A study of placenta and its blood vessels in high risk pregnancies by Colour Doppler USG and its correlation with maternal and neonatal outcome

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Abstract

Objective-To study the placenta and its blood vessels by colour flow Doppler ultrasonography and its histological correlation with neonatal and maternal outcome. ***Methods-*** A prospective comparative study was conducted in 60 antenatal women >28 weeks gestation. Out of these, 30 cases of high risk pregnancies and other 30 normal antenatal cases were taken as controls. All the women were subjected to colour Doppler study and study of placental anatomy and histology done and results were correlated to perinatal and maternal outcome.
Results- It was found that colour Doppler was abnormal in 63.3% cases of high risk groups and abnormal histopathological changes were found in 100% cases of high risk group while 33.3% cases of control group where colour Doppler was normal. And it was seen that perinatal outcome was poor in the group with abnormal pulsatility index and it was correlated with abnormal histology of placenta. Rate of caesarean section was also higher in high risk groups. ***Conclusion-*** By doing colour Doppler we can detect placental pathologies at their earliest so that the pathological process can be checked at an early stage thus leading to favourable maternal and fetal outcomes.

Key Words- PI= Pulsatality Index, IUGR = Intrauterine growth restriction, NICU = Neonatal Intensive Care Unit.

INTRODUCTION

"**Bundle of life**" the placenta, with its multifaceted roles in pregnancy for the developing fetus has been rightly quoted to in the old testament. Modern life's advent of technologies like ultrasonography are quite apt in localizing variations and detecting pathologies in the "**External soul"**of a pregnant woman.

Doppler flow velocimetry based colour changes have revolutionized our quest for detecting placental insufficiency, especially in "high risk ones". It gives us the precise follow up of hemodynamic events that happen subsequent to placental insufficiency.

Functional capacity of the placenta being a difficult study, anatomical studies are important to establish the normal relationship between placental pathology and maternal and neonatal outcome.

Thus, without overemphasizing, determination of placental insufficiency is absolutely essential for prevention of intrauterine and perinatal morbidity and mortality.

OBJECTIVE

To study placenta and its blood vessels in high risk pregnancies by Colour Doppler ultrasonography and correlate it with histology, and maternal and neonatal outcome

MATERIALS AND METHOD

This study was conducted in Department of Obstetrics and Gynaecology in Index Medical College and Research Centre, Indore from May 2013 to October 2013.Total 60 cases out of which 30 cases were of normal pregnancy in group 1 and 30 cases of group 2 were of high risk pregnancy of >28 weeks gestational age (**cases-**pregnancy induced hypertension,suspected IUGR, postmaturity, maternal diabetes, anemia, antepartum hemorrhage, bad obstetric history, chronic renal disease) were included.

Each patient was subjected to a thorough history taking, general physical examination, systemic examination and obstetric examination. Then each patient was subjected to serial colour Doppler study, ultrasound examination and obstetrical examination.The colour Doppler study was carried out using pulsed Doppler SONACE 8000 SE ultrasound system using 2.5 M.hz and 3.5 Mhz duplex transducers. Doppler readings were taken from umbilical artery. Pulsatility index was used for data analysis.

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Doppler studies were considered abnormal when any one of the parameters monitored below was abnormal

1. Pulsatility index of umbilical artery (U.A.)>2 S.D. for gestational age.

2. Absence or reversal of end diastolic flow in umbilical artery.

The above tests were repeated depending upon the severity of the condition. The patients were followed up through delivery and postpartum.

After the delivery the placenta was thoroughly examined. The size, shape, colour of maternal and fetal surface of placenta, thickness and diameter were noted. Umbilical cord was examined and manner of insertion of umbilical cord was noted along with the pattern of branching of chorionic blood vessels. Then the placenta was preserved and sent to pathology department for histopathological examination.

Maternal and neonatal outcomes were noted in the form of delivery, birth weight, APGAR score at 1 min and 5 min, NICU admission and perinatal death.

OBSERVATIONS AND RESULTS

The 60 women selected for study were distributed into control (I) and high risk group (II) according maternal characterstics.(**Table-I).**

Table-I- Maternal Characterstics

Maternal Characteristics	Control Group-I	Control Group-II
Mean age (years)	24.95	24.96
Primigravida (%)	50.0	53.3
Multiparity (%)	50.0	46.7
Mean period of gestation (weeks)	36.23	35.03
Socioeconomic status in majority	Class-III	Class-IV

TABLE-II shows that pulsatility index was normal in 100% and 36.7% abnormal in 0% and 63.3% respectively in control (I) and high risk groups (II).

