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Comparative Evaluation of Arterial and Venous Doppler In Predicting Perinatal Outcome In Fetus With Iugr.

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Abstract: *Antepartum fetal surveillance is the corner stone of preventive obstetric management aimed at reducing perinatal mortality and morbidity. Ante partum detection of fetus at risk of death or compromise in utero remains the major challenge in modern obstetrics. Specific and accurate methods for detection of fetus at risk can result in early appropriate intervention and hence reduce fetal loss.Intrauterine growth retardation is a common condition affecting about 10–15% of the general maternity population [1] . Diagnostic ultrasound is the main stay in the evaluation and management of obstetric patient.This study compares the arterial and venous Doppler velocimetry in IUGR fetus and the evaluation of perinatal outcome in respect to severity of Doppler changes.*

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I. Aims

To compare changes in Doppler velocimetry of umbilical artery, uterine artery and middle cerebral artery with umbilical vein, ductus venosus and inferior vena cava in intrauterine growth restricted pregnancies in third trimester and evaluation of perinatal outcome.

II. Objectives

1. To record the arterial Doppler and venous Doppler flow patterns in all pregnant women in the gestation age of 28-37 weeks with clinical signs of IUGR.
2. To detect any abnormalities in fetoplacental unit and fetal circulation in IUGR fetuses.
3. To predict the prognosis in IUGR cases based on both arterial, venous Doppler study.
4. To evaluate the fetus in the perinatal period for any evidence of complications.

III. Materials And Methods

Study design: Prospective study ,Place of study: Department of Radiology, in collaboration with Department of Obstetrics and Gynaecology, in our institute,Number of cases: 50 ,Duration of study: Two years - from January 2016 to October 2017

Source of the study : All pregnant women with IUGR admitted in Department of Obstetrics Gynecology in our Hospital who are referred to the department of radiodiagnosis for color Doppler evaluation.

INCLUSION CRITERIA:

- All pregnant women in third trimester (gestational age > 28 weeks).
- Singleton pregnancy.

EXCLUSION CRITERIA :

- Multiple pregnancy.
- Fetuses with congenital anomalies.
- Pregnant women in advance labour
- Maternal chronic Medical disorders like Chronic Hypertension, Diabetes Mellitus, Cardiac disease etc.

IV. Observation & Results:

A total of 50 patients with pregnancies complicated by intra uterine growth restriction were included in this study. The study was conducted in our Medical College/hospital, Hyderabad between January 2016 to October 2017. Ultra sonogram was done and the following parameters including fetal biometry, estimated fetal

weight, amniotic fluid index, and Doppler ultrasound of the uterine artery, umbilical artery, middle cerebral artery, umbilical vein, ductus venosus, inferiorvenacave were noted.
Immediately after delivery, the newborn APGAR and weight were noted. NICU admissions and early neonatal deaths are recorded.

TABLE 1: INCIDENCE OF NORMAL AND ABNORMAL DOPPLER

DOPPLER	NO. OF IUGR CASES
NORMAL DOPPLER	22(44%)
ABNORMAL DOPPLER	28(56%)

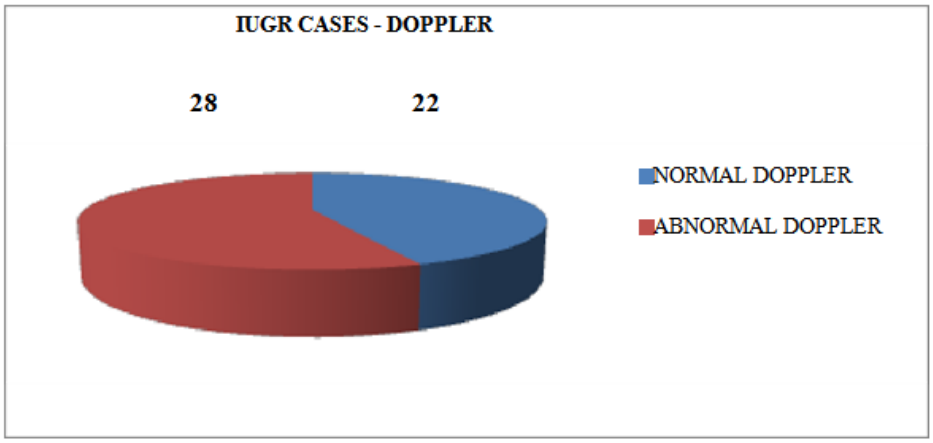

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TABLE 2 : AGE DISTRIBUTION:

AGE DISTRIBUTION	NUMBER OF CASES
≤ 20 YEARS	11
21- 25 YEARS	25
26-30 YEARS	11
>30 YEARS	3

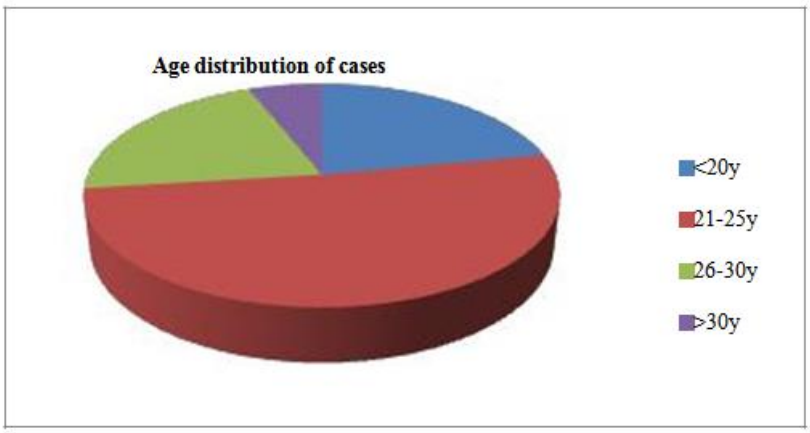


TABLE 3: MATERNAL AGE:

AGE	NORMA L DOPPLER	ABNORMAL DOPPLER	ARTERIES				VEINS	
			GRA DE 1	GRA DE 2	GRA DE 3	GRADE 4	GRADE 5	GRADE 6
≤ 20y	5(23%)	6(21%)	1	2	1	1	1	0
21-25y	11(50%)	15(52%)	3	4	3	2	3	0

26-30y	5(23%)	5(20%)	0	2	1	1	1	0
>30y	1(4%)	2(7%)	0	2	0	0	0	0

Chi-squared test	0.3243
P value	0.9553

Most of the patients in our study were in the age group of 21 -30 years (72%)

TABLE 4 : GESTATIONAL AGE

The distribution of gestational age at which Doppler analysis was done in the study group is shown in the table below.

GESTATIONAL AGE	**NUMBER OF CASES**
30-34 WEEKS	14
35-37 WEEKS	14
TERM	22

TABLE 5: GESTATIONAL AGE:

GESTATIONAL AGE	NORM AL DOPPLER	ABNORMAL DOPPLER	**ART ERIES**				**VEINS**	
			GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5	GRADE 6
30-34 W EEKS	0	14(48%)	1	4	3	2	4	0
35-37 W EEKS	8(35%)	6(23%)	1	2	1	1	1	0
TERM	14(65%)	8(29%)	2	4	1	1	0	0

Chi-squared test	15.4242
P value	<0.0004 (Highly Significant)

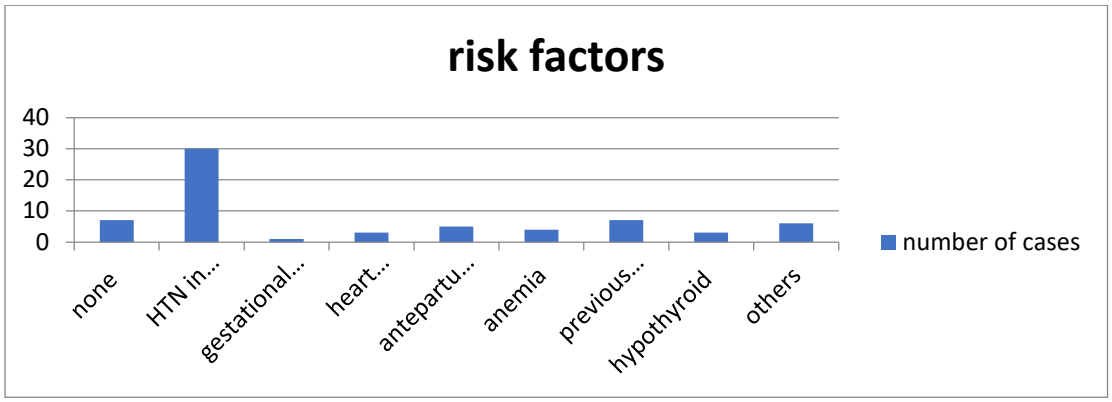
Out of 50 cases, 22 were term, 28 were preterm. Most of our patients with mild Doppler abnormalities were adequately monitored till term. Patients with higher grades of Doppler abnormalities were induced earlier based on their biophysical profile, non-stress test and liquor status for best fetal outcome. With increasing gestational age most of the cases showed normal Doppler. Most of the cases with abnormal Doppler had gestational age less than 37 weeks (preterm). 71% cases with abnormal Doppler had preterm delivery but only 36% cases with normal Doppler had preterm delivery.

