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Triple Vessel Wave Pattern By Doppler Studies of Fetomaternal Circulation In High Risk Pregnancies (Gestational Hypertension And IUGR) And Its Perinatal Outcome

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Introduction

Preeclampsia and intrauterine growth restriction are important causes of perinatal morbidity and mortality[1,2] .Therefore early diagnosis help in reducing in maternal as well as perinatal morbidity and mortality. The introduction of fetal Doppler technology has provided the first opportunity for repetitive non invasive hemodynamic monitoring in human pregnancy. This study is used to determine the qualitative aspects of uteroplacental and fetal circulation. . Abnormalities in any one or more vascular systems occur prior to clinical and laboratory appearance of,or as a result of, many pathological conditions of pregnancy. The ability to obtain information on the velocity and impedance of blood flow through maternal and fetal vessels during Doppler velocimetry has become an important tool in evaluation and management of high risk pregnancies.

Aims And Objectives

1. This study aims to apply Triple Vessel Doppler techniques to investigate the fetal, fetoplacental, uteroplacental circulation in high risk pregnancies(hypertension in pregnancy and IUGR) to determine perinatal outcomes in these patients.
2. To plan the management of patient according to Doppler studies.
3. To council the patient regarding perinatal outcome.

Materials And Methods

This study was conducted in the Obstetrics and Gynaecology department, J.L.N Medical College and Hospital, between March 2016- Mar 2017. A total of 100 singleton pregnancies constituted the study population.

Inclusion Criteria

Color Doppler study in pregnant women who have:

1. Singleton Pregnancy with
   - >26 weeks period of gestation by LMP or 1st trimester USG
   - with cephalic presentation
2. Hypertensive disorders of pregnancy
   - Gestational hypertension
   - Pre eclampsia
   - Eclampsia
   - Chronic hypertension with superimposed preeclampsia
3. Women identified to have IUGR: there was >2cm difference in symphysio fundal height to the clinical gestational age.
4. Previous history of hypertension in pregnancy

Exclusion Criteria

- Multigestation
- Malpresentations
- Abnormal Placentation
- Overt Diabetes
- Chronic renal diseases

- Severe malnutrition
- Chronic hypertension
- Hypertension due to other causes like endocrinal, neurogenic.
- Symmetrical IUGR-due to genetic causes and infection, chromosomal disorders occurring in 1st trimester.

Method

The scan were performed on the Siemens G-50 color Doppler unit being using 2-5MHz curvilinear transducer in the department of Radiodiagnosis at JLN Medical College, Ajmer. Studies were done with the patient in semi-recumbent position and the fetus in a quiet resting and apnoeic state. This was determined both by direct observation using real-time ultrasound and by the absence of doppler waveform patterns typical of gross fetal movements and breathing, i.e., irregularity of arterial waveforms and swaying of the venous waveforms. The Doppler determinations were done by one consultants in the unit for all the study patients.

Results:

Table 1: Age distribution in the study (yrs) in Hypertension in pregnancy and IUGR cases.

Age (Yrs)	Frequency of hypertension in pregnancy	Percentage	Frequency of IUGR	Percentage
<20	5	7	4	13.33
21-25	40	57.14	9	30
26-30	14	20	15	50
>30	11	15.71	2	6.67
Total	70	100	30	100

Table 2: Parity Distribution in Hypertension in pregnancy cases

Gravida	Frequency of hypertension in pregnancy	Percentage	Frequency of IUGR	Percentage
1	35	50	16	53.3
2	22	31.4	9	30
3	9	12.8	4	13.33
4	3	4.2	1	3.34
5	1	1.8	-	0
Total	70	100	30	100

Table 3: Socioeconomic Status of Study cases

Socioeconomic Status	Frequency of hypertension in pregnancy	Percentage	Frequency of IUGR	Percentage
Upper Class	20	28.57	6	20
Upper Middle Class	15	21.4	6	20
Lower Middle Class	10	14.2	8	26.7
Lower Class	15	21.4	10	33.4
Total	70	100	30	100

Table 4: Doppler analysis in study group

	At 11 weeks	Percentage	At 26 weeks	Percentage
Abnormal Doppler	60	60	75	75
Normal Doppler	40	40	25	25
Total	100	100	100	100

Table 5:Antenatal Risk Factors for abnormal Doppler

Antenatal Risk Factors	Cases	
	No.	Percentage
Hypertension in Pregnancy	77	77
Previous history of SGA/preeclampsia	4	4
IUGR	13	13
No specified cause	6	6
Total	100	100

