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Efficacy Of Umbilical Artery Doppler In Prediction Of Perinatal Outcome In IUGR Pregnancies At DVVPF'S Medical College, Ahmednagar, Maharashtra, India.

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ABSTRACT

Estimated foetal weight less than the 10th percentile at that gestational age is known as intra uterine growth restriction (IUGR). Over the period of 1st July 2021 till 31st June 2022, a descriptive longitudinal study was conducted in department of OBGY DVVPF's medical college and hospital Ahmednagar. 90 women visiting OBGY OPD at DVVPF's medical college and hospital Ahmednagar carrying single fetus with 32 completed weeks of gestation, having IUGR were included in the study. There are considerable differences between categories and within categories when umbilical artery Doppler indices were used to analyse newborn outcome in terms of birth weight. P value exceeded 0.0005. A better outcome in terms of birth weight of more than 2 kg occurs when the umbilical artery Doppler diastolic flow revealed strong forward diastolic flow. Planning the antenatal fetal surveillance requires the identification of IUGR fetuses caused by uteroplacental insufficiency. Doppler imaging of the umbilical artery reveals changes, which in turn forecasts the resistance present at the placenta. Increased prenatal mortality and morbidity are related to the absence or reversal of umbilical artery diastolic flow. Hence One of the most useful tools for performing prenatal fetal surveillance on IUGR fetuses is the umbilical artery Doppler.

Keywords: Color Doppler, umbilical artery Doppler

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INTRODUCTION

Estimated foetal weight less than the 10th percentile at that gestational age is known as intra uterine growth restriction (IUGR). The genetic potential of the foetus, which is influenced by the fetus's access to nutrients and mother and father genetic makeup, determines its growth. When this genetic potential is not realised, IUGR is taken into account. According to the diagnostic criteria employed, incidence of IUGR ranges from 3 to 10% of all pregnancies [1]. Chandra and Mathews observed an incidence of 14.1% [2, 3]. Low birth weight babies are more likely to experience foetal death, birth asphyxia, meconium aspiration, hypoglycemia, hypothermia, respiratory distress syndrome, necrotizing enterocolitis, and intraventricular haemorrhage, regardless of gestational age [3-6].

The later emergence of the metabolic syndrome, which includes arterial hypertension, coronary artery disease, dyslipidemia, visceral obesity, impaired glucose tolerance, and Type 2 diabetes mellitus, is strongly correlated with IUGR. Clinical abdominal palpation and the lag in symphysio-fundal height both point to the clinical suspicion of IUGR [6]. Two dimensional ultrasonograms are used to confirm IUGR. When the estimated or actual abdominal circumference is below the fifth percentile and the foetal weight is below the tenth percentile, IUGR is definitely identified. abdominal artery In comparison to estimated foetal weight alone, Doppler blood flow investigations were a superior predictor of newborn outcome [3, 7-10]. The umbilical artery, middle cerebral artery, aortic isthmus, inferior vena cava, ductus venosus, and umbilical vein are among the foetal arteries used in Doppler velocimetry. One week before CTG and BPP changes, venous and arterial velocimetry measurements alter. It can show the circulatory variability in foetuses and is non-invasive. Doppler velocimetry determines the ideal delivery method in addition to the ideal delivery time.

Aims and objectives

To find the usefulness of umbilical artery doppler velocimetry in determining the perinatal outcome in IUGR (intrauterine growth restriction) pregnancies.

Over the period of 1st July 2021 till 31st June 2022, a descriptive longitudinal study was conducted in department of OBGY DVVPF's medical college and hospital Ahmednagar. 90 women visiting OBGY OPD at DVVPF's medical college and hospital Ahmednagar carrying single fetus with 32 completed weeks of gestation, having IUGR were included in the study. Approval from institutional ethical committee was obtained.

Exclusion criteria

- Multiple pregnancies.
- Pregnancies below 32 weeks.
- Pregnancies with unreliable dating scan or LMP
- Abruption.
- Uterine rupture.

Color doppler used: GE logic F6

Patients' names, ages, educational backgrounds, past obstetric outcomes, menstrual histories, specifics of their most recent period, and high-risk conditions like chronic hypertension, gestational hypertension, kidney diseases, collagen vascular disease, thyroid disorders, anaemia, and heart disease must be recorded.

For collection of data, informed consent as well as a semi structured questionnaire was used. The patients were examined accordingly. During per Abdo examination the lag of 4 wks. or more, if seen, was immediately subjected to ultrasound (USG) examination.

