



Original Article

Triple vessel wave pattern by Doppler studies in normal and high risk pregnancies and perinatal outcome

Sharma Urmila¹, Bhatnagar Beena²

^{1,2}Department of Obstetrics and Gynecology (Mahila Chikitsalaya),
Sawai Man Singh Medical College, Jaipur (Rajasthan) – 302003

Abstract

Objective(s): To evaluate the role of triple vessel (umbilical, middle cerebral and uterine artery) color Doppler study in normal and high risk pregnancy in relation to perinatal outcome. **Method(s):** A prospective study was done including fifty women with high risk pregnancy and 50 normal pregnant women during the year 2006-2007. Doppler examination was done after recording patients' history, clinical examination and ultrasound. Mode of delivery, perinatal outcome including birth weight, perinatal death, Apgar score at 1 and 5 minutes and admission to nursery were compared. **Result(s):** There was significant difference between the Doppler indices of the three vessels in the study and the control group. In women with abnormal Doppler indices, there was high incidence of cesarean section (78%), low birth weight babies, low Apgar score, higher admission rate to nursery (36%) and high incidence of neonatal deaths as compared to that of the control group. **Conclusion(s):** Triple vessel color Doppler sonography is very useful in high risk pregnancy diagnosis and in predicting perinatal outcome.

Key words: high risk pregnancy, triple vessel color Doppler, perinatal outcome.

Introduction

Doppler velocimetry is a rapid non-invasive test that provides valuable information about hemodynamic situation of the fetus and is an efficient diagnostic test of fetal jeopardy that helps in management of high risk pregnancy. The development of Doppler ultrasound evaluation of uteroplacental and fetoplacental circula-

tion is one of the most important achievements of modern obstetrics.

Abnormal Doppler findings are associated with fetal growth restriction and have been used as a screening test for fetal stress. Absent or reversed diastolic flow is a particularly ominous finding indicating extreme downstream resistance, placental dysfunction and fetal compromise.

Doppler evaluation of blood flow through cerebral vessels might be used to detect altered cerebral circulation before there is hypoxemia significant enough to alter the fetal heart rate pattern. Fong et al¹ compared the diagnostic performances of fetal MCA (middle cerebral artery), umbilical artery and renal artery Doppler ultrasound for prediction of adverse perinatal outcome in high risk pregnancies. Zha² studied P.I. of fetal MCA

Paper received on : 04/01/2007 accepted on : 26/12/2009

Correspondence:
Sharma Urmila
103, Chitragupt Nagar,
1st Imli Phatak, Jaipur - 302005.
E-mail : urmishvijay@yahoo.in
Cell: 09314491232.

and umbilical artery in 84 normal late pregnancies and 31 IUGR (intrauterine growth restriction) cases by Doppler ultrasonography.

The uterine artery Doppler waveform is unique and increased resistance to flow and development of a diastolic notch has been associated with pregnancy induced hypertension.

The present study was conducted to evaluate the diagnostic value of various indices combined with Doppler ultrasound of triple vessel (Uterine artery, umbilical artery, middle cerebral artery) waveforms in high risk pregnancies.

Material and Methods

Fifty women with high risk pregnancy and 50 with normal growth of the fetus were included as study and control group respectively. Doppler examination was done after recording the history of the patients, clinical examination and ultrasound.

Waveforms were obtained for umbilical, uterine and middle cerebral artery and various indices were calculated viz. Pulsatility index (PI), difference between peak systolic and diastolic flow over the mean flow velocities, Resistance index (RI), difference between peak systolic and diastolic flow over systolic flow and S/D ratio - ratio of peak systolic and diastolic flow.

Table 1: Categorization of cases

S.No	Categories	No. of Cases (%)
1	PIH (Pregnancy induced hypertension)	11 (22%)
2	IUGR (Intrauterine growth restriction)	9 (18%)
3	PIH + IUGR	7 (14%)
4	PIH + BOH	3 (6%)
5	IUGR + Rh Negative pregnancy	2 (4%)
6	PIH + IUGR + BOH	1 (2%)
7	IUGR + BOH	1 (2%)
8	IUGR + Anemia	2 (4%)
9	BOH (Bad obstetric history)	10(20%)
10	Rh Negative pregnancy	4(8%)
	Total	50

