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Role of Foetal Doppler in High Risk Pregnancy with Relation to Perinatal Outcome

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Abstract

Introduction: Doppler ultrasound would be a useful in antenatal fetal well-being and timely intervention. On the basis of abnormal Doppler results, obstetrical decision makingmay improve and prevent intrauterine death because hypoxic cerebral damage may begin before labor and intrapartum asphyxia is probably more damaging when superimposed on underlying hypoxia.

Aims: To evaluate the role of Foetal Doppler in high risk pregnancy with relation to perinatal outcome.

Materials and methods: A total of 50 patients over a period of 16 month were screened with Doppler scans at late second and third trimester. The patients with high-risk pregnancies were volunteers recruited from women undergoing routine ultrasound examination in the late second and third trimesters.

Results: intrauterine growth restriction (IUGR) (n=39); preeclampsia; preeclampsia with IUGR, obesity; and others. Most of the patients were primigravida and constituted 62% of total in each group. MCA PSV increased and PI decreased with advanced gestational age. The mean PI ratios were 0.75 ± 0.15 respectively. The values in high risk group were statistically significantly reduced from the mean in values in normal pregnancy. Of 50 patients 39 (78%) had normal flow, 4 (85) had pulsation and 7 (14%) had reversal of flow. Reversal of flow was significantly related to fetal morbidity and mortality. PV IV of Ductus Venosus in high risk group was (0.78 ± 0.54). The values were statistically significant increased as compared to pregnant women with no high risk factors. None of the patients had reversal of "A" wave. For adverse fetal outcome abnormality, fetal venous parameters were more sensitive and specific as compared to the arterial parameters.

Conclusion: Fetal Doppler velocimetry studies of the foetal circulation play a crucial role in the monitoring of high risk pregnancies and henceforth, help to evaluate the optional time for delivery

Keywords: High Risk Pregnancy; Perinatal; Fetal Doppler velocimetry.

Introduction

There are various reasons for perinatal mortality and morbidity, impaired placentation being a major one. Various end results of foetal placentation are found out, fetal death is the dreaded one. Other complications like preeclampsia, abruption placenta and foetal growth restriction also notified. Conventional methods of foetal surveillance like non stress test (NST) and fetal biophysical profile (BPP) are giving lot of false positive results, leading to false prediction of foetal distress. Foetal heart monitoring is also not considered as a full

proof test for diagnosing foetal distress.[1] Newer methods diagnosing foetal distress will reduce the incidence of perinatal morbidity and mortality. Perinatal outcome can be improved by timely prediction of antenatal risk factors contributing to these complications, by providing appropriate antenatal surveillance and if required, therapeutic intervention.

Failure or inadequate trophoblastic invasion of the spiral arteries is related with defected placentation, leading to flow impedance increase in the uterine arteries. Doppler study of uterine arteries gives status of uteroplacental circulation. With the advancement of maternal gestational age, reduction in the resistance of flow in uterine artery takes place in normal pregnancy. Research works regarding detection of unfavourable pregnancy outcomes at the different periods of gestation by performing uterine artery Doppler studies has been done extensively in past, providing different sensitivity and specificity indicates for the first and second trimesters.[2] Risk for intrauterine growth restriction (IUGR) and preeclampsia were predicted more efficiently in comparison to other possible unfavourable outcome, by uterine artery Doppler studies.

Doppler abnormalities in venous circulation of foetuses like ductus venosus (DV) and umbilical vein are indicators of severely affected foetuses, who are at the highest risk of death. Abnormalities in the Doppler findings of the UA and middle cerebral artery (MCA) are seen at an early stage of improper peripheral and central circulatory systems of fetus, followed by pulsatile umbilical venous flow and reversal flow in the DV.

Presently, more importance is given to Doppler studies of foetal venous system. Pulsatile umbilical vein and reversal of flow in the ductus venosus are considered as the clear signs of perinatal mortality and ventricular failure. Ductus venosus is considered as the only direct link between the inferior vena cava and the umbilical vein. It has been postulated that umbilical vein pulsations are a result of reversed flow in the ductus venosus.[3]

Triphasic pulsatile forward flow velocity pattern in foetal cerebral transverse sinus (TS) is similar to that delineated in other fetal venous vessels. Preliminary studies assessing foetal transverse sinus blood flow for fetal well-being assessment were being published in the last decade. Due to substantial increase in blood volume, the maternal venous system is also having major role in outcome of pregnancy. Alternation in venous compliance play a part in material cardiac function regulation and uteroplacental perfusion maintenance.