Table II-Comparision of Umblical Artery Pulsatility Index in group I and II

Pulsatility Index	Group-I		Group-II	
	No.	%	No.	%
Normal	30	100.0	11	36.7
Abnormal	00	00.0	19	63.3
Total	30	100.0	30	100.0

In group I (control group) the mean pulsatility index was 0.872±0.11 while in high risk group (II) the mean pulsatility index was 1.273±0.215 among 28 patients, one had absent flow and in one flow was reversed in umbilical artery.

TABLE-III shows the distribution of cases according to presence or absence of abnormal pathological histological changees in the placenta. In the present study abnormal histological changes were seen only in 10 (33.33%) patients in group I and in group II all the 30 (100%) patients showed abnormal histological changes. The P value was <0.001which was significant.

Table-III- Distribution of Cases According To Presence/Absence Of Pathological Histological Changes In Placenta

Abnormal histological changes	Group-I		Group-II	
	No.	%	No.	%
Absent	20	66.7	00	00.0
Present	10	33.3	30	100.0
Total	30	100.0	30	100.0

TABLE -IV shows the Correlation of Gross Morphological Pattern of Blood Vessels of the Placenta with Umbilical Artery Pulsatility Index of Pulse Doppler Wave Form Analysis in Both Group 1 and Group 2. Disperse arrangement of blood vessels was seen in 20 (66.7%) patients in group 1 6 (54.5%) patients in group 2 with

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normal pulsatility index and in 13 (68.4%) patients with abnormal pulsatility index. Magistral pattern of blood vessels was seen in 10 (33.3%) patients in group 1 5 (45.5%) patients with normal pulsatility index and 6 (31.6%) patients with abnormal pulsatility index showed magistral pattern of blood vessels. The P value was .0.05 which was not significant.

Table-IV- Correlation of Gross Morphological Pattern of Blood Vessels of The Placenta With Umbilical Artery Pulsatility Index of Pulse Doppler Wave Form Analysis In Both Group-I And Group-II

Pattern	Pulsatility Index					
	Group-I		Group-II			
	Normal		Normal		Abnormal	
	No.	%	No.	%	No.	%
Disperse	20	66.7	06	54.5	13	68.4
Magistral	10	33.3	05	45.5	06	31.6
Total	30	100	11	100	19	100

TABLE V shows that all the abnormal histological changes; villous infarcts (78.9%), syncytiotrophoblastic knots (84.2%), cytotrophoblastic proliferation (78.9%), thickening of villous trophoblastic basement membrane (73.68%), hyalinized villi (84.2%), were maximally found in high risk groups of abnormal pulsatility index in comparision to control group I , which was highly significant.

Table-V-Correlation Of Pathological And Histological Changes Of The Placenta With The Umbilical Artery Pulsatility Index Of Pulsed Doppler Waveform Analysis In Both Group-I And Group-II

Histology	Pulsatility Index						'Z' value
	Group-I		Group-II				
	Normal		Normal		Abnormal		
	No.	%	No.	%	No.	%	
Villous infarcts	02	06.7	04	36.36	15	78.9	4.601
Syncytiotrophoblastic knots	06	20.0	05	45.45	16	84.2	3.892
Cytotrophoblastic proliferation	03	10.0	04	36.36	15	78.9	4.286
Thickening of villous Trophoblastic basement membrane	00	00.0	04	36.36	14	73.68	5.070
Hyallinised villi	00	00.0	02	03.03	16	84.2	5.070

TABLE-VI shows Correlation between fetal and maternal outcome and umbilical artery pulsatility index and histology of placenta. Perinatal mortality was higher (15.7%) in patients with abnormal umbilical artery pulsatility index and (6.7%) in patients with abnormal histology. There were maximum NICU admissions (36.9%) in group with abnormal pulsatility index in which 5 babies had APGAR score <7 at 5 minutes and 2 minutes and <2 at 5 minutes. While in normal P.I. group NICU admissions were 2(6.7%)having APGAR score <7at 5 minutes In normal histology group only 1 admission in NICU while in abnormal histology 7 (23.3%)had NICU admissions. Maximum no. of IUGR babies seen in 8(42.1%) in abnormal P.I. group. While in normal P.I. group there were only 1(3.3%) IUGR baby. In abnormal histology group 8(26.7%) and with normal histology 1(5%) had IUGR baby. Vaginal delivery was more commonin normal P.I. (80%) and normal histology group (85%). Rate of emergency caesarian section was higher in (79%) in group with abnormal P.I. and 53.3% in patients with abnormal histology. Thus perinatal outcome was poor in group with abnormal pulsatility index and placentae with abnormal histology.