TABLE 6: RISK FACTORS

This table shows the distribution of risk factors in IUGR cases.

RISK FACTORS	NUMBER OF CASES
NONE	7
HYPERTENSION IN PREGNANCY	30
GESTATIONAL DIABETES	1
HEART DISEASE	3
ANTEPARTUM ECLAMPSIA	5
ANEMIA	4

PREVIOUS CESAREAN	7
HYPOTHYROID	3
OTHERS	6



30 cases had hypertension in pregnancy as the risk factor. 1 cases had gestational diabetes. 3 cases had heart disease, 5 had antepartum eclampsia, 4 had anemia, 3 had hypothyroid, 7 cases had previous cesarean section. 6 cases had other risk factors like breech, past dates, pulmonary tuberculosis. 7 cases had no risk factors. Few cases had more than one risk factor.

TABLE 7: MODE OF DELIVERY:

MODE OF DELIVERY	NUMBER OF IUGR CASES	NORMAL DOPPLER	ABNORMAL DOPLER
SPONTANEOUS VAGINAL DELIVERY	14	5	9
INDUCED VAGINAL DELIVERY	14	4	10
CESAREAN SECTION	22	13	9

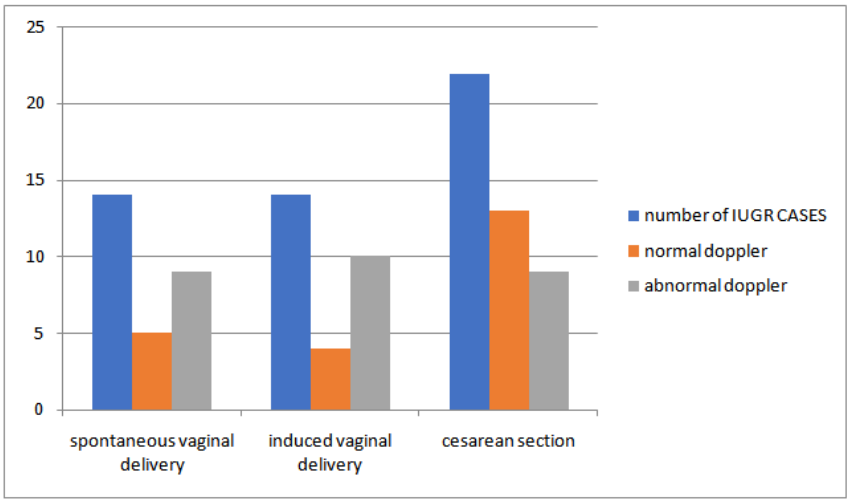
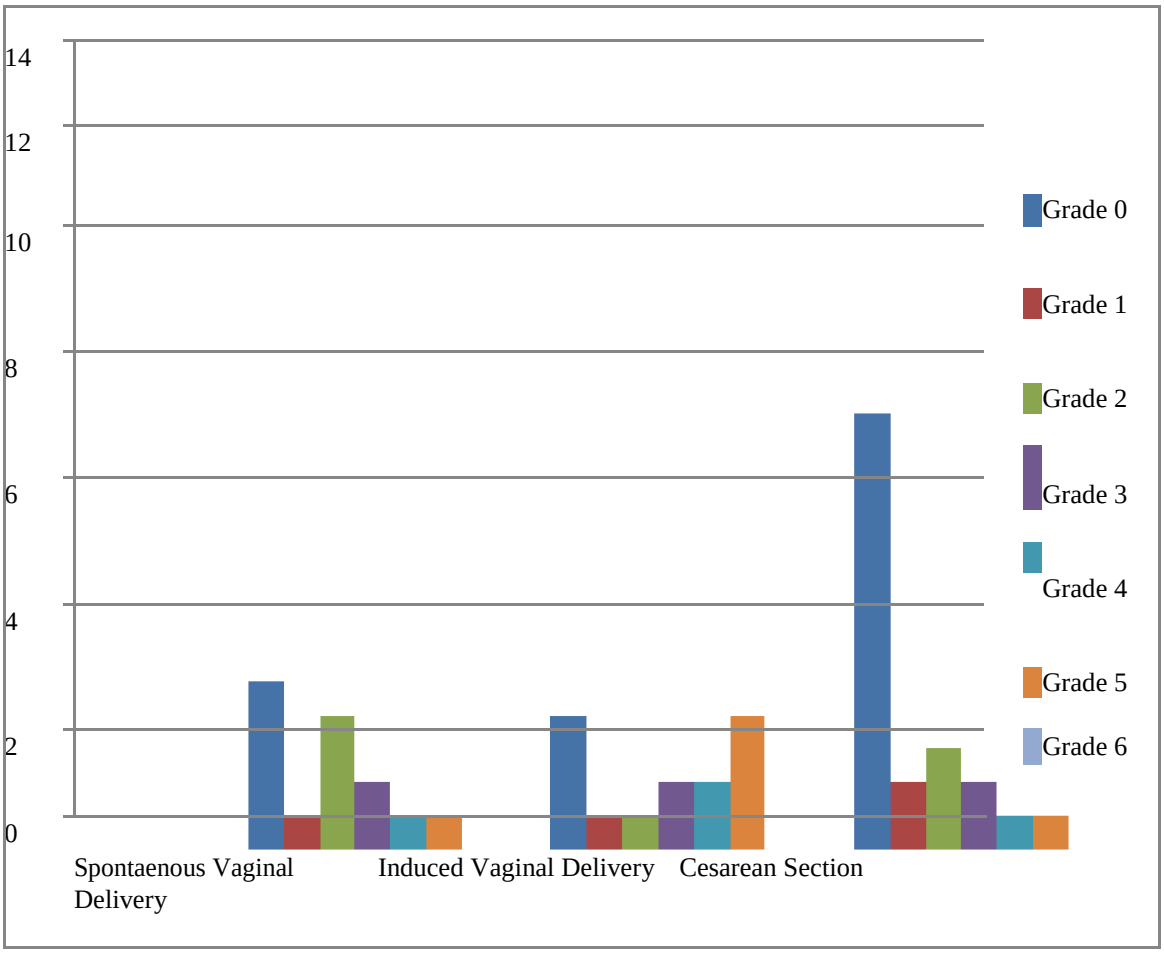


TABLE 8: MODE OF DELIVERY

MODE OF DELIVERY	NORM AL DOPPLER	ABNORMAL DOPPLER	ART ERIES				VEINS	
			GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5	GRADE 6
SPONTAN-EOUS VAGINAL DELIVERY	5	9	1	4	2	1	1	0
INDUCED VAGINAL DELIVERY	4	10	1	3	1	2	3	0
CESAREAN SECTION	13	9	2	3	2	1	1	0