Multiple vessel maternal and fetal Doppler ultrasonography in the assessment of high-risk pregnancies has not been done prior. It is important to know the exact changes in uteroplacental and fetal circulation using Doppler velocimetry parameters to forecast perinatal outcome and help in appropriate timely management. Henceforth this study was planned to analyse multiple vessel colour Doppler study in high risk pregnancy and to correlate them with fetal outcome.

Materials and Methods

The descriptive study was carried out in the over a period of 16 months. 50 Patients referred from Obstetrics and Gynaecology department, OPD and IPD will be included in the study. After taking a proper written informed consent, permission from ethical committee, complete history and thorough clinical examination was done and these patients were subjected to ultrasound sonography. Clinical and radiological data from the study was recorded as per the proforma.

Inclusion Criteria

High risk pregnant women with gestational age ≥ 26 weeks, Anaemia, Maternal Thyroid disorder, Diabetes, Renal disease, Chronic hypertension, Elderly primigravida (>30 years), Previous preeclampsia requiring delivery before 34 weeks gestation, previous preeclampsia or gestational hypertension with delivery after 34 weeks gestation, previous spontaneous premature delivery, previous low birth weight, previous abruption, previous still birth/ early neonatal death, ≥2 previous miscarriage or induced abortion.

Exclusion criteria

Pre or postnatal diagnosis of a fetal chromosomal or structural abnormality, Women with multiple gestation, uterine malformation, pelvic malignancy.

All the grey scale and color Doppler analysis of the vessels were obtained using low frequency transducer (frequency 2–5 MHZ) curvilinear probe. Seimens Accuson 300, Siemens Medical Solutions USA, Inc. Prior to Doppler assessment, initially all pregnant women will undergo gray scale ultrasonography to evaluate head circumference (HC), biparietal diameter (BPD), abdominal

circumference (AC) and femur length (FL). Estimated fetal weight will be calculated according to the Shepard and Hadlock formulas. Furthermore, amniotic fluid volume and placental grade will be evaluated.

MCA To measure the MCA, an ultrasound scan of the fetal head was performed to obtain a transverse view at the level used usually to measure BPD. The transducer was then moved parallel to this plane, at the level of the lesser wing of the sphenoid bone towards the base of the skull to identify the circle of Willis. At the level of the lesser wing of the sphenoid bone, the MCA was easily demonstrated as a major branch of the circle of Willis. After localization of the MCA by color Doppler flow, PSV and PI was measured from proximal portion of MCA.

Umbilical artery blood velocity was also recorded from a free-floating central part of the cord. Multiple waveforms recording such as RI, PI and S/D ratio was calculated. Umbilical venous blood flow was recorded from a free-floating central part of the cord. The flow was recorded for any pulsation and reversal flow. Umbilical venous pulsations were defined as a diastolic decrease in blood velocity exceeding 15% of the baseline maximum.

The Ductus venosus (DV) was identified in mid-sagittal section or in an oblique transverse section of the fetal abdomen. The angle of insonation was determined by color Doppler, and pulsed Doppler signals were recorded from the isthmic portion of the DV. Velocities were measured as mean values of at least 4 heart cycles and PVIV was calculated automatically according to the formula (S–A)/D, where S is the peak velocity during ventricular systole, A is the lowest velocity during a trial contraction in late diastole and D is the peak velocity during early diastole. If any, flow reversal a wave was found, that also was recorded.

Perinatal outcome variables that were included in high-risk pregnancies; Mode of delivery, metabolic complication, birth weight, APGAR score at 5 min, Fetal distress, admission in NICU, need for artificial intubation, perinatal and neonatal mortality. SGA was defined as fetal weight <10th percentile of gestational age.