Biparietal diameter (BPD), head circumference, girth (AG), and femur length (FL) information on foetal biometry was recorded. The Haddock formula is used to compute the estimated foetal weight. Based on the percentile table, IUGR pregnancies in this study are classified as such when the estimated foetal weight is less than the 10th percentile for the gestational age and the belly circumference is less than the 5th percentile. Doppler velocity measurements of the umbilical artery were performed on these 60 IUGR

pregnancies. Umbilical artery RI, PI, and S/D ratio data were recorded. The percentages of placental insufficiency indicated by high umbilical artery PI (above the 95th centile for Gestational age) with positive end-diastolic flow, absent end-diastolic flow (AEDF), and reverse end-diastolic flow (REDF), respectively, are 50%, 70%, and 90%. [10]

Table 1.11 lists the reference range of umbilical artery pulsatility index (PI) measured at free loops from 32 to 41 weeks.

We have categorized these IUGR pregnancies according to percentile charts for each index into category I, II and III.

32	0.716	0.980	1.254
33	0.700	0.963	1.236
34	0.684	0.946	1.218
35	0.668	0.928	1.199
36	0.651	0.910	1.180
37	0.634	0.891	1.160
38	0.615	0.872	1.139
39	0.595	0.851	1.117
40	0.573	0.828	1.093

CALLEN

Category I

Umbilical artery Doppler indices less than 95th percentile for that gestational age.

Category II

Umbilical artery Doppler indices more than 95th percentile for that gestational age. But umbilical artery had forward diastolic flow.

Category III

Absent diastolic flow or reverse end diastolic flow.

These patient were throughout monitored till delivery and methods used for monitoring were fetal kick count, CTG, BPP and Serial Doppler velocimetry study.

Patients were subjected to deliver if one or more of the following conditions were seen.

- 37-week gestational age
- When end diastolic flow is absent, end diastolic flow is reversed.
- The state of the mother getting worse, such as HELLP, impending eclampsia, or unmanageable hypertension
- Oligohydramnios (AFI<5).

Most oligohydramnios instances involved non-reactive NST. The delivery method, the infant's birth weight, the APGAR scores at 1 and 5 minutes, and the admittance to the NICU were noted. Additionally mentioned were foetuses who died in the early neonatal period and those who were stillborn.

RESULTS

Out of the 90 patients studied, all three of umbilical artery doppler indices were within 95th percentile in 57 cases and abnormality was seen in 33 Cases. (table 1)

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Table 1

Total IUGR cases	90	%
Normal UA doppler	57	63.34%
Abnormal UA doppler	33	36.67%

Out of the 33 Patients with abnormal doppler indices 24 patients fall into category 2 and 9 Patients fall into category 3.

Table 2: Categorization of IUGR

Total IUGR cases	90	%
Category 1	57	63.34%
Category 2	24	26.67%
Category 3	9	10%

The most common age group affected was 24-27 yrs (59%) (Table 3).

Majority of the patients were primigravida (62.22%) followed by 2nd gravida(18.89%) (table 4).

Table 3: Age distribution among IUGR pregnancies.

Age group	Category 1	Category 2	Category 3	%
<20	3	0	1	4.45%
20-23	11	1	0	13.33%
24-27	34	14	5	59%
28-31	3	6	2	12.22%
>31	6	3	1	11.12%

Table 4: distribution of IUGR pregnancies according to gravida status.

Gravida status	Category 1	Category 2	Category 3	%
Primigravida	40	12	5	56(62.22%)
2nd gravida	9	5	3	17(18.89%)
3rd gravida and more	8	7	1	16(17.78%)

Most frequently patients were diagnosed at 39-40 wks. There were many risk factors present in our study population like gestational hypertension, chronic hypertension, malnutrition, gestational diabetes; out of which 50(49.5%) patients had no risk factors. 36 (32.4%) patients had gestational hypertension and 2 (2.22%) patients had chronic hypertension. (Table 5)

Table 5: Risk factors.

Risk factor	Category 1	Category 2	Category 3	%
Nil	36	11	3	49.5%
Pregnancy induced hypertension	21	11	4	32.4%
Asthma	0	2	0	2.22%
Long standing hypertension	0	0	2	2.22%

In Category 1 & 2, 57(70.3%) pregnancies were terminated because of oligohydramnios, 7(7.77%) because of severe hypertension & 1 (1.11%) because of post term. In Category 3, 6 out of 9 pregnancies (6.66%) were terminated due to absent end diastolic flow. Rest of them were terminated due to reversal of end diastolic flow. (Table 6)

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Table 6

Indication for termination	Category 1	Category 2	Category 3	%
Oligohydramnios	43	14	0	63.33 %
Gestational hypertension	1	2	0	3.33 %
Uncontrolled hypertension	5	2	0	7.77 %
Post term	1	0	0	1.11 %
HELLP	0	1	0	1.11 %
Impending eclampsia	2	1	0	3.33 %
Previous LSCS	2	2	0	4.44 %
Term	1	0	0	1.11 %
Spontaneous labour	2	2	0	4.44 %
AEDF	0	0	6	6.66 %
REDF	0	0	3	3.33 %

In the study, 45 women (or 50%) had LSCS, while 45 women (or 50%) gave birth vaginally. Non-reactive CTG- (15.7%), foetal distress (22.8%), severe oligohydramnios (35.0%), and failed induction (26.6%) were grounds for LSCS in category 1 patients. In category II, non-reactive CTG was the primary indication (73%), while four patients from category III were taken for LSCS with non-reactive CTG as the indication.