Chi-squared test	3.7759
P value	0.1513

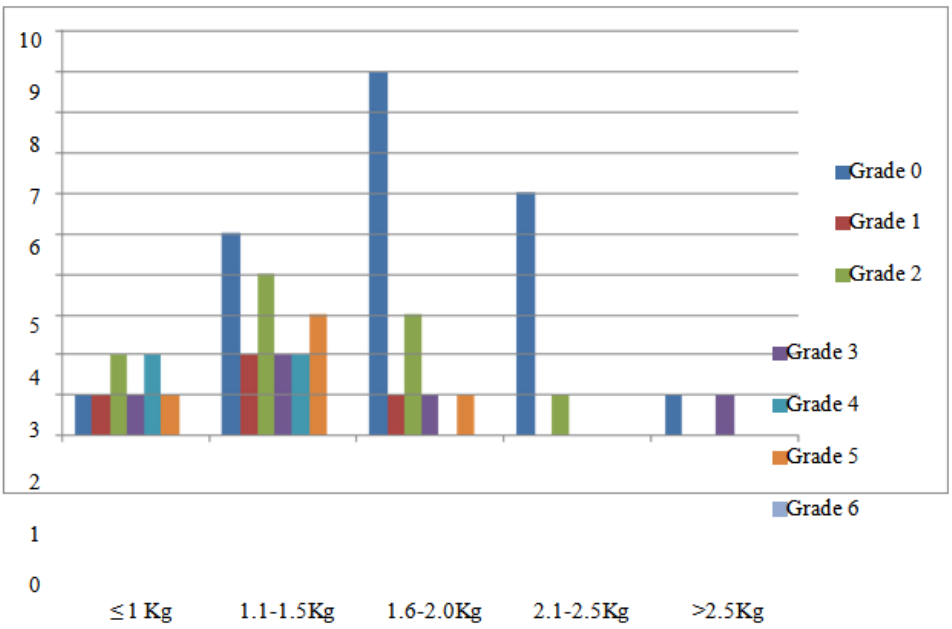


The table shows that 29 cases had vaginal delivery and 21 had cesarean section. More number of cases with normal Doppler had cesarean compared to cases with abnormal Doppler. In those cases with absent diastolic flow in umbilical artery, and abnormal ductus venosus the labour was induced and in some cases labour was induced for maternal indications like severe preeclampsia.

TABLE 9: BIRTH WEIGHT DISTRIBUTION

BIRTH WEIGHT	NORM AL DOPPLER	ABNORMAL DOPPLER	ART ERIES				VEINS	
			GRADE 1	GRADE 2	GRADE 3	GRADE 4	GRADE 5	GRADE 6
≤ 1 KG	1	7	1	2	1	2	1	0
1.1-1.5 KG	5	13	2	4	2	2	3	0
1.6-2 KG	9	6	1	3	1	0	1	0
2.1-2.5 KG	6	1	0	1	0	0	0	0
>2.5 KG	1	1	0	0	1	0	0	0

Chi-squared test	11.6751
P value	<0.0199 (Highly Significant)



Most of babies with normal Doppler had birth weight greater than 1.5kg compared to babies with abnormal Doppler who had birth weights less than 1.5 kg. 26 cases had birth weight less than 1.5kg and 24 had birth weight greater than 1.5kg. Among normal Doppler only 6 cases had birth weight less than 1.5kg and 16 cases had birth weightgreater than 1.5kg. Among abnormal Doppler 20 cases had birth weight less than 1.5kg and 8 cases had birth weight greater than 1.5kg.

TABLE 10: PERINATAL OUTCOME IN PERCENTAGE

PERINATAL OUTCOME	ARTERIAL DOPPLER ABNORMALITY	PERCENTAGE	VENOUS DOPPLER ABNORMALITY	PERCENTAGE
NO ADVERSE AFFECTS	4	17 %	0	-

NICU ADMISSION	5	23 %	0	-
NEONATAL DEATHS	4	17 %	3	60 %
STILLBORN	1	04 %	1	20 %
INTRAUTERINE DEATH	9	39 %	1	20 %

Chi-squared test	7.0707
P value	0.0078 (Highly Significant)

Out of the 50 cases, 28 cases had Doppler abnormality among which 23 were artetrial abnormality and 5 had additional venous abnormality. In abnormal arterial Doppler group only 4 had no adverse effects, 4 (17%) cases hadneonatal deaths, 9 (39%) had intrauterine deaths. In abnormal venous Doppler group all (100%) had adverse effects. 3 (60%) had neonatal death, 1 was still born , 1 was intrauterine death. The only statistically significant relation between Doppler indices and outcome was the association betweenabnormal ductus venosus flow and fetal death ($r^2 = 0.24$, $P < 0.05$).