For the prediction of perinatal outcome, ultrasound Doppler study results were analysed. Variables for the neonatal outcome included Weight of the neonate at birth, Perinatal death, Emergency Caesarean section for fetal distress, Low Apgar score (5 min (APGAR score <7) and Admission to neonatal ICU for complications of Low Birth Weight.

'Adverse Pregnancy outcome' was considered when any of the following complications were present as perinatal death, emergency caesarean section for foetal distress, 5 minute APGAR score of <7 and Admission to normal ICU for complications of low birth weight. When the above complications were not present, pregnancy outcome was considered uneventful or favourable. The outcome for each pregnancy was obtained by examining the labour ward records and neonatal intensive care unit records wherever appropriate.

If the value of the MCA pulsatility index (PI) was <5th percentile of previously published values for gestational age, it was considered abnormal.[22]

It was observed that during the last 10 weeks of gestation, the cerebro-placental ratio (MCA/UA PI ratio) remains usually constant. Wladimiroff *et al*.[19] reported that it is possible to use a single cut off value after 30th week because cerebral-umbilical Doppler ratio does not vary considerably between 30th and 40th weeks.

They also observed significant differences in cerebro-placental ratio only between 26–38 weeks. No significant differences between the intervals considered were noticed after 26th week, as shown by the statistical comparison. Arbeille *et al*.[23] also found the cerebral-placental ratio constant during the pregnancy and suggested one as the cut off value; all values below one were considered abnormal. Gramellini *et al*.[11] also used a single cut off value of 1.08. Therefore, in our study a single cut off value (1.08) was used, above which velocimetry was considered normal and below which it was considered abnormal.

Statistical analysis

The data was expressed in number, percentage, mean and standard deviation. Statistical Package for Social Sciences (SPSS 18.0) version used to calculate the mean and standard deviation. Number and percentage was calculated by using MS Excel 2010. Correlation was done with negative and positive curves by using SPSS 18.0.

Results

Maximum number of patients (n=35) were in age between 20–25 years. Least number of patients were observed above 30 years (n=4). Above 62.0% patients were primigravida and only 38% were multigravida. Among the 50 patients, 78% patients had IUGR (Table 1).

Table 1: Demographic Details in present study

Age (years)	Number	Percentage (%)
20–25	35	70.00
26–30	11	22.00
Above 30	4	8.00
Total	**50**	**100.00**
Parity		
Primigravida	31	62.00
Multigravida	19	38.00
Multigravida	50	100.00
IUGR		
0	11	22.00
1	39	78.00

Fifteen patients had normal Doppler waveform for umbilical artery, 25 showed abnormal, 6 patients had absent end diastolic flow and 4 had reverse end diastolic flow. 39 patients had normal umbilical vein waveform, 7 had reversal of flow and 4 were pulsatile. 60.0% showed normal middle cerebral artery Doppler findings and 34.0% showed abnormal. 37 patients had normal flow in ductus venosus. 8 had reversal of flow and least number of patients 5 had abnormal flow (Table 2).

Table 2: Number and percentage of patients based on Doppler findings in present study.

USG findings	Number	Percentage (%)
Normal	15	30.00
Abnormal	25	50.00
Absent end diastolic flow	6	12.00
Reverse end diastolic flow	4	8.00
Total	**50**	**100.00**
Umbilical vein		
Normal	39	78.00
Pulsatile	4	8.00
Reversal flow	7	14.00
Middle cerebral artery		
Normal	33	66.00
Abnormal	17	34.00
Middle cerebral artery		
Normal	33	66.00
Abnormal	17	34.00
Fetal ductus venosus (PVIV)		
Normal	37	74.00
Abnormal	5	10.00
Reversal flow	8	16.00

In the present high risk group of pregnant women, 96% births were preterm, 4% term and nil post-term. c36 neonates showed foetal distress and 14 were born normal without any foetal distress. c56.0% women had elective LSCS followed by 26% with emergency LSCS.8 had normal vaginal delivery. Only one patient had instrumental mode of delivery. About 3:80% patients had live birth and 4% had still birth. 16.0% had neonatal death. 1652.04 grams was the mean fetal weight (Table 3).