Table 2: Doppler findings in the different categories of cases_

S. No.	Categories (High risk)	No. of Cases	Diastolic Notch in Uterine Artery	Umbilical Artery S/D>3	Abnormal C/U (PI.MCA/PI.Umb.Art)	Low Apgar (<7)	LBW Babies (<2500gm)	Nursery Admission	Neonatal deaths
1	PIH	11	8	8	8	1	4	2	1
2	IUGR	9	7	8	9	3	8	4	0
3	PIH+IUGR	7	7	7	7	5	7	7	1
4	PIH+BOH	3	3	3	3	1	0	1	0
5	IUGR+Rh Negative	2	2	2	1	0	0	0	0
6	PIH+IUGR+BOH	1	1	1	1	1	1	1	0
7	IUGR+BOH	1	1	1	0	0	0	0	0
8	IUGR+Anemia	2	2	2	1	2	2	2	0
9	BOH	10	0	0	1	0	3	0	0
10	Rh Negative	4	0	0	0	0	1	1	0
	Total	50	31	32	31	13	26	18	2

Table 3 : Comparison of umbilical artery Doppler indices

Doppler indices	Mean \pm SD		P value
	Study	Control	
PI	1.18 \pm 0.260	0.87 \pm 0.150	< .001
RI	0.71 \pm 0.082	0.59 \pm 0.068	< .001
S/D	3.71 \pm 0.970	2.46 \pm 0.401	< .001

Table 4 : Comparison of umbilical artery Doppler indices

Doppler indices	Mean \pm SD		P value
	Study	Control	
PI	1.08 \pm 0.265	1.28 \pm 0.236	< .001
RI	0.66 \pm 0.073	0.74 \pm 0.196	< .001
S/D	3.03 \pm 1.03	3.93 \pm 0.946	< .001

Table 5 : Comparison of uterine artery Doppler indices

Doppler indices	Mean \pm SD		P value
	Study	Control	
PI	0.61 \pm 0.173	0.56 \pm 0.145	> .05
RI	0.44 \pm 0.092	0.41 \pm 0.068	> .05
S/D	1.87 \pm 0.062	1.70 \pm 0.212	< .001

All data thus calculated was charted, tabulated and analyzed statistically. The different parameters were determined as normal or abnormal for gestational age by using previous studies as reference values. The mode of delivery was tabulated whether vaginal or caesarean. Perinatal outcome of these pregnancies was also studied, in the form of perinatal death, mean Apgar at 1 and 5 minutes, birth weight and admission to neonatal ICU (intensive care unit).

Results

The most common risk factor found in the study group was PIH (44%) either alone (22%) or in combination with other risk factors like IUGR and BOH (22%).

The second most common risk factor was IUGR either alone (18%) or in combination with PIH, BOH, Anemia or Rh negative pregnancy (26%).

Table 6: Comparison of birth weight, Apgar score at 1 & 5 minutes and amniotic fluid index in study & control groups

Variables	Study group (n=50)	Control group (n=50)	P value
Birth weight (gms)	2310 ± 610	2800 ± 400	<0.001
Apgar score at 1 minute	6.8 ± 0.66	7.32 ± 0.58	<0.001
Apgar score at 5 minutes	7.54 ± 0.61	7.94 ± 0.37	<0.001
Amniotic fluid index	10.18 ± 3.25	15.14 ± 2.84	<0.001

Table 7: Comparison of cases according to mode of delivery

Mode of Delivery	Study (n=50)	Control (n=50)
	No of cases %	No of cases %
Normal Delivery	16.00	76.00
Preterm Normal Delivery	6.00	0.00
LSCS	78.00	24.00

LSCS = Lower segment caesarean section

The other risk factors included BOH, Rh negative pregnancy and anemia either alone or in combination with other risk factors as shown in Table 1.

The Doppler findings were most abnormal in the group with concomitant PIH and IUGR (seven cases). All the seven (100%) cases had diastolic notch in uterine artery, umbilical artery S/D>3 and abnormal C/U (PI, MCA/PI, umb, art). Also the perinatal outcome was worst in this group with low Apgar score in five (71%) neonates, LBW babies in all seven (100%) cases and all the seven (100%) neonates were admitted in nursery out of which there was one (14%) neonatal death.

In PIH group, Doppler findings were abnormal in eight (73%) cases, with low Apgar score in one (9%) neonate, LBW babies in four (36%) cases and two (18%) neonates were admitted to nursery out of which there was one (9%) neonatal death.

The Doppler findings and the perinatal outcome in other

categories are shown in Table 2.

Table 3 shows that the PI, RI and S/D of the umbilical artery were significantly higher in the study group (1.18, 0.71, 3.71) than the control group (0.87, 0.59, 2.46). Table 4 shows that the PI, RI and S/D ratio of MCA in high risk pregnancy group 1.08, 0.66, 3.03 were significantly lower than the control group. Table 5 shows the comparison of uterine artery indices in the study and the control group. Only the S/D ratio was significantly different between the two groups (p<0.001).