Table 6: Diastolic Notch in Uterine Artery

	At12 weeks (no.)	Percentage	At 26 weeks (no.)	Percentage	Total no. Of cases
HTN in pregnancy	27	90	21	70	30
HTN in pregnancy +IUGR	26	86.7	23	76.7	30
IUGR	9	60	5	33.4	15

Table 7: Umbilical artery flow pattern at different gestational age in study group

	28-30 weeks	32-34 weeks	34-37 weeks	37 weeks	Total cases
Increase S/D Ratio	9	14	16	21	60
AEDF	2	4	3	3	12
REDF	1	1	2	1	5

Table 8: Middle Cerebral Artery Doppler abnormality in study group

Decreased S/D Ratio	No. of Cases	Percentage
Hypertension in pregnancy	21	30
IUGR	12	40

Table 9:Mode Of delivery

	Vaginal Delivery			Caesarean Section			Instrumental delivery	
	Preterm (no.)	Term (no.)	%	Preterm (no.)	Term (no.)	%	(no.)	%
Increased S/D ratio in umblical artery	9	31	66.7	4	12	26.7	4	6.6
AEDF in umbilical artery	1	2	25	3	5	66.7	1	8.3
REDF in umbilical artery	2	1	60	1	0	20	1	20
Diastolic Notch in Uterine Artery	19	20	65	6	13	31.7	2	3.3
Reduced S/D ratio in Middle Cerebral Artery	2	4	18.1	10	16	78.8	1	3.1

Table 10: Umbilical artery and perinatal outcome

Umbilical artery	Perinatal outcome			
	Abnormal		Normal	
	No.	%	No.	%
Abnormal (68)	59	86.8%	9	13.2%
Normal (32)	2	6.3%	30	93.7%

Table 11: Uterine artery and perinatal outcome

Uterine artery Doppler	Perinatal outcome			
	Abnormal		Normal	
	No.	%	No.	%
Abnormal (60)	34	56.6	26	43.4
Normal (40)	8	20	32	80

Table 12:Middle Cerebral artery and Perinatal outcome

Middle Cerebral artery	Perinatal Outcome			
	Abnormal		Normal	
	No.	%	No.	%
Abnormal(33)	31	93.9	2	6.06
Normal(67)	11	16.4	56	83.6

Table 13: Fetal outcome in present study

	No. Of patients	Percentage
Preterm deliveries	17	17
IUFD	5	5
Low birth weight	30	30
NICU Admission	18	18

Table 14: For Predicting Perinatal outcome

S.No	Index	Sensitivity %	Specificity %	Positive Predictive Value %	Negative Predictive Value %
1.	Uterine Artery	100	55.17	56.5	80
2.	Umblical Artery	96.7	76.9	86.7	93.7
3.	Middle Cerebral Artery	73.8	96.55	93.4	83.5

Discussions

The main objective of antepartum fetal surveillance in a high risk pregnancy is to detect compromised fetus to allow timely delivery. Doppler velocimetry study is one such noninvasive tool which can be carried out to prevent adverse perinatal outcome.

In normal pregnancy the 3 indices S/D, PI and RI decreases with advancing gestation in umbilical artery [3] but in IUGR first there is decreased diastolic flow in umbilical arterydue to increase in the resistance that occurs in small arteries and arterioles of the tertiary villi. This raises the S/D ratio; PI and RI of umbilical artery. As the placental insufficiency worsens, the diastolic flow decreases, then becomes absent, and later reverses. The prevalence of perinatal death in fetuses with absent or reversed end diastolic flow velocity is reported is reported to be over 40% [4]. Yoon *et al.*[5] demonstrated in their study that absent umbilical artery waveform is a strong and independent predictor of adverse perinatal outcome. Fetal MCA is low resistance circulation throughout pregnancy and accounts for 7% cardiac output of the fetus[6,7]. The MCA seems to react earlier and sensitively to hypoxia and ischemia.

Forty per cent of women with bilateral notches of uterine arteries and high pulsatility index have chances of developing preeclampsia, while in 45% there is chance of

developing IUGR.[8,9] Color Doppler is an excellent tool for non-invasive hemodynamic monitoring of PIH patients. It helps to identify the foetus at risk and predict perinatal morbidity and mortality [10]. The waveform is essentially a high resistance form in the non-pregnant state. As the pregnancy progresses, there is gradual removal of the notch and an increase in the diastolic flow, as seen by the fall in resistance index (RI) [11]. By using the persistence of the notch of the uterine arteries as the definition of abnormality, it was found that it persists in the majority of the women diagnosed with Gestational hypertension.