Table 3: Number and percentage of gestational age at delivery

Gestational age at delivery	Number	Percentage (%)
Preterm	48	96
Term	2	4

Gestational age at delivery	Number	Percentage (%)
Post-term	0	0
Total	**50**	**100.00**
Foetal distress		
Present	36	72.00
Absent	14	28.00
Mode of delivery		
Normal vaginal	8	16.00
Instrumental	1	2.00
Emergency LSCS	13	26.00
Elective LSCS	28	56.00
Status of birth		
Live birth	40	80.00
Still birth	2	4.00
Neonatal death	8	16.00
Fetal body weight (in grams)(Mean + SD)	1652.04 ± 2.01	

There were 36 neonates had APGAR score value <7 at 5 min and 14 had normal APGAR value of >7 at 5 min. Majority number of neonates (n=29) had NICU stay. Only 21 had no NICU stay.40 had gone to home. 8 had neonatal death and 2 had still birth (Table 4).

Table 4: Number and percentage of neonates condition in present study.

APGAR score at <7 at 5 min	Number	Percentage
Yes	36	72.00
No	14	28.00
Total	**50**	**100.00**
NICU Stay		
Yes	29	58.00
No	21	42.00
Total	**50**	**100.00**
Neonatal complications		
No complication	39	78.00
Intubation at birth	3	6.00
IVH	0	0.00
Hypoglycemia	0	0.00
Hypocalcemia	0	0.00
Hyperbilirubinemia	0	0.00
Above 2 complications	8	16.00
Total	**50**	**100.00**

All 15 women with normal umbilical artery Doppler waveforms had live birth. 25 live births were noted with abnormal USG. All 6 women with Absent end diastolic flow had neonatal deaths. Out of 4 women with Reverse end diastolic flow, 2 had still birth and 2 had neonatal death. Out of 15 neonates born to women with normal waveform, 10 had APGAR score <7 at 5 min and 5 had >7 at 5 min. Out of 25 neonates born to women with abnormal waveform, 18 had APGAR score <7 at 5 min and 7 had >7 at 5 min. Out of 6 neonates born to women with Absent end diastolic flow, 4 had APGAR score <7 at 5 min and 2 had >7 at 5 min. All 4 neonates born to women with Reverse end diastolic flow had APGAR score <7 at 5 min. Out of 15 neonates born to women with normal waveform, 8 had NICU stay. Out of 25 neonates born o women with abnormal waveform, 11 had NICU stay and 14 were shifted towards. All 6 neonates born o women with Absent end diastolic flow and 4 neonates born to women with Reverse end diastolic flow had NICU stay. Out of 15

neonates born to women with normal waveform, only I had neonatal complication. Out of 25 neonates born to women with abnormal waveform, 2 had intubation at birth. Out of 6 neonates born to women with Absent end diastolic flow, 2 had more than 2 neonatal complications. All 4 neonates born to women with Reverse end diastolic flow had more than 2 neonatal complications (Table 5).

Table 5: Correlation of umbilical artery Doppler velocimetry findings with status of birth, APGAR score <7 at 5 min, NICU stay, neonatal complications and fetal outcome

USG findings	Normal (15)	Abnormal (25)	Absent end diastolic flow (6)	Reverse end diastolic flow (4)
Status of birth				
Live birth	15	25	0	0
Still birth	0	0	0	2
Neonatal death	0	0	6	2
APGAR score <7 at 5 min				
Yes	10	18	4	4
No	5	7	2	0
NICU stay				
Yes	8	11	6	4
No	7	14	0	0
Neonatal complications				
No complication	14	23	2	0
Intubation at birth	1	2	0	0
IVH	0	0	0	0
Hypoglycemia	0	0	0	0
Hypercalcemia	0	0	0	0
Hyperbilirubinemia	0	0	0	0
Above 2 complications	0	0	4	4
Fetal outcome				
Home	15	25	0	0
Still birth	0	0	0	2
Neonatal death	0	0	6	2

Point nine-one was the mean PI, 1.76 RI and 5.67 S/D ratio for the neonatal death. 0.62 is mean PI, 0.93 RI and 3.89 S/D ratio for APGAR score <7 at 5 min. Patients with >2 neonatal complications had 0.76 PI, 1.87 RI and 6.56 S/D ratio (Table 6).