The mean amniotic fluid index (AFI) in high risk group was 10.18 cm and in control group was 15.14 cm. Mean birth weight in the study group (2310gm) was significantly lower than in the control group (2800gm). Apgar score at 1 minute and 5 minutes was significantly lower in the high risk group than the control group (Table 6).

In the high risk group majority of the patients (78%) had LSCS (lower segment cesarean section) while in

the control group most of the patients had vaginal delivery (Table 7). High risk cases had higher admission rate to nursery (36%) as compared to the control group (4%).

Discussion

In the present study, mean age was 25.5 years for the study group and 23.7 years for the control group. Majority of the patients in the study group had PIH (pregnancy induced hypertension) and IUGR. The mean amniotic fluid index was significantly low in high risk group as compared to the control group. In the present study PI, RI and S/D value of the umbilical artery showed significantly higher values in the study group as compared to the control group ($p < 0.001$) indicating increased peripheral resistance and consequently decreased diastolic flow leading to fetal compromise. The PI, RI and S/D ratios of MCA in high risk pregnancy group were significantly lower than that in the control group, indicating increase in the diastolic flow and cerebral vasodilatation. This suggested the presence of brain sparing effect in the presence of fetal hypoxia due to placental insufficiency.

Sieroszewski et al³ conducted a study to analyze the usefulness of uterine artery Doppler velocimetry in high risk pregnancy diagnosis. In the present study, among the uterine artery indices, only the S/D ratio was significantly higher in the study group as compared to the control group (p value < 0.001).

In the present study, most of the women in the control group had vaginal delivery while in the high risk group majority of the women had LSCS thus indicating increased operative intervention in the high risk group based on abnormal Doppler velocimetry. The mean birth weight and the Apgar score were lower in the study group as compared to the control group and the difference was highly significant. In the present study, there was higher admission rate to the nursery (36%) in the study group as compared to the control group (4%) as seen in the study conducted by Seyam⁵, where it was found that the average birth weight and gestational age at delivery were significantly lower for fetuses with abnormal Doppler velocimetry than for those in the normal Doppler group.

The umbilical and MCA artery indices were abnormal in the group whose babies were admitted in the nursery as compared to those whose babies were not admitted.

This implied poor perinatal outcome in the presence of abnormal indices and hence in the presence of fetal anoxia. When the uterine artery indices were compared in the two groups, it was found that, although the PI, RI, S/D ratio in the high risk group were higher than that in the control group, the difference was not statistically significant.

In the present study, there were two neonatal deaths in the study group while none of the neonates died in the control group thus indicating poor perinatal outcome in the high risk group associated with abnormal Doppler findings. Mikovic et al⁶, in their study found that in the high risk group with abnormal Doppler indices, the average birth weight was 1327 ± 245 gm, neonatal mortality 8.6%, while perinatal mortality was 14.3%.

Conclusion

There was high incidence of LSCS due to fetal distress, low birth weight, increased incidence of nursery admissions and low Apgar score at 1 and 5 minutes with abnormal Doppler indices in the study group. Thus triple vessel Doppler study is very useful in predicting high risk pregnancies with adverse perinatal outcome when the Doppler velocimetry is abnormal.

References

1. Fong KW, Ohlsson A, Hannah ME et al. Prediction of perinatal outcome in fetuses suspected to have intrauterine growth restriction. Doppler US study of fetal cerebral, renal and umbilical arteries. *Radiology* 1999;213:681-9.
2. Zha C, Li J, Li X. Pulsatility indexes of fetal middle cerebral artery and umbilical artery for predicting intrauterine fetal growth retardation. *Zhonghua Fu Chan Ke Za Zhi* 1996;31:345-7.
3. Sieroszewski P, Guzowski G, Sosnowski D et al. The usefulness of uterine artery Doppler velocimetry in high-risk pregnancy diagnosis (PIH and/or IUGR). *Ginekol Pol* 2005;76:342-7.
4. Karsdorp VH, van Vugt JM, van Geijn HP et al. Clinical significance of absent or reversed end diastolic velocity waveforms in umbilical artery. *Lancet* 1994;344:1664-8.
5. Seyam YS, Al-Mahmeid MS, Al-Tamimi HK. Umbilical artery Doppler flow velocimetry in intrauterine growth restriction and its relation to perinatal outcome. *Int J Gynaecol Obstet* 2002;77:131-7.
6. Mikovic Z, Mandic V, Djukic M et al. Longitudinal analysis of arterial Doppler parameters in growth retarded fetuses. *Srp Arh Celok Lek* 2003;131:21-5.