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Doppler Ultrasound as Predictor of Obstetric Outcome in High Risk Pregnancy

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Abstract: ***Objectives: To determine and compare diagnostic accuracy of Doppler of Uterine Artery, Umbilical Artery, Middle Cerebral artery & Ductus Venosus in high risk pregnancy. To study prognostic efficacy of Doppler in early detection of fetal compromise. Method: A prospective study comprising 110 patients of high risk pregnancy having IUGR admitted in Civil Hospital, OBGY Department, B. J. Medical College from JUNE 2016 to MAY 2017. Doppler examination of Uterine Artery, Umbilical Artery, Middle Cerebral Artery & Ductus Venosus was done after recording patients' history, clinical examination and ultrasound. Mode of delivery, perinatal outcome. A comparison was carried out between the Doppler indices of above mentioned vessels in predicting the perinatal outcome & deciding the further management. Result: Bilateral diastolic notches in uterine artery had highest specificity (93.02%) and highest PPV (85%) for prediction of abnormal perinatal outcome. Using 95th percentile as a cutoff for raised S/D ratio, 12 out of 31 patients had abnormal perinatal outcome. UA S/D ratio has sensitivity 0f 69.7%, specificity 81.6%, PPV 67.6% & NPV 83.05%. 10 out of 16 patients who had reduced diastolic flow of UA had abnormal perinatal outcome & none of those who had AEDF or REDF had normal perinatal outcome.27 out of 41 patients having low MCA PI had abnormal perinatal outcome.Of all tests, Cerebro-umbilical Ratio has highest sensitivity 52.5 %& Specificity 92.8% for predicting the outcome. All patients with abnormal Ductus venosus flow had abnormal perinatal outcome.50% underwent Caeserian Section and in 60% cases indication for LSCS was fetal distress. Conclusion: Use of Doppler ultrasound in high risk pregnancy appears to improve the obstetric care & outcome. It helps in reducing perinatal deaths. Increasing UA PI and decreasing MCA PI are the early markers for detection of fetal compromise. Ratio of indices between MCA PI & UA PI reflects brain sparring effects as well as placental insufficiency and these are more specific in detection of IUGR than individual arteries.***

Keywords: High Risk Pregnancy, Color Doppler, Perinatal Outcome

1. Introduction

- Doppler ultrasound is a well established technique used to diagnose problems during pregnancy. In the same way that a speed radar measures how fast cars are travelling, Doppler ultrasound can monitor how fast blood is moving in the uteroplacental , fetoplacental and fetal circulation.
- We can then decide which high risk pregnancies need assistance in delivering the baby and which women can be left to deliver without assistance.

2. Aims and Objectives

- To determine and compare diagnostic accuracy of Doppler of Uterine Artery, Umbilical Artery, Middle Cerebral artery & Ductus Venosus in high risk pregnancy.
- To study prognostic efficacy of Doppler in early detection of fetal compromise.

3. Materials and Method

This is a prospective study comprising 110 patients of high risk pregnancy having IUGR admitted in Civil Hospital, OBGY Department, B. J. Medical College from JUNE 2016 to MAY 2017.

- **Criteria for selection:**

All pregnant women irrespective of age and parity, with high risk factors complicating pregnancy like PIH, preeclampsia, Oligohydramnios, Anaemia, renal disease, post date etc.

Criteria for exclusion:

1. Women with multiple pregnancy
2. Congenital malformation in fetus
3. Placental previa, abruptio placenta

Following vessels were studied:

1. Uterine artery
2. Umbilical artery
3. Middle cerebral artery
4. Ductus venosus

In all patients detailed history was recorded.

- Past obstetric history taken in detail including history of abortion, still births, IUD, neonatal deaths and no. of living births, PIH, IUGR & LBW babies.
- Routine investigations like CBC, SGPT, SGOT, Total protein, uric acid & fundoscopy was done.
- EDD was calculated from LMP & USG done in 1st trimester.
- Ultrasound scanning:- After ensuring single live pregnancy, lie, presentation, gestational age, amount of liquor, placental localization & maturation, any congenital abnormalities, presence/absence of IUGR were recorded.
- Doppler velocimetry was done beyond 28 weeks of gestation in all patients, repeated after 2 weeks or early if required.
- Doppler Indices calculated:-

1. Peak systolic velocity(S)
2. End diastolic velocity(D)
3. Mean velocity
4. S/D ratio

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5. Pulsatility index(PI) and resistance index(RI) of middle cerebral artery
6. Ductus venosus S/A ratio

Interpretation of Doppler finding:

1) Uterine artery having bilateral diastolic notches.
2) Umbilical artery S/D ratio more then 3 or more than 95 percentile of references values, pulsatality index more than 95 percentile of references values by Acharya G et al or if the diastolic flow was absent or reversed.
3) Middle cerebral artery PI less than lower limit of reference value by Mari G et al.
4) MCA/UA PI ratio less than 1 of reference values by Gramellini D et al.
5) MCA/UA S/D ratio less than 1.
6) DV having absent or reversed flow as seen in 'a' wave

Follow Up of patients:-

1) With normal Doppler-follow up till delivery
2) With abnormal Doppler-weekly or earlier

Following neonatal information was obtained:-

1) Mode of delivery
2) Indication of cesarean section
3) APGAR score at 5,10 minutes
4) Antepartum/intrapartum sign of fetal distress
5) Birth weight
6) Admission to intensive care unit
7) Any intrauterine death or still birth
8) Gestation age at birth

4. Observation & Results

- In our study, 50% of cases were in 21-25 years age group.
- Primigravida accounted for 51% of total cases. This has been compared to a similar study conducted by Lakhar et al, in which 60% patients were primiparous
- Majority of babies weighed between 1501-2499 grams at birth followed by those weighed >= 2500 grams.
- Average birth weight was 2150 grams in this study population compared to only 1798.7grams in Lakkhar et al study.

Table 1: Distribution of Cases in relation to Pregnancy Complications

Pregnancy complication	Present study	
	N	%
Oligohydramnios	60	55
SFGR	53	48
Pre-eclampsia	36	33
Anemia	21	19
PIH+oligo	11	10
Post dated pregnancy	6	5
PIH+Anemia	6	5
Cardiac disease	3	3
Anemia+oligo	2	2
Bad obstetric history	2	1
Renal disease	1	1
Liver disease	1	1

Table 2: Abnormal perinatal outcome in the study population

Perinatal outcome	n	%
Still birth	6	5
Neonatal death	10	9
Neonatal hyperbilirubinemia	4	4
Early onset septicemia	6	5
5 min APGAR<7	16	14
Admission to NICU>24 hrs	44	40
Caesarean section for fetal distress	33	30

Table 3: Correlation of uterine artery waveform with perinatal outcome (p-value<0.01)

Uterine artery Doppler	Perinatal outcome	
	Adverse	Normal
Bilateral notch present (28)	20	8
Bilateral notch absent (82)	31	51

Bilateral diastolic notches in uterine artery had highest specificity (93.02%) and highest PPV (85%) for prediction of abnormal perinatal outcome. Our study has been supported by Park et al.

Table 4: Correlation of umbilical artery S/D ratio &abnormal perinatal outcome (n=93)(n=17) with AEDV & REDV are excluded (p-value<0.01)

UA S/D ratio	Perinatal outcome	
	Adverse	Normal
>95th percentile	12	9
<95th percentile	21	51
>3	23	11
<3	10	49

UA S/D ratio>3	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
	69.7	81.6	67.6	83.05

Amongst the high-risk pregnancies with suspected IUGR, the use of umbilical arterial Doppler assessment, significantly decrease the likelihood of labour induction, Caeserian delivery, and perinatal deaths. S/D ratio and indices were increased in some patients, but they did not show any abnormal perinatal outcome.

Table 5: Correlation of UA AEDV & REDV and abnormal perinatal outcome (n=100)(p-value<0.01)

End diastolic velocity	Perinatal outcome		PNM
	Adverse	Normal	
Reduced	10	6	1
AEDF	8	0	5
REDF	9	0	9
Normal	23	54	1

AEDV & REDV are good markers of hypoxic & acidotic fetus. Closer to term, severe placental insufficiency, reflected by absent umbilical artery end-diastolic flow velocity, is an indication for delivery.

Fetus with AEDV are

- More severely growth restricted.
- At higher risk of intrauterine death, perinatal morbidity and mortality. They require delivery at an earlier gestational age than those with normal end-diastolic flow.

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a) The findings of AEDF or REDF in UA Doppler are associated with a high perinatal mortality (89%) while Lakkhar et al reported it to be 100%.
b) Madzeli et al found that fetus with AEDV, if not delivered will die within 3 weeks (median 7 days). This duration is mainly determined by gestational age and maternal hypertension.

Table 6: Correlation of MCA PI value and Perinatal outcome:

MCA PI	Perinatal outcome	
	Abnormal	Normal
<lower limit	27	14
>lower limit	20	49

Table 7: Correlation of MCA PI/UA PI and Perinatal outcome(n=110)(cerebro umbilical ratio):

MCA PI/ UA PI	Perinatal outcome	
	Abnormal	Normal
<1	28	5
>1	19	58

CU (Cerebro-Umbilical Ratio) ratio is a Doppler index that reflects both umbilical-placental and cerebral vascular beds and hence can be useful in identifying fetus with increased placental and/or decreased cerebral resistance.

Table 8: Comparison of standard diagnostic tests in prediction of abnormal perinatal outcome:

Test characteristics	Study		
	MCA PI	UA PI	CU ratio
Sensitivity	56.81	56.81	59.58
Specificity	76.78	82.14	92.85
PPV	65.78	71.92	86.66
NPV	69.35	70.76	75.28

Our results with MCA/UA PI<1 are most in agreement (RR-3.4, CI-0.5 to 0.350, p-value<0.01) with those of Habek et al. Our findings confirm those of gramellini D et al study that the best results come from using the cerebro-umbilical ratio rather than the PI of MCA or UA separately.

Table 9: Ductus venosus abnormal flow pattern(n=6):

Ductus venosus waveform	n	%
Exaggerated 'a' wave	3	50%
Absent 'a' wave	1	16.66%
Reversed 'a' wave	2	33.32%

All the 6 patients with abnormal flow pattern in ductus venosus had abnormal perinatal outcome (mortality=4). Baschat et al found that Doppler velocimetry of venosus circulation correctly identified and predicted the acid base status at birth of growth retarded fetus.

Since our sample size was small, we could not draw a conclusion out of this.

Table 10: Distribution of cases according to mode of delivery:

Mode of delivery	**Study**	
	N	%
Vaginal delivery		
Full term	30	27
Preterm	25	23
Caesarion section		
Full term	33	30
Preterm	22	20

Table 11: Indication for caesarean section in the study population:

Indication for caesarion section	Study