Table 6: Correlation of USG findings with PI, RI and S/D score of umbilical artery

USG findings	PI (MEAN ± SD)	RI (MEAN ± SD)	S/D ratio (MEAN ± SD)
Status of birth			
Live birth	0.64 ± 0.56	1.12 ± 0.45	2.67 ± 0.34
Still birth	0.83 ± 0.23	1.62 ± 0.84	6.12 ± 0.45
Neonatal death	0.91 ± 0.13	1.76 ± 0.83	5.67 ± 0.23
APGAR score <7 at 5 min			
Yes	0.62 ± 0.45	0.93 ± 1.02	3.89 ± 0.67
No	0.72 ± 0.32	1.24 ± 0.87	4.98 ± 0.19
NICU stay			
Yes	0.61 ± 0.56	0.98 ± 0.45	3.56 ± 0.45
No	0.72 ± 0.93	1.15 ± 0.34	5.78 ± 1.56
Neonatal complications			
No complication	0.62 ± 0.13	0.91 ± 0.56	2.84 ± 1.89
Intubation at birth	0.65 ± 0.03	0.90 ± 0.0.01	2.67 ± 0.67
IVH	0	0	0

USG findings	PI (MEAN ± SD)	RI (MEAN ± SD)	S/D ratio (MEAN ± SD)
Hypoglycemia	0	0	0
Hypocalcemia	0	0	0
Hyperbilirubinemia	0	0	0
Above 2 complications	0.76 ± 0.92	1.87 ± 0.94	6.56 ± 1.67
Fetal outcome			
Home	0.63 ± 1.56	1.10 ± 0.45	2.67 ± 1.89
Still birth	0.80 ± 0.00	1.70 ± 0.00	6.12 ± 1.12
Neonatal death	0.85 ± 0.12	1.83 ± 0.56	4.78 ± 2.45

All 39 women with normal umbilical vein Doppler waveforms had live birth. Neonatal death was noted in all 4 women with pulsatile umbilical vein. Out of 7 women with reverse umbilical vein Doppler waveforms, 3 had live birth, 2 had still birth and 2 had neonatal death. Out of 39 neonates born to women with normal waveform, 27 had APGAR score <7 at 5 min and 12 had >7 at 5 min. Out of 4 neonates born to women with pulsatile umbilical vein, 2 had APGAR score <7 at 5 min and 2 had >7 at 5 min. All 7 neonates born to women with reverse umbilical vein Doppler waveforms had APGAR score <7 at 5 min. Out of 39 neonates born to women with normal waveform, 20 had NICU stay. Out of 4 neonates born to women with pulsatile umbilical vein, 3 had NICU stay. All 7 neonates born to women with reverse umbilical vein Doppler waveforms had NICU stay. Out of 39 neonates born to women with normal waveform, only 2 had neonatal complication. Out of 4 neonates born to women with pulsatile umbilical vein, 3 had more than 2 neonatal complications. Out of 7 neonates born to women with reverse umbilical vein Doppler waveforms, 3 had more than 2 neonatal complications (Table 7).

Table 7: Correlation of USG findings with status of umbilical vein

USG findings	Normal (39)	Pulsatile (4)	Reversal flow (7)
Status of birth			
Live birth	39	0	3
Still birth	0	0	2
Neonatal death	0	4	2
APGAR score <7 at 5 min			
Yes	27	2	7
No	12	2	0
NICU stay			
Yes	20	3	7
No	19	1	0
Neonatal complications			
No complication	37	1	4
Intubation at birth	2	0	0
IVH	0	0	0
Hypoglycemia	0	0	0
Hypocalcemia	0	0	0
Hyperbilirubinemia	0	0	0
Above 2 complications	0	3	3
Fetal outcome			
Home	39	0	3
Still birth	0	0	2
Neonatal death	0	4	2

Out of 33 women with normal middle cerebral artery Doppler waveforms, 27 had live birth, 2 had still birth and 4 had neonatal death. Out of 17 women with abnormal middle cerebral artery Doppler waveforms, 13 had live birth and 4 had neonatal death. Out of 33 neonates born to women with normal waveform, 23 had APGAR score <7 at 5 min and 10 had >7 at 5 min. Out of 17 neonates born to women with abnormal middle cerebral artery Doppler waveforms, 13 had APGAR score <7 at 5 min and 4 had >7 at 5 min. Out of 33 neonates born to women with normal waveform, 17 had NICU stay. Out of 17 neonates born to women abnormal middle cerebral artery Doppler waveforms, 13 had NICU stay. 2 neonates born to women with normal waveforms had intubation at birth and 4 had more than 2 neonatal complications. Out of 17 neonates born to women with abnormal Doppler waveforms, 4 had more than 2 neonatal complications (Table 8).

