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Umbilical artery Doppler velocimetry and adverse perinatal outcome in high risk pregnancies in a tertiary care center

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Abstract
Background: This is a prospective study conducted at the department of obstetrics and gynecology Mgmgh, Trichy attached to K.A.P. Vishwanatham Government Medical College, Trichy, From January 2018 To December 2018.this is a Tertiary Care Center in which total number of deliveries per month is around 1000.
Objective: The main goal of antenatal fetal surveillance is to identify fetal compromise, to ascertain fetal well being and to improve the perinatal outcome in normal and high risk pregnancies so as to take timely and active intervention to reduce the maternal and perinatal mortality and morbidity.
Methods: Study conducted at the department of obstetrics and gynecology MGMGH, Trichy attached to K.A.P. Vishwanatham government Medical College, Trichy January 2018 TO December 2018. Sample size is 100.
Results: In this study group, umbilical artery flow was abnormal in 22 patients and normal in 28 patients. When analysing the perinatal outcome with abnormal umbilical artery doppler, where the flow is abnormal, 86.36% patients had abnormal perinatal outcome compared to13.63% who had normal perinatal outcome Umbilical artery flow velocity waveform correlates with the hemodynamic changes occurring in the fetoplacental circulation. Increased resistance to umbilical artery blood flow is significantly associated with perinatal mortality and morbidity.
Conclusion: Doppler velocimetry is a non invasive technique used for evaluation of status of fetus in response to alteration in the uteroplacental and fetoplacental circulation.

Keywords: doppler velocimetry, perinatal outcome, AEDF, REDF, FGR, preterm delivery

Introduction
Every mother has an expectation and anxiety of delivering a term, healthy baby. Quality of life for both mother and the newborn has become the top priority in the field of obstetrics. Fetal growth and development remains one of the most complex and fascinating biological process. The main goal of antenatal fetal surveillance is to identify fetal compromise, to ascertain fetal well being and to improve the perinatal outcome in normal and high risk pregnancies so as to take timely and active intervention to reduce the maternal and perinatal mortality and morbidity.

High risk pregnancy contributes to conditions that predispose to placental insufficiency. They cause fetal compromise and are detected early by antepartum surveillance saving infant life and decreasing fetal disabilities. High risk pregnancy is a situation in which the mother has a condition likely to cause an adverse effect in the developing fetus.

High risk pregnancy refers to either identification of high risk factors like anaemia, cardiac disease, systemic hypertension, respiratory illness like bronchial asthma, thyroid, diabetes mellitus, renal and liver disorders, Rh alloimmunization, connective tissue disorders, seizure disorders, infections like hepatitis and syphilis during antenatal period in the previous or current pregnancy like Anaemia, Gestational hypertension, Pre eclampsia, Eclampsia and Gestational diabetes mellitus that leads to poor maternal or fetal outcome [1].

Fetuses with abnormal flow velocity waveform have a high incidence of perinatal asphyxia and death than those with normal flow characteristics. Doppler velocimetry decides not only the frequency of antenatal testing and optimum time of delivery but also the mode of delivery whether to do conservative management or interventions so as to reduce the maternal and neonatal morbidity [2].

Although most antepartum fetal monitoring tests have shown the significant diagnostic efficacy, only the Umbilical artery doppler ultrasound has shown the clinical effectiveness in improving the perinatal outcome [3]. Umbilical artery was the first fetal vessel evaluated by doppler

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velocimetry to study the fetal well being [4].

The present study was conducted to analyse doppler indices using umbilical artery waveforms in normal and high risk pregnancies to predict perinatal outcome.

In this study high risk factors taken into consideration are hypertensive disorders of pregnancy, diabetes mellitus with vasculopathy, chronic renal disease, BOH and postdated pregnancy [5].

Reduced/ Absent/ Reversed end diastolic flow in umbilical arteries studies show that elevated impedance in umbilical arteries is evident only when there is atleast 60% of placental vascular bed is obliterated [6].

The results of abnormal umbilical artery Doppler were more significant than the uterine artery in prediction of perinatal outcome. Colour Doppler is an excellent one for non invasive haemodynamic assessment of patients with PIH [7]. AEDF or REDF in umbilical artery of IUGR fetuses are ominous signs of fetal compromise [8]. Uterine and umbilical artery Doppler findings are comparable as predictors of pregnancy outcome in pregnancies complicated by IUGR. Although Umbilical artery Doppler be normal, the uterine artery Doppler may detect high risk pregnancies in the surveillance of fetuses with growth restriction [9]. Among preterm IUGR fetuses, with AEDV in umbilical Artery the UA/MCA Ratio is an excellent predictor of neonatal morbidity [10].

Aim of the study
- Analysis of the fetoplacental circulation using umbilical artery Doppler velocimetry in high risk pregnancies.
- To determine the indices like Resistance index, Pulsatility index and S/D ratio in umbilical artery.
- To evaluate the efficacy of umbilical artery Doppler velocimetry in early diagnosis of fetal hypoxia and to decide the mode of termination before the occurrence of acidemia.
- To study the predictive value of umbilical artery Doppler in high risk pregnancies in relevance to perinatal outcome.

Study group
Antenatal women between 26 to 34 weeks of gestation with high risk factors like GHTN, previous history of GHTN, preeclampsia, eclampsia, chronic hypertension, Diabetes complicating pregnancy, BOH and prolonged pregnancy.

Control group: Antenatal women between 26 to 34 weeks of gestation without any risk factors like anemia, hypertension, diabetes, BOH, prolonged pregnancy, chronic renal disease, Rh negative pregnancy and multiple pregnancy.

Inclusion criteria
- Antenatal mother with gestational age between 26 to 34 weeks
- Singleton pregnancy.
- Presence of high risk factors like GHT, Preclampsia, Eclampsia, chronic hypertension, diabetes mellitus-overt and GDM, post dated pregnancy, previous BOH with recurrent fetal loss and perinatal death.

Exclusion criteria
- Multiple pregnancy
- Congenital fetal abnormalities

- Fetuses with chromosomal malformations
- Cardiovascular disease
- Rh alloimmunization

Method of study
Informed written consent from the antenatal women were obtained after explaining the procedure, its advantages and the absence of any radiation hazards to the fetus or herself in detail.

Thorough general and obstetric history was elicited and recorded.

General examination, systemic examination and obstetric examination were done. Investigations like urine routine, hemoglobin, bleeding time, clotting time, random blood sugar, blood urea, serum creatinine, blood grouping & typing, serum bilirubin, SGOT and SGPT were done. Fundus examination for hypertensive and diabetic mothers was done. Ultrasound was done followed by Doppler evaluation. Doppler velocimetry was done with Duplex Doppler system using curvilinear probe with 3.5 MHz, with pulsed Doppler transducer attached to it.

Umbilical artery is assessed by pointing the probe towards the fetus through abdomen. Flow velocity waveforms were recorded from the free floating loop of cord.

Abnormal Waveforms
S/D Ratio> 3
High Resistance Flow
Absent End Diastolic Flow
Reversed end diastolic flow

All the patients were followed up with regular antenatal examination for assessing the interval growth. If any abnormality detected, repeat Doppler evaluation was done and managed appropriately.

Decision to deliver was taken in situations such as
- Gestational age -37 weeks for hypertensive mothers
- Absent end diastolic flow
- Reversed end diastolic flow
- Abruption
- Worsening of maternal conditions like HELLP, Imminent eclampsia, uncontrolled hypertension and deteriorating renal function.
- Evidence of Fetal distress either by Biophysical profile or abnormal CTG, Fetal alarm signal
- Oligohydramnios with AFI<5

Mode of delivery, gestational age at delivery whether delivery was induced or spontaneous, mode of delivery-labor naturale/ elective or emergency LSCS was noted

Following were taken as adverse Perinatal outcome
- Preterm delivery
- IUGR
- APGAR at 5minutes less than 6/10
- Admission to NICU
- Perinatal death and still birth
- Presence of respiratory distress syndrome, Hypoxic Ischemic Encephalopathy, Intraventricular haemorrhage, Necrotising Enterocolitis, seizures.

Results and Analysis

Table 1: Age Distribution

Age	Study		Control		Total		Statistical Inference
	No	%	No	%	NO	%	
Below 20yrs	2	4	4	8	6	6	X2=5.643
21-25yrs	22	44	29	58	51	51	Df=3
26-30yrs	20	40	16	32	36	36	P=0.130>0.05
Above 30yr	6	12	1	2	7	7	Not significant
TOTAL	50	100	50	100	100	100	

Age	No	Mean	SD	T	DF	Statitical Interference
Study	50	26.06	4.249	2.384	98%	0.019<0.05
Control	50	24.22	3.424			Significant

In this study, 6 patients were below 20 yrs. 51 patients were between 20-25 yrs 36 patients were between 26-30yrs and 7 patients were above 30yrs. The mean age in study group was 26.06years and the mean age in control group was 24.22yrs. By applying Chi square test, the p value was 0.019 (<0.05) which is significant.

Table 2: Gravida

Gravida	Study Group No50		Control no 50		Total no100		Statistical inference
	No	%	No	%	no	%	
Primi	28	56	32	64	60	60	X2=2.369
Second gravid	9	18	10	20	19	19	Df =3
Third gravid	9	18	7	14	16	16	P.499>0.05
Forth gravida and above	4	8	1	2	5	5	Not significant
Total	50	100	50	100	100	100	

In the study group, primigravida, second gravid third gravid fourth gravid and above were 28,9,9 and 4respectively and in the control group these were 32,7,10,7 and 1respectively.there is no significant difference in parity between both the groups by chi square test, which showed p value of 0.499(>0.05) which is not significant.

Table 3: High Risk Factors

High Risk Factors	No	%
Hypertensive disorders of pregnancy	33	66
Diabetes mellitus in pregnancy	8	16
Bad obstetric history	5	10
Post dated pregnancy	3	6
Chronic renal disease	1	2

In this study, patients with gestational hypertension, mild pre eclampsia, severe pre eclampsia, imminent eclampsia, HELLP syndrome, chronic hypertension, and pre eclampsia superimposed on chronic hypertension were categorised under Hypertensive disorders of pregnancy. Patients with overt diabetes mellitus on insulin gestational diabetes mellitus on meal plan and gestational diabetes mellitus on insulin were categorized under diabetes mellitus in pregnancy. Patients with previous history of unexplained loss, antiphospholipid antibody syndrome and connective tissue disorders were categorized under BOH.

Table 4: Umbilical Artery S/D Ratio

S/D Ratio	N	Mean	S.D	T	DF	Statistical Inference
Study	50	2.8590	0.94787	4.335	98	0.000<0.05
Control	50	2.2232	0.42100			Significant.

In this study, S/D ratio was abnormal >3 in 19 patients in study group and 1 patient in control group. P value is 0.000 (<0.05) which is significant. 3 patients in study group and 1 patient in control group showed absent end diastolic flow in umbilical artery Doppler velocimetry.

Table 5: High Resistance Flow

High Resistance Flow	Study		Control		Total		Statistical Inference
	N	%	N	%	N	%	
No	31	62	49	98	80	80	X2=20.250
Yes	19	38	1	2	20	20	Df=1
Total	50	100	50	100	100	100	0.000<0.05 Significant.

In this study, umbilical artery Doppler shows high resistance flow in 19 patients belonging to study group and 1 patient in control group. P value is 0.000(0.05) significant.

Table 6: Absent end diastolic flow

Absent End Diastolic Flow	Study		Control		Total		Statistical Inference.
	N	%	N	%	N	%	
No	48	96	49	98	97	97	2 X =0.344
Yes	2	4	1	2	3	3	Df=1
Total	50	100	50	100	100	100	0.558>0.05 Not significant.

In this study absent end diastolic flow in umbilical artery Doppler study was noted in 2 patients of study group and one patient of control group.

Table 7: Reversed end Diastolic flow -chi square chart

Reversed End Diastolic Flow	Study		Control		Total		Statistical Inference
	No	%	No	%	No	%	
Yes	1	2	-	-	1	1	X2=1.010 df=1
No	49	98	50	100	99	99	.315>0.005
TOTAL	50	100	50	100	100	100	Not significant

Reversed diastolic flow in umbilical artery Doppler study was noted in 1 case belonging to study group.

Table 8: Amniotic Fluid Index

Afi	Study		Control		Total	
	N	%	N	%	N	%
<5	11	22	5	10	16	16
>5	39	78	45	90	84	84
Total	50	100	50	100	100	100

AFI	N	MEAN	S.D	T	DF	
Study	50	7.2740	2.70780	-3.950	98	0.000<0.05 significant.
Control	50	9.1900	2.10512			

In this study AFI <5 was present in 11 patients and 5 patients in the study and control group respectively. The P value was 0.000(<0.05) which is significant.

Table 9: Gestational Age At Delivery

Gestational Age At Delivery	Study		Control		Total	
	N	%	N	%	N	%
<34 weeks	8	16	2	4	10	10
35-37weeks	35	70	14	28	49	49
>37weeks	7	14	34	68	41	41
Total	50	100	50	100	100	100

Gestational age At delivery.	N	Mean	S.D	T	Df	Statistical Inference.
Study.	50	36.54	1.992	-3.870	98	0.000<0.05 Significant.
Control.	50	37.88	1.423			

In this study 8 and 2 patients delivered at gestational age <34 weeks in study and control group respectively. 35 and 14 patients delivered at gestational age between 35 to 37 weeks in study and control group respectively.7 and 34 patients delivered at term I.e >37 weeks of gestation in study and control group respectively.

Table 10: Mode of delivery

Mode of delivery	Study		Control		Total		Statiatical Inference.
	N	%	N	%	N	%	
Labour Naturale.	18	36	34	68	52	52	2
LSCS.	31	62	14	28	45	45	X = 11.679
Outlet Forceps.	1	2	2	4	3	3	Df=2 0.004<0.05
Total.	50	100	50	100	100	100	Significant.

In this study group 31 patients had operative delivery in the study group, but only 14 patients had operative delivery in the control group. Applying chi square test, the P value was 0.004(<0.05) was significant association between abnormal Doppler and operative intervention.

Table 11: TERM / PRETERM

Term / Preterm	Study		Control		Total		Statistical Inference
	N	%	N	%	N	%	X2 =10.187
Term	30	60	49	88	74	74	Df =1
Preterm	20	40	6	12	26	26	P=0.001<0.005
Total	50	100	50	100	100	100	significant

In this study group 20 babies were delivered preterm, where as 6 babies were delivered preterm in the control group. P value is 0.001<0.05, which is significant.

Table 12: APGAR AT 5 MIN

APGAR at 5 min	Study		Control		Total	
	No	%	No	%	No	%
<6	9	18	2	4	11	11
>6	41	82	48	96	89	89
Total	50	100	50	100	100	100

APGAR at 5 min	N	Mean	S.D	T	Df	Statistical Inference
Study	50	7.2600	1.12141			
Control	50	7.8800	0.52060			
Study	50	7.2600	1.12141	-3.546	98	.001 <0.005 Significant
Control	50	7.8800	0.52060			

APGAR at 5 minutes was <6/10 for 9 babies in Study group and 2 babies on the control group with a significant p value of 0.001 (<0.005).

Table 12: Birth Weight in Kg

Birth weight in Kg	Study		Control		Total	
	NO	%	NO	%	NO	%
2.01 – 2.50 kg	11	22	12	24	23	23
2.51 – 3 kg	7	14	23	46	30	30
>3kg	11	22	12	24	23	23

Total	50	100	50	100	100	100
Birth weight in kg	N	mean	SD	T	Df	Statistical inference
Study	50	2.2476	0.72897	-4.357	98	.000 < 0.05 significant
Control	50	2.7790	0.46093			

In the study group, 21,11,7, 11 babies had birth weight of < 2 kg,2-2.5kg,2.5-3 kg and >3kg respectively. In the control group, 3,12,23 and 12 babies had birth weight of < 2kg,2-2.5kg,2,5-3kg and >3kg respectively. Hence there was significant assocsiation between abnormal Doppler and low birth weight.

Table 13: Nicu Admission

NICU Admission	Study		Control		Total	
	N	percent	N	Percent	N	Percent
Yes	31	62	6	12	37	27
No	19	38	44	88	63	63
Total	50	100	50	100	100	100

Totally 37 babies were admitted in the Neonatal Itensive Care Unit. Among those 37 babies, 31 were babies of study group mothers and only 6 were babies of control group mothers.

Table 14: Neonatal Morbidity

Neonatal morbidity	Study group		Control group		total		Statistical inference
	no	%	No	%	no	%	
1.Respiratory distress	6	12	1	2	7	7	
2. Intrauterine growth retardation	8	16	-	-	8	8	$X2=30.901$
3.Neonatal hyperbilirubinemia	4	8	1	2	5	5	df=6
4.Birth asphyxia	5	10	1	2	6	6	.000<0.05
5.Preterm baby	6	12	3	6	9	9	significant
6.Infant of diabetic mother	3	6	-	-	3	3	

Respiratory distress syndrome was noted in 6 babies & 1 baby in study group and control group respectively. IUGR was present in 8 babies in study group.

Neonatal hyperbilirubinemia was present in 4 and 1 babies in study and control group respectively. Birth asphyxia was present in 5 and 1 baby of study and control group respectively. Preterm delivery occurred in 6 and 3 cases in study and control group respectively.

Discussion

Doppler velocimetry is a non invasive technique used for evaluation of status of fetus in response to alteration in the uteroplacental and fetoplacental circulation.

Type of Doppler abnormality in umbilical artery

Type of umbilical artery Doppler abnormality	Study Group	
	No	Percentage
High resistance flow (increased S/D ratio >3)	19	38 %
AEDF	2	4%
REDF	1	2%

High resistance flow i.e increased S/D ratio (>3), presence of AEDF and REDF in the umbilical artery are used as predictors of adverse perinatal outcomes. In this study, increased S/D ratio >3 in the umbilical artery are found in 19 (38 %) patients which is near to v. Gupta *et al* (39%), saxena *et al* (40%) and Trudinger *et al* (40%). *Absent* end diastolic flow was noted in 2 patients (4%), and reversed end diastolic flow was found in 1 patient (2%) [6, 11].

Umbilical artery Doppler flow pattern	LSCS		Vaginal delivery	
	No	percentage	No	percentage
High resistance flow (increased S/D ratio >3)	12	63.15%	7	36.84%
AEDF	1	50 %	1	58%
REDF			1	100%

Among the 19 cases with high resistance flow, 12 patients were taken up for emergency lscs and 7 patients delivered vaginally. Out of 12 patients who underwent emergency lscs, the indication for lscs were 1 case of fetal distress, 2cases of fetal alarm signal, 1 case of severe oligohydramnios with fetal distress, 4 cases of failed induction and 4 cases of previous lscs with non reactive CTG.

2 patients with AEDF were induced with PGE2 gel intracervically. Among 2 patients with AEDF, one patient was taken up for emergency LSCS for fetal alarm signal and one patient delivered vaginally. Both babies had birth asphyxia and admitted in NICU.

One patient with REDF was induced with PGE2 gel intracervically, delivered vaginally. APGAR at 5 min was 4/10 admitted in NICU expired on 6 th day due to respiratory distress syndrome with pulmonary haemorrhage.

Umbilical artery Doppler and perinatal outcome

Umbilical Artery Doppler	Perinatal Outcome	
	Abnormal	Normal
Abnormal	19(86.36%)	3 (13.65%)
Normal	7(25%)	21(75%)

In this study group, umbilical artery flow was abnormal in 22 patients and normal in 28 patients. When analysing the perinatal

outcome with abnormal umbilical artery doppler, where the flow is abnormal, 86.36% patients had abnormal perinatal outcome compared to13.63% who had normal perinatal outcome Umbilical artery flow velocity waveform correlates with the hemodynamic changes occurring in the fetoplacental circulation. Increased resistance to umbilical artery blood flow is significantly associated with perinatal mortality and morbidity. When there is high impedence flow inumbilical artery, 86.36% has abnormal perinatal outcome and 13.63% has normal perinatal outcome.

Flischer *et al* 1989, documented S/D ratio of umbilical artery has a sensitivity of 78 %, specificity of 83 %, positive predictive value of 95%, in predicting adverse perinatal outcome.
Ozeren *et al* elir obstetrics and gynecology reprod biol -1999 jan documented that umbilical artery S/D ratio has sensitivity of 88% and diagnostic accuracy 94%in determining the adverse perinatal outcome [12].

Doppler study in umbilical artery and perinatal outcome

Umbilical artery Doppler	Perinatal outcome							
	Normal		Total		Perinatal mortality		Perinatal morbidity	
	No	Percentage	No	Percentage	No	Percentage	No	Percentage
High resistance flow (increased S/D ratio >3)	3	15.78	16	84.21	2	10.52	14	73.68
AEDF	-	-	2	100	-	-	-	-
REDF	-	-	1	100	1	100	-	-

When there is high resistance flow (increased S/D ratio) in umbilical artery doppler, the perinatal mortality is 10.52 % (2/19) and perinatal morbidity is 73.68% (14/19).

With AEDF, the perinatal morbidity is 100 %.
No mortality is observed with AEDF in this study
With REDF, perinatal mortality is 100 %

Abnormal umbilical artery Doppler	Perinatal Outcome							
	APGAR<6/10		PRETERM		RDS		IUGR	
	No	Percentage	No	Percentage	No	Percentage	No	Percentage
High resistance flow (increased S/D ratio >3)	4	21.05	14	73.68	3	15.78	4	21.05
AEDF	2	100	2	100	-	-	2	100
REDF	1	100	1	100	1	100	1	100

On analysis of perinatal morbidity pattern for 22 patients with abnormal Umbilical artery Doppler, 19 babies had perinatal morbidity.7 babies had APGAR <6/10. 17 babies were preterm. 4 babies had respiratory distress syndrome.7 babies were IUGR,

2 babies of mother with high resistance flow and 1 baby of mother with REDF died in early neonatal period.

Abnormal Doppler and birth weight

	Birth Weight							
	<1.5 KG		1.6-2KG		2.1-2.5KG		>2.5KG	
	No	%	No	%	No	%	No	%
High resistance flow (increased S/D ratio >3)	4	21.05	10	52.63	4	21.05	1	0.05
AEDF	100	-	-	-	-	-	-	-
REDF	100	-	-	-	-	-	-	-

On analysis of abnormal uterine artery doppler, out of 19 patients with high resistance flow,4 babies delivered babies with birth weight < 1.5kg (21.05%) 10 babies with birth weight 1.6-2kg (52.63%) 4 babies with 2.1-2.5kg(21.05%) and only one baby had birth weight >2.5kg(0.05%). 2 patients with REDF delivered babies with birth weight <1.5kg. The patient with REDF delivered a baby with birth weight < 1.5kg.
Thus, there is a significant association between abnormal Doppler and low birth weight.
In this study the Doppler abnormalities in umbilical artery in the control group were much less and perinatal outcome was better than the study group. The observations from this study showed that there is increased risk of maternal and perinatal morbidity and mortality in antenatal mothers with high risk factors [13].
Out of high risk factors taken into consideration for this study umbilical artery Doppler abnormality was noted in 17 patients with hypertensives disorder. 4 patients with bad obstetric history and 1 patient with overt diabetes on insulin. As the umbilical artery Doppler abnormalities are seen more with antenatal mothers with hypertensive disorder. Antenatal fetal surveillance with Doppler is essential for patients with hypertensive disorders in the present as well as past pregnancies where fetal growth restriction is more common.
In this study patients with gestational diabetes mellitus on meal

plan and insulin showed no significant adverse perinatal outcomes, which is reinforced by studies conducted by Zimmermann *et al* who documented that there was no significant correlation between abnormal Doppler indices and poor glycemic control. Abnormal umbilical artery Doppler indices are seen only if diabetes complicating pregnancy is associated with preeclampsia or fetal growth restriction [14, 15].
Doppler velocimetry has less role in normal pregnancies. Hence in antenatal surveillance it is possible to predict the adverse perinatal outcome using Doppler velocimetry so as to take timely interventions to reduce the maternal and perinatal morbidity and mortality.

Statistical significance of umbilical artery Doppler

Umbilical artery doppler	Perinatal outcome	
	Abnormal	Normal
Abnormal	19(a)	3(b)
Normal	7©	21(d)

Sensitivity = $\dfrac{\text{True positive} \times 100}{\text{True positive +false negative}}$

=19/19+7 x100 = 73.07 %

Specificity = $\dfrac{\text{True negative}}{\text{True negative +false positive}}$ X 100

=21/21+3 x100 = 87.5%

Positive predictive value = $\dfrac{\text{True positive}}{\text{True positive +false positive}}$ X 100

=19/19+3 x100 =86.36%

Negative predictive value = $\dfrac{\text{True negative}}{\text{True negative +false negative}}$ X 100

=21/21+7 x100 =75%

False positive % = b /b+d x100

= 3 /3+21 x100 =12.5 %

False negative % = c /a +c x100

= 7 /19 +7 x100 = 26.92 %

In this study abnormal umbilical artery Doppler has a significant correlation with adverse perinatal outcome with a sensitivity of 73.07 % and specificity of 87.5 %, Positive predictive value of 86.36% and negative predictive value of 75 %, False positivity rate of 12.5 % and False negative value of 26.92 %.

After investigating the effectiveness of the umbilical artery abnormal velocimetry in prediction of adverse perinatal outcomes trudinger *et al* concluded that SD ratio had sensitivity of 37 % and specificity of 92 %. Nicholes *et al* showed that ADEF had a sensitivity of 90 %, specificity of 92 % PPV of 53 %, and NPV of 100 % in prediction of perinatal outcome [16].

50 patients with high risk factors like Hypertensive disorders of pregnancy, Diabetes in pregnancy, Bad obstetric history, Postdated pregnancy and Chronic renal disease in pregnancy were grouped as study group. 50 patients without high risk factors were categorised as control group. All 100 patients were subjected to umbilical artery doppler velocimetry at gestational age between 26-34 weeks of gestational age and further followup by clinical examination and doppler evaluation was done.

S/D ratio of > 3, AEDF & REDF were considered as abnormal in umbilical artery doppler velocimetry.

In this study, mean age in the study group was 26.06 years and for control group 24.22 years. Most of the patients in both study and control group were primigravida i.e 28 patients (56%) in study group and 32 patients (64%) in control group were primigravida.

Abnormal umbilical artery doppler indices was seen in 22 patients in study group & 2 patients in control group.

Among the high risk factors, abnormal umbilical artery doppler indices were more common with hypertensive disorders of pregnancy.

- Fetal growth restriction was seen in 8 patients(16%) of patients belonging to study group and FGR was not seen in control group
- Operative intervention was seen in 31(62%) in study group whereas only 14(28%) patients had operative delivery in control group
- Preterm delivery was observed in 20(40%) cases in study group and 6 patients in control group
- Low APGAR of less than 6/10 at 5 minutes was observed in 9(18%) babies in the study group and only 2(4%) babies in

control group had low APGAR score
- LBW of < 2kg was seen in 21(42%) babies in study group and only 3(6%) babies in control group had low birth weight.
- 3 perinatal deaths were reported in study group and one perinatal death occured in control group
- NICU admission was more in babies of study group 31(62%) than of control group 6(12%)

Conclusion
High risk factors in pregnancy are found to be associated with significant antenatal and fetal morbidity and mortality. Analysis of fetoplacental circulation show that significant abnormal indices such as increased S/D ratio, AEDF and REDF in the Umbilical artery which significantly predicts the perinatal outcome. In patients with umbilical artery doppler indices, there was an increased incidence of operative deliveries and NICU admission due to fetal distress, LBW, low APGAR, RDS and IUGR. Hence doppler flow velocimetry is useful for prediction of adverse perinatal outcome. With this use of umbilical artery doppler, it is possible to predict that an IUGR fetus is not hypoxic.

- Predictive value of normal doppler is 100 %. So if the doppler is normal in IUGR fetus, the possibility of abnormal perinatal outcome is very rare. Hence unnecessary interventions can be reduced in pregnancy with normal amniotic fluid volume and normal doppler.
- With absent or reversed diastolic flow in umbilical artery, the perinatal mortality is nearly 100%.

In Umbilical artery doppler ultrasound, finding of increased resisitance detects the fetus at risk of complication 2 weeks earlier than the other methods of antepartum surveillance like NST.

- After identifying those fetuses at risk of complication, close monitoring is done by NST and biophysical scoring for planning the time of delivery in order to improve the perinatal outcome. Abnormal doppler velocimetry alarms the obstetrician to plan the delivery in a tertiary care centre with a better NICU set up, as it warrants the effective and close monitoring of the patient and expert neonatal care.
- Hence doppler velocimetry should be a primary tool of antepartum fetal surveillance, since it is a noninvasive test which is easy to perform and to interpret that predicts the fetal status in utero and perinatal outcome

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