGA fetus, unexplained fetal death, poorly controlled diabetes mellitus and a twin transfusion syndrome and concluded that umbilical artery waveform study has the potential being an important aid in prenatal care. David griffin et al4 and other in a study of third trimester Doppler flow velocity waveform of descending thoracic aorta of 98 normal and 20 several growth retarded fetuses demonstrated significant reduction on end diastolic velocities and diastolic blood flow may indicate reduced placental vascularity and predict impending fetal hypoxia. Jouppilla5 compared a flow velocity waveform with standard mean of fetal surveillance and found them equally predictive of abnormal fetal outcome. Trudinger et al2 found that physicians who had flow velocity data available for clinical management were less likely to perform caesarian section too late for fetal distress.

Instead they were likely to deliver healthy infants at the proper time, requiring less intensive care, the result suggested that Doppler flow data. When available were more likely to be associated with timely and appropriate clinical management. Jain et al6 Study inducted assessment ofIUGR by clinical fetal monitoring and ultrasonography in 100 cases. Incidence of IUGR was 57% in risk cases and 18.38% in without risk cases. Maximum % was found in primigravidae. IUGR appeared suddenly in the 3rd trimester APH, severe anemia toxemia of pregnancy carried the highest risk for IUGR. Use accurate and non-invasive method for IUGR diagnosis. Perinatal mortality was done amongst IUGR infants as compared to non IUGR. Trudinger et al7 suggest that the availability of umbilical artery ware from analysis with improved obstetric decision making, reduced fetal distress and informed neonatal outcome. An absent diastolic waveform component from the umbilical from the umbilical artery has been associated with altered lift ventricular function in cases of IUGR and multiple congenital abnormalities with high perinatal morbidity and a perinatal mortality rate 40-42%. In a study done by Kirkinen Pet al found that Doppler studies in obstetrics and gynaecology made a significant advance which is now recognized as a key examination to predict patient HF in hypoxic foetus and I an important indicator of immunent foetus. Blood flow velocity waveforms were recorded by pulsed Doppler examination from fetal intracranial arteries in 83 normal and 84 high-risk pregnancies. The normal cases showed a decreasing resistance index of the waveform toward the end of pregnancy, and a continuous forward flow that was always present in these arteries. A low resistance index predicted the birth of a small-for-dates newborn and/or the appearance of subsequent cardiotocographic abnormality, with 57% sensitivity and 94% specificity.

A Cochrane review on doppler ultrasound in high risk pregnancies 2004 published by geneva foundation. Concluded that screening is only worthwhile if an effective treatment id available and Doppler ultrasound has identified the fetuses at risk and resulted in reduced perinatal deaths and unnecessary obstetric intervention. Examination of individual indices of perinatal mortality show no result of statistical significance. But in each case the trend is towards reduction in the deaths.9

Conclusion

Assessment of fetal well-being in high risk pregnancies is done by a variety of methods includes NST, biophysical profile and daily fetal movement count (DFMC).

The positive predictive value for assessment of fetal Doppler flow velocimetry has revolutionized the diagnosis of abnormal blood flow the foeto-placental bed, and early identification of these abnormal patterns are useful in the determining the optimal time for delivery to reduce the perinatal mortality. In high risk women like pre eclampsia, diabetes and IUGR. Color Doppler flow velocimetry done repeatedly can predict address foetal events with a great degree of accuracy. Results obtained in study where clinically and statistically significant. Every tertiary hospital should routinely make use of facility for the assessment of fetal wellbeing in high risk cases and ensure a better perinatal outcome.

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