Table 8: Correlation of USG findings with middle cerebral artery findings

USG findings	Normal (33)	Abnormal (17)
Status of birth		
Live birth	27	13
Still birth	2	0
Neonatal death	4	4
APGAR score <7 at 5 min		
Yes	23	13
No	10	4
NICU stay		
Yes	17	13
No	16	4
Neonatal complications		
No complication	27	12
Intubation at birth	2	1
IVH	0	0
Hypoglycemia	0	0
Hypocalcemia	0	0
Hyperbilirubinemia	0	0
Above 2 complications	4	4
Fetal outcome		
Home	27	13
Still birth	2	0
Neonatal death	**4**	**4**

Point nine-eight (0.98) was mean PI, 1.65 RI, 54.90 PSV ratio for live birth. 0.93 was mean PI for APGAR score <7 at 5 mn. 0.90 PI, 1.82 RI and 53.19 PSV ratio for NICU stay. 56.89 wa mean PSV ratio for no complications. 0.93 wa PI, 1.87 RI and 55.34 PSV ratio 0.67 for home fetal outcome (Table 9).

Table 9: Correlation of USG findings with RI, PI, PSV ratio of middle cerebral artery

USB findings	Middle cerebral artery		
	PI (MEAN ± SD)	RI (MEAN ± SD)	PSV (MEAN ± SD)
Status of birth			
Live birth	0.98 ± 1.45	1.65 ± 0.84	54.90 ± 1.95
Still birth	0.81 ± 0.34	1.82 ± 0.45	39.45 ± 0.45
Neonatal death	0.84 ± 0.23	2.16 ± 1.23	78.34 ± 1.45
APGAR score <7 at 5 min			
Yes	0.93 ± 0.34	1.76 ± 0.93	54.23 ± 0.56
No	0.82 ± 1.23	1.49 ± 0.14	42.25 ± 1.45

USB findings	Middle cerebral artery		
	PI (MEAN ± SD)	RI (MEAN ± SD)	PSV (MEAN ± SD)
NICU stay			
Yes	0.90 ± 0.18	1.82 ± 0.72	53.19 ± 0.34
No	0.78 ± 0.45	1.64 ± 0.34	41.90 ± 0.45
Neonatal complications			
No complication	0.98 ± 0.34	1.62 ± 0.94	56.89 ± 1.23
Intubation at birth	0.76 ± 0.12	1.10 ± 0.13	40.23 ± 0.45
IVH	0	0	0
Hypoglycemia	0	0	0
Hypocalcemia	0	0	0
Hyperbilirubinemia	0	0	0
Above 2 complications	0.56 ± 0.45	1.83 ± 2.45	78.23 ± 1.67
Fetal outcome			
Home	0.93 ± 0.34	1.87 ± 0.92	55.34 ± 1.12
Still birth	0.81 ± 0.26	1.67 ± 0.23	38.34 ± 0.19
Neonatal death	0.67 ± 0.82	1.62 ± 0.40	84.67 ± 0.73

Thirty-four with normal fetal ductus venosus had live birth. 6 with reversal flow had neonatal death. 24 with normal flow, 4 with abnormal flow and 8 with reversal flow had APGAR score <7 at 5 min. 19 in normal, 4 in abnormal and 8 in reversal flow had NICU stay. 4 in normal and 4 in reversal flow had more than two neonatal complications. 33 with normal ductus venosus had home fetal outcome (Table 10).