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Table-VI-Correlation between Fetal And Maternal Outcome With Umbilical Artery Pulsatility Index And Histology Of Placenta

Fetal Outcome	Pulsatility Index				Histology			
	Normal (30)		Abnormal (19)		Normal (20)		Abnormal (30)	
	No.	%	No.	%	No.	%	No.	%
Perinatal Mortality	00	00.0	03	15.7	00	00.0	03	6.7
* Fetal death	00	00.0	01	5.23	00	00.0	01	2.3
* Neonatal death	00	00.0	02	10.47	00	00.0	02	4.4
NICU admission	02	06.7	07	36.9	01	05.0	07	23.3
* Apgar Score (<7 at 5 min.)	02	06.7	05	26.36	01	05.0	04	13.31
* Apgar Score (<2 at 5 min.)	00	00.0	02	10.64	00	00.0	03	9.99
IUGR	01	03.3	08	42.1	01	05.0	08	26.7
Maternal outcome								
Vaginal delivery	24	80.0	04	21.0	17	85.0	12	40.0
Emergency caesarean section	05	16.7	15	79.0	02	10.0	16	53.3
Elective caesarean section	01	03.3	00	00.0	01	05.0	02	06.7

DISCUSSION

We have done the study of placenta and its blood vessels i.e. umbilical artery by colour Doppler and correlated it with pattern of blood vessels and histology of placenta. It is evident in our study that perinatal outcome is poor in cases with abnormal pulsatility index and abnormal histology group. The perinatal mortality, neonatal morbididy and IUGR are higher in high risk group babies.

Kristel van Asselt et al (1998) [1] showed that arterial blood velocity waveforms were significantly associated with low birth weight, increased caesarean section rate and more frequent admission to the neonatal intensive care unit.

Seyam YS et al (2002) [2] showed that fetuses with abnormal Doppler velocimetery had significantly lower birth weight, and more chance of admission to neonatal intensive care unit. Significance of umbilical artery velocimetery in predicting perinatal outcome of growth restricted fetuses was reported from Mumbai by ***Arora et al (2005)*** [3].

Our study also shows that perinatal mortality and neonatal morbidity and incidence of Caesarean Section are higher in groups with abnormal Doppler velocity waveform.

Madazli R, Somunkiran et al (2002) [4] showed that placenta from IUGR cases with abnormal umbilical artery Doppler velocimetry had a significantly increased number of villous infarcts cytotrophoblastic proliferation and thickening of villous trophoblastic basement membrane.Abnormal placental pathology was significantly associated with abnormal umbilical artery Doppler velocimetry. The patients with abnormalDoppler velocimetry had lower mean birth weight.

Mardi and Sharma (2003) [5] found that the weight of the placentafrom growth retarded pregnancies was less than those of normal placenta,There was significant increase in the incidence of infarction, intervillousfibrin deposition, stromal fibrosis and syncytial knotting in IUGR placenta as compared to normal placentas. There is also basement membrane thickening and cytotrophoblastic hyperplasia. All these changes lead to reduced blood flow to the fetus.

Majumdar'S et al (2005-2007) [6] found that mothers with moderate to severe PIH had smaller, irregular placenta with marginal insertion of umbilical cord with deviation in respect of foci of calcification, infarction and histological features of vascular insufficiency like thrombosis, infarction, etc. Histological findings like cytotrophoblastic cellular proliferation, syncytial knot formation, fibrin plaque formation etc. were present in greater amount in hypertensive placentae. Babies of such mothers were

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mostly small for date, few of them have birth asphyxia. The changes in the placenta may be the cause/effect or both of hypertension in pregnancy of mothers who were normotensive.

In our study also the percentage of abnormal histopathological changes were higher in the group with abnormal pulsatility index.

CONCLUSION

Our study indicates that abnormal doppler findings in uteroplacental blood flow is a reflection of unfavourable intrauterine environment for the growing fetus. As the magnitude of abnormal placentation increases, intervillous blood flow decreases leading to placental vascular pathologies which in turn affect fetal growth and well being.

So if we can diagnose these pathologies earlier by colour doppler the pathological process can be checked at an early stage leading to a favourable maternal and fetal outcome.

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