V. Discussion

Intrauterine growth restriction is a major obstetric problem and is associated with high perinatal morbidity and mortality. Doppler assessment of the uterine artery, umbilical artery, middle cerebral artery, umbilical vein, ductus venosus, inferior vena cava is an established test of fetal well-being in pregnancy with IUGR. It is generally accepted that intrauterine events have an important effect on neonatal mortality and the development of long-term morbidity.In this study 50 antenatal cases with pregnancies complicated by IUGR were identified. For each case, ultrasonogram was done and following parameters including fetal biometry, estimated fetal weight, amniotic fluid index, and Doppler ultrasounds of the uterine artery, umbilical artery, middle cerebral artery, umbilical vein, ductus venosus, inferior vena cava were noted. Based on Doppler findings the cases were categorised as with normal flow, uterine artery diastolic notch, reduced / absent / reversed end diastolic flow in umbilical artery, MCA brain sparing effect. Absent / reversal "a" wave in ductus venosus, pulsatile flow in umbilical vein and inferior vena cava. Fetal biometry by B-Mode Ultrasound is a reliable method of investigation to distinguish between IUGR and normal fetuses. However the B-Mode ultrasound did not reliably detect the adverse perinatal outcome. Predictive capability of Doppler of adverse outcome in USG confirmed IUGR cases, was analyzed. The following data are used to compare and contrast our data with those of earlier studies and observation.

INCIDENCE OF NORMAL AND ABNORMAL DOPPLER:

	KAZANDI et al[4]	**OUR STUDY**
NORMAL DOPPLER	52%	44%
ABNORMAL DOPPLER	48%	56%

Incidence of normal and abnormal Doppler in our study is correlating with Kazandiet al[3] study and is highly significant statistically. Normal and abnormal Doppler is almost equal in IUGR cases.

MATERNAL AGE: It has been determined that maternal age has an indirect impact on intrauterine growth (Kramer MS, 1987).[5] In reality, very few studies found an independent effect of maternaI age on birth weight (Kirchengast S *etal.*, 1998)[6]. According to a recent study in Udipi by Acharya[7]incidence ofIUGR is more common in the age group of 21-30 years.

The majority of patients in our study group belonged to the age group of 21 to 30 years (72%) which is consistent with the study by Acharya et al in Udipi.

Incidence of IUGR among 21-30 years	**Our study**	**Udipi study[7]**
%	72%	76%

RISK FACTORS:

Incidence of hypertension	**Madazli et al[9] study**	**Our study**
Normal Doppler	49%	45%
Abnormal Doppler	68%	71%

In our study, the incidence of hypertension in pregnancy was more often associated with abnormal Doppler wave forms. This is consistent with the study done by Madazliet al[9] where there is increase in incidence of hypertension in pregnancy associated with abnormal Doppler.

BIRTH WEIGHT:

In our study of 50 cases of IUGR, 25 cases had birth weights less than 1.5kg of which 6 had normal Doppler flow, remaining 20 had abnormal Doppler flow. Most of the cases with abnormal Doppler had birth weight less than 1.5 kg compared to cases with normal Doppler where most of the babies had birth weight greater than 1.5kg. These findings are in consistent with the birth weight distribution in a study done by Y S Seyam et al[8]. There is high incidence of low birth weight in cases with abnormal Doppler which is consistent with Y S Seyam et al study and is statistically highly significant.

PERINATAL DAETHS:

Doppler study	IUGR cases	Perinatal Deaths	Live
Normal	22	3	19
Abnormal	28	19	9

Positive predictive value	67.5%
Negative predictive value	86.5 %

In our study of 50 cases of IUGR, 28 cases had Doppler abnormality in which 19 are perinatal deaths.In 22 cases Doppler was normal in which 3 were perinatal deaths. There were 2 intrauterine deaths which were caused by abruptio placentae due to chronic hypertension and severe preeclampsia and 1 neonatal death due to intrapartum fetal distress (meconium stained liquor). Rest 19 cases were healthy. Negative

predictive value of normal Doppler is 86.5 %. It means that if the Doppler is normal in an IUGR fetus the possibility of an abnormal perinatal outcome is rare.

NEONATAL DEATHS:

	Roy et al[10]	**Our study**
Normal Doppler	0%	4%
Abnormal Doppler	14%	14%

5 minute APGAR in our study is correlating with Kazandiet al[4] study and is statistically highly significant. Incidence of neonatal deaths in our study is comparable with Roy at al study and Hecher et al are also highly significant statistically. The patients who had normal Doppler velocimetry had less adverse perinatal outcome compared to cases with Doppler abnormality. With increasing severity of abnormal Doppler there is increase in adverse perinatal outcome. In cases with absent/reverse diastolic flow in umbilical artery one fetus survived out of 4 fetuses. In cases with absent/reverse flow velocity in ductus venosus none of the fetus survived.

Cases with normal Doppler had good perinatal outcome. There was one neonatal deaths in normal Doppler group and was due to intrapartum fetal distress (meconium stained liquor) 2 intrauterine deaths due to abruptio placenta. These patients had severe preeclampsia. This is in consistent with the study conducted by Rochelson et al (1987)[11]. In this study few cases with normal Doppler velocimetry showed signs of fetal distress during labor. Majority of fetal distress was seen in cases with abnormal Doppler. There is no difference in incidence of intrapartum fetal distress between Doppler and non-Doppler group according to Neilson et al[12].

ABNORMAL VENOUS DOOPLER VELOCIMETRY:

	Hecher et al[13]	**Our study**
Neonatal Death	63%	100%
Live	37%	0 %

In our study,5 fetuses had absent or reverse flow in ductus venosus and all of them were died ,1 was still birth,1 was intrauterine death and 3 were neonatal deaths. This is consistent with the study done Hecheret al[13] that 5 of 8 fetuses with absent or reversed flow in the ductus venosus on the day of delivery died.

In our study, the incidence of perinatal death was more often associated with abnormal Doppler velocimetry of the ductus venosus. This is consistent with the study done by Oacan.T[14] where there is perinatal death, low 5-mins Apgar values and necrotizing enterocolities in gestational age-dependent adverse outcome parameters and abnormal Doppler velocimetry of the ductus venosus was the only significant parameter associated with perinatal death and low 5-mins Apgar scores.Baschat et al [2] and Schwarze et al [15] stated that pulsation in the UV followed by waveform abnormalities in the DV was the most sensitive Doppler parameter for identifying fetuses at risk for stillbirth, perinatal or neonatal death and that the most specific parameters with higher positive predictive values regarding adverse perinatal outcomes were abnormal venous Doppler values, which supports the results in the present study.

Growth restricted fetuses with abnormal venous flow have worse perinatal outcome compared to those where flow abnormality is confined to the umbilical or middle cerebral artery. In fetuses with low middle cerebral artery pulsatility, venous Doppler allows detection of further deterioration. While abnormal venous flows can be significantly associated with fetal demise, gestational age at delivery significantly impacts on all short-term outcomes.

Our study was similar to a study conducted by Baschat et al [2] where neonatal death was most strongly related to an absent or reversed ductusvenosus A-wave and pulsatile UV blood flow ($R^2 = 0.33$, $P = 0.007$).

Perinatal outcome in our study is comparable to other studies and is statistically highly significant.The multi-vessel Doppler Ultrasonography can effectively stratify IUGR fetuses with placental vascular insufficiency into risk categories. Worsening arterial Doppler results do parallel worsening fetal status, but only the addition of venous Doppler has allowed a comprehensive understanding of cardiovascular deterioration.

VI. Conclusion

- The diagnosis of utero -placental insufficiency causing fetal growth restriction identifies a group of fetuses who are prone for perinatal complications.
- Many fetuses with IUGR are hypoxemic and some are acidemic even prior to the onset of labor.
- The role of antenatal surveillance is identification of the hypoxemic fetus, since the sequelae of hypoxemia can only be altered by iatrogenic intervention. Delivery is timed to precede acidemia. Doppler ultrasound velocimetry is a noninvasive, repeatable and simple method for antepartum fetal surveillance which holds great promise in this area.
- There is a strong correlation between fetal hypoxemia and Doppler measured flow indices of the fetal arterial circulations.
- Venous Doppler waveforms become abnormal after the brain-sparing effect and correlate better with academia.
- Grading of the Doppler abnormalities can accurately predict the perinatal outcome of the potentially compromised IUGR baby much earlier than NST and thus it can be used as a prognostic tool as proved in our study.
- Cases with normal Doppler had good perinatal outcome.
- Abnormalities in venous system Doppler waveforms are sensitive tools for the assessment of fetal well-being. It is a more instantaneous indicator for hemodynamic performance than is the umbilical artery velocity pattern .
- Doppler ultrasound should be used in patients with fetal growth restriction, to identify impending hypoxia, to optimise the time of delivery, and hence to optimise the perinatal outcome in these patients.

Venous Doppler is superior to arterial Doppler in predicting poor perinatal and neonate

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