Table 10: Correlation of USG findings with fetal ductus venosus findings

USG findings	Normal (37)	Abnormal (5)	Reversal flow (8)
Status of birth			
Live birth	34	4	2
Still birth	1	1	0
Neonatal death	2	0	6
APGAR score <7 at 5 min			
Yes	24	4	8
No	13	1	0
NICU stay			
Yes	19	4	6
No	18	1	2
Neonatal complications			
No complication	30	5	4
Intubation at birth	3	0	0
IVH	0	0	0
Hypoglycemia	0	0	0
Hypocalcemia	0	0	0
Hyperbilirubinemia	0	0	0
Above 2 complications	4	0	4
Fetal outcome			
Home	33	5	2
Still birth	2	0	0
Neonatal death	2	0	6

Point three-four (0.34) was PVIV for live births. 0.54 for neonates with APGAR score <7 at 5 min. 0.94 for NICU stay and 1.45 for neonates with more than 2 complications (Table 11).

Table 11: Correlation of USG findings with PVIV of fetal ductus venosus

USB findings	PVIV (MEAN ± SD)
Status of birth	
Live birth	0.34 ± 1.34
Still birth	0.46 ± 0.34
Neonatal death	1.73 ± 1.34
APGAR score <7 at 5 min	
Yes	0.54 ± 0.92
No	0.34 ± 1.34
NICU stay	
Yes	0.94 ± 1.76
No	0.93 ± 0.45
Neonatal complications	
No complication	0.85 ± 1.45
Intubation at birth	0.64 ± 0.34
IVH	0
Hypoglycemia	0
Hypocalcemia	0
Hyperbilirubinemia	0
Above 2 complications	1.45 ± 1.03
Fetal outcome	
Home	0.67 ± 1.23
Still birth	0.40 ± 0.01

Discussion

The present study was conducted on 50 singleton pregnancies with various risk factors and their evaluation by Doppler velocimetry of umbilical arteries, umbilical vein, middle cerebral artery and fetal ductus venosus. The introduction of Doppler technology has provided an opportunity for non-invasive hemodynamic monitoring in pregnancy. It is an important tool for feto-material surveillance in high risk pregnancies.

In present study it was observed that majority of patients were in ≤ 25 years (70%). None of the patients were below 19 or >35 years. Most of the pregnant women were primigravida (62%). Odibo AO *et al*. suggested that material age >35 years is an independent risk factor for foetal growth restriction.[4] Young maternal age as a risk factor for foetal growth restriction in our study is consistent with study conducted by Muhammad *et al*. where mean maternal age was 24.[5] Gestational age (in weeks) at the time of ultrasound was (29.25 ± 1.56) and at the time of delivery was (29.85 ± 1.56). Majority of patients had elective LSCS. Elective caesarean section was done in 56% of cases, 26% had emergency LSCS. In the study conducted by Maroni E *et al*. patients with abnormal Doppler velocimetry had more number of caesarean sections to prevent fetal distress than with normal Doppler.[6]

During normal pregnancy, physiological modifications of the utero-placental and umbilico-placental bed take place to permit a decrease in vascular resistance and consequent increase in diastolic flow. Failure of this physiological process results in increased vascular resistance and fall in diastolic flow resulting in abnormal pathological conditions. The main goals of prenatal testing is to identify foetuses at increased risk for perinatal morbidity & mortality. Among high risk patients several studies suggested a significant decrease in neonatal morbidity & mortality when Doppler evaluation was a part of fetal surveillance. Doppler US provides a means of studying these circulatory beds and detecting abnormal vascular resistance patterns in the uterine and umbilical arteries non-invasively.[7,8]

The reproducibility of MCA-PSV has been shown to be consistent for both intra-observer and inter-observer reliabilities, with the best result shown when the proximal MCA, 2 cm from its origin from the internal carotid artery, is measured. Several authors have also constructed reference ranges

for MCA-PSV with respect to gestation, and have found that it has a significant positive association with gestation.

Fetal MCA is a low resistance circulation throughout pregnancy. Fetal MCA accounts for 7% of total fetal cardiac output. The MCA seems to react earlier and more to hypoxia and ischemia. The MCA impedance varies during gestation with a parabolic pattern during pregnancy and no significant change is noted after delivery. Increase in diastolic flow with reduced pulsatility index shows the brain sparing taking place in compromised foetuses.

In the present study we concluded that MCA PSV increases and PI decreases with advancing gestational age. The mean PSV and PI ratios were 54.6 ± 20.14 and 0.75 ± 0.15 respectively.

Similar findings were noted by G. Mari *et al*. who constructed reference values for the foetal MCA peak velocity for non-Asian obstetric populations.[9] They conducted, that MCA-PSV increases with advancing gestational age, in the second half of pregnancy. The fall in MCA PI after 28th week of gestation was probably reflected a decreasing vascular resistance with increasing gestational age or correlation with deoxyribonucleic acid production in fetal brain. Bahlmann *et al*. also demonstrated that the MCA PSV was increased.[10]

In normal pregnancy, as placental growth continues there is an overall increase in the number of tertiary stem villi and total number of small arterial channels (resistance vessels). This causes a normal drop in vascular resistance in the umbilical artery. In cases of umbilical placental insufficiency, there is a decrease in the resistance vessel count thereby leading to high resistance in the umbilical artery. In normal pregnancy, the three indices; S/D; PI and RI decrease with advancing gestation in Umbilical artery.

In the present study the mean RI, PI and S/D ratios were 0.69 ± 0.09, 1.29 ± 0.43 and 3.57 ± 1.61 respectively. Due to resistance increase in small arteries and arterioles of the tertiary villi; Campbell reported that in IUGR, there is decreased diastolic flow in the umbilical artery.[11] This raises the S/D ratio, PI and RI of umbilical artery. First, the diastolic flow decreases with placental insufficiency worsening and gradually, then it becomes absent and later reverses. It is observed that in some foetuses who have decreased diastolic velocity that remains constant with advancing gestation and never become absent or reversed, might be due to a milder form of placental insufficiency. In our study, 40% prevalence rate was reported for perinatal death in fetuses with absent or reversed end diastolic flow velocity.

Trudinger BJ *et al*. also documented that normal outcome pregnancies without SGA babies and PIH, showed an elevation in diastolic flow and reduction in indices in umbilical artery.[12] Campbell and Farmakides also reported that in pregnancies with abnormal outcome, umbilical arteries had a reduced diastolic flow or even absent/reversed diastolic flow.[11,13]

The DV, which plays a fundamental role in fetal hemodynamic, as a method for fetal monitoring in high-risk pregnancies, including diabetic pregnancies, has been garnering interest. The DV is a small vein connecting the umbilical vein to the left side of the inferior vena cava near the entrance to the heart, and directs well-oxygenated blood via the foramen ovale into the left atrium and the left ventricle. The flow can be altered in several fetal conditions, such as fetal acidemia and cardiac function abnormally, which are known to be associated with pregestational diabetic pregnancies.

In the present study PVIV in high risk group was 0.78 ± 0.54. Similar association of ductus venosus abnormally with adverse fetal outcome was noted by Gomez *et al*. in 82 diabetic pregnancies.[14] 30.5% were found to have an abnormal DV-PVIV. Of these, 32% had an abnormal perinatal outcome, of which emergency delivery by Caesarean section for non-reassuring fetal status was the most common. The ability of an abnormal DV Doppler index to predict adverse perinatal outcome was 32%.

A high sensitivity was noted by Doppler parameters especially of the venous pulsation, with regard to fetal outcome for small for gestational age. But specificity calculated was relatively less. High degree of specificity was displayed by the arterial and venous parameters in uterine waveform and venous pulsation respectively. Difference in specificity and sensitivity with previous studies could be due to earlier intervention in cases of high risk pregnancies due to fear of fetal complications.

Conclusion

Respective noninvasive haemodynamicmonitoring in human pregnancy has been possible for the first time with the introduction of ultrasound Doppler technology. After various researches and studies conducted, ample evident data is available to prove the reliability of fetal Doppler indices in prediction

of adverse perinatal outcome in an obstetric patient population with a high complications prevalence. Abnormal venous changes occur in severely compromised fetus and are more likely to predict poor perinatal outcome.

Fetal Doppler velocimetry studies of the foetal circulation play a crucial role in the monitoring of high risk pregnancies and hence forth, help to evaluate the optional time for delivery. Thus the information provided by Doppler study is the one which is not readily obtained from other conventional tests of fetal well-being. Therefore, it has a very crucial role to play in the high risk pregnancies management.

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