Out of 90 babies delivered 85 (94.4%) were live and 5 (5.6%) were stillborn. Still birth rate was 33.34 % in category 3, 4.1% in category 2, 1.7% in category 1. (Table 7)

Table 7: Birth outcomes

Birth outcomes	Category 1	Category 2	Category 3	%
Live born	56	23	6	94.4%
Still born	1	1	3	5.6%

The birth weights of the infants varied from 950 g to 2.6 kg. Baby weight was less than 2 kilogrammes in 21 (36.8%) of category I and 17 (70.8%) of category II. In group III, only 8 (88.8%) of the infant weights remained less than 1.5 kg, and no infant weighed more than 2 kg. (Table 8).

Table 8: Birth weights

Birth weight	Category 1	Category 2	Category 3	%
900 gm-1.5 kg	6	10	8	26.66%
1.5-2 kg	12	7	1	22.22%
>2 kg	39	7	0	51.11%

In total, 31 newborns were admitted to the NICU, with 13 (41.9%) falling into category 1, 12 falling into category 2, and 6 (19.3%) falling into category 3. Admissions were made for a variety of reasons, including hypoxic ischemic encephalopathy, respiratory distress, necrotizing enterocolitis, hypoglycemia, meconium aspiration syndrome, and hyperbilirubinemia.

Out of 31 NICU admissions, there are around 11 (12.2%) early neonatal deaths. Early newborn death occurred in 1 (9.09%) of the category I, 5 (45.45%) of the category II, and 5 (45.45%) of the category III groups. The most common causes of mortality were necrotizing enterocolitis, intraventricular haemorrhage, and hypoxic ischemic encephalopathy. In total, 8 (88.88%) of the newborns in the category III group had a poor perinatal outcome, either as a stillbirth or as an early neonatal mortality.

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DISCUSSION

The perinatal outcome was analyzed on the basis of total NICU admissions, early neonatal deaths in NICU and stillbirth rate. Although two-dimensional ultrasonography was used to diagnose IUGR foetuses, it did not predict neonatal outcome. As a result, these IUGR foetuses were studied using umbilical artery Doppler and their prognostic value for perinatal outcome was determined. (Table 9)

Out of the 90 IUGR fetuses,

Specificity of abnormal Doppler in predicting adverse perinatal outcome: 75.92%.

Sensitivity of abnormal Doppler in predicting adverse perinatal outcome: 55.55%.

Positive predictive value (PPV) of abnormal Doppler in predicting adverse perinatal outcome: 60.60%

Negative predictive value (NPV) of abnormal Doppler in predicting adverse perinatal outcome: 71.92%

Table 9: Perinatal outcomes

Perinatal outcomes			
	Poor	Good	Total
Abnormal doppler	20	13	33
Normal doppler	16	41	57
Total	36	54	90

The likelihood of a poor perinatal outcome increases when the Doppler diastolic velocity drops. In the current investigation, the negative predictive value outweighed the positive predictive value and the specificity of aberrant Doppler data outweighed the sensitivity. This outcome is analogous to the report on tiny for gestational age foetuses by Dicke JM et al [12]. In the study by Berkowit et al., aberrant Doppler had sensitivity, specificity, positive predictive value, and negative predictive value that were, respectively, 66.7%, 62.5%, 57.1%, and 71.4% effective at predicting unfavourable outcomes. These findings were 49%, 94%, 81%, and 77% in Divion M et al's study [13, 14], respectively. When using umbilical artery Doppler to predict a negative outcome, Dhand H et al. reported sensitivity and specificity of 44% and 61.5%, respectively [15]. The perinatal mortality rises as the umbilical artery doppler parameters deteriorate.

The patients' mean gestational age at the time of their IUGR diagnoses was 36.8 weeks. To prevent the impact of preterm birth on perinatal morbidity and death, individuals with IUGR who had gestational ages of less than 32 weeks were not included in the study cohort. Gestational hypertension was a risk factor in the current study for 45.8% of category II patients and 44.44percent of category III patients. Studies by Bynn YJ et al. and Sharma U et al. revealed that 30% of patients had pregnancy induced hypertension as a risk factor [16, 17]. In the Deshmukh A et al study, hypertension predisposed 78.6% of patients with low diastolic flow and 82.35% of patients with nonexistent or reverse diastolic flow [18].

Severe oligohydramnios was seen as a cause for pregnancy termination in 63.33% of patients. According to Deshmukh A. et al., 82.35% of the ADF/RDF group and 64.30% of the low diastolic flow group both exhibited oligohydramnios [11]. In the current investigation, oligohydramnios was found in 82.6% of category II and 90% of category III individuals. In category III patients, the pregnancy was terminated due to 70% missing diastolic flow and 30% flow reversal.

In the current study, 50% of deliveries occurred vaginally and 50% involved LSCS. 49.12% of category I deliveries were made via LSCS, while 50.87% were made vaginally. The main method of delivery in other categories is vaginal delivery. 66.66% of women in category II and 88.88% of women in category III gave birth vaginally. Comparing the category I and II mean umbilical artery S/D ratios to the Deshmukh A et al study, these figures were 2.53 and 3.82, respectively [18]. The study group's average pulsatility indexes for categories I, II, and III were 0.8816, 1.5087, and 2.8340, respectively. These values

in Deshmukh A et al. equated to 0.954, 1.354, and 5.18. For categories I, II, and III, the mean resistance indices in our study group were 0.5586, 0.7785, and 1.108, respectively.

The S/D ratio, pulsatility index, and resistance index were all employed whenever umbilical artery Doppler was used to assess the foetus. Analysis of baby outcomes comparing stillbirth and live birth was done. There are significant variations in baby outcomes within and between populations. P value greater than 0.0005 denotes significant significance (Table 10)

Table 10: Umbilical artery doppler indices and fetal outcome

Umbilical artery doppler indices	Sum of squares	Df	Mean square	F	P value
S/D	82.620	2	42.01	35.054	<0.0005
RI	2.098	2	1.056	108.115	<0.0005
PI	32.089	2	15.902	210.002	<0.0005

There are considerable differences between categories and within categories when umbilical artery Doppler indices were used to analyse newborn outcome in terms of birth weight. P value exceeded 0.0005. A better outcome in terms of birth weight of more than 2 kg occurs when the umbilical artery Doppler diastolic flow revealed strong forward diastolic flow. Early infant death rises from 6.1% to 60% when the umbilical artery diastolic flow deteriorates from excellent diastolic flow to absence or reversal of flow. There is a significant difference (P>0.0005) between categories and within categories when the Doppler diastolic flow in the umbilical artery is analysed for its relationship to early infant death using an ANOVA table (Table 10).

The diagnoses of the infants admitted to the NICU ranged from respiratory distress to necrotizing enterocolitis, hyperbilirubinemia, meconium aspiration syndrome, and hypoxia ischemic encephalopathy. The time spent in the NICU ranged from one to thirteen days (Table 9).

In our study, the overall perinatal mortality rate is 17.77%, which includes neonatal mortality of 12.22% and intrapartum mortality of 5.55%. A 40% perinatal morbidity rate. According to the Deshmukh et al study, perinatal mortality and morbidity were 18% and 49%, respectively [18]. In the group with nonexistent or reverse diastolic flow, perinatal mortality was shown to be higher.

Increased perinatal mortality is linked to absent or reversed diastolic flow in the umbilical artery.

In the study by Mohamed K et al, Lakhar BN et al, and Narulla H et al, there was a 100% mortality rate [19-21]. Bhatt et al. reported a 50% mortality rate [22]. In the current study, group III experienced 50% of all perinatal deaths. Perinatal mortality in category II was 25%. The death rate would have been higher than in the absence or reversed group if category II had not been followed up after the shift in the umbilical artery's diastolic flow.

In category I, the studies mentioned above had 100% negative predictive value in favour of favourable prenatal outcomes; nevertheless, in the current investigation, these individuals also experienced adverse perinatal outcomes in terms of both mortality (12.5%) and morbidity (37.1%). According to a study by Figueras F. et al., normal prenatal Doppler results cannot be used as a predictor of a successful postnatal outcome in mothers with IUGR fetuses [23]. The use of Doppler ultrasonogram in high risk pregnancies appears to enhance a number of obstetric outcomes and appears promising in aiding in the reduction of perinatal death, according to a Cochrane database systematic review in high risk pregnancies published in 2000 [24].

The outcomes of the present study unequivocally showed that umbilical artery Doppler is effective at forecasting fetal fate. A more accurate way to evaluate the health of IUGR fetuses is required in order to increase the prediction utility of this technique, such as an integrated prenatal test that includes BPP and a Doppler scan using different vessels.

CONCLUSION

Planning the antenatal fetal surveillance requires the identification of IUGR fetuses caused by uteroplacental insufficiency. Doppler imaging of the umbilical artery reveals changes, which in turn forecasts the resistance present at the placenta. Increased prenatal mortality and morbidity are related to the absence or reversal of umbilical artery diastolic flow. Hence One of the most useful tools for performing prenatal fetal surveillance on IUGR fetuses is the umbilical artery Doppler.

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