The incidence of uterine notch in color Doppler was in 70% women who developed hypertension in pregnancy,in 76.7% women who developed hypertension in pregnancy and IUGR and in 33.4% women who developed IUGR.

In the present study, on gross analysis of the perinatal outcome with abnormal umblical artery flow, when the flow was abnormal 86.8% had abnormal outcome and 9% had nomal outcome. Whereas when the flow was normal 93.7% had normal and only 6.3% had adverse perinatal outcome

In the present study, on gross analysis of the perinatal outcome with abnormal uterine artery flow, when the flow was abnormal 56.6% had abnormal outcome and 43.4% had nomal outcome. Whereas when the flow was normal 80% had normal and only 20% had adverse perinatal outcome.

In the present study, on gross analysis of the perinatal outcome with abnormal middle cerebral artery flow, when the flow was abnormal 93.9% had abnormal outcome and 6.06% had nomal outcome. Whereas when the flow was normal 83.6% had normal and only 16.4% had adverse perinatal outcome.

Most sensitive index for detection of perinatal outcome was Uterine artery(100%).The most specific index was MCA (96.55%) and also had the highest positive predictive value (93.4%).

SUMMARY

This study was conducted to determine the importance of fetomaternal Doppler velocimetry in pregnancies complicated by hypertension in pregnancy and intrauterine growth restriction.

After obtaining complete clinical data and examination, routine ultrasound biometry profiles of fetus were obtained. Then a color mode and pulsed Doppler study was done to include various uterine artery, umbilical artery and Middle cerebral artery disease. Data from all the patients were tabulated, statistically analyzed. We arrived at the following inferences:

Hypertension in pregnancy was more frequent in age group of 21-25 years and IUGR was more frequent in age group of 26-30 yrs. Duen Halter reported that pregnancy induced Hypertension was common in very young teenage.

Hypertension in pregnancy & IUGR was more frequently seen in primigravidas as compared to multigravidas. The correlate with the study of Chesley et al - where they found higher incidence of Hypertension in pregnancy & IUGR in nulliparus.

Umbilical artery waveform

Out of 100 pregnant women of Hypertension in pregnancy & IUGR Pregnancies, 68 women (68%) showed abnormal umbilical artery indices. This indicates that umbilical artery indices are sensitive in patients with Hypertension in pregnancy & IUGR. REDF was found in 7.3% of women & AEDF in 17.6% of women. All these cases showed abnormal neonatal outcome. Mode of delivery in women who had AEDF 25% were delivered by vaginal delivery,8.3% by instrumental delivery, rest 66.7% by Caesarean Section. Mode of delivery in women who had

REDF 60% were delivered vaginally,20% by instrumental delivery, rest 20% by Caesarean Section.

Uterine artery waveform

Abnormal uterine artery wave forms were seen in 75% women indicated significant association between uterine artery indices & Hypertension in pregnancy & IUGR.

It was concluded that of the various parameters of uterine artery, early diastolic notch persistence beyond 26 weeks (present in 49 women) is the most sensitive parameter associated with Hypertension in pregnancy.

Middle cerebral artery waveform

In Hypertension in pregnancy cases the MCA indices were abnormal in only 30% women. In IUGR cases the MCA indices were abnormal in only 40% women.

The use of Colour Doppler USG has provided the excellent opportunity for repetitive noninvasive hemodynamic monitoring in pregnancies with Hypertension in pregnancy and IUGR. There is ample evidence that Doppler indices from the fetomaternal circulation can reliably predict adverse perinatal outcome in an obstetric population with a high prevalence of Hypertension in pregnancy and thus it is a primary tool for fetomaternal surveillance in hypertensive pregnancies. It helps us to take timely action in consultation with obstetrician and neonatologist to plan the timing and mode of delivery to improve the perinatal outcome in Hypertension in pregnancy & IUGR cases. We can also decrease the maternal morbidity and mortality associated with caesarean section in those pregnancies where the Doppler study indicative of imminent fetal demise by conducting these deliveries through vaginal route if possible.

Thus we conclude that currently fetomaternal Doppler velocimetry of the uteroplacental, umbilical and fetal vessels in pregnancies complicated by Hypertension in pregnancy & IUGR has become established method of antenatal monitoring, allowing the non- invasive assessment of fetal circulation and its indices provide important information on the haemodynamics of the vascular area under study that were not readily obtained from more conventional tests of fetal well-being. Circulatory changes, reflected in certain fetal Doppler waveforms, predict adverse perinatal outcome. In experienced hands, waveforms from a number of fetal vessels predict the occurrence and timing of adverse events. A combination of several Doppler parameters is superior to a single parameter, although the parameters are strongly correlated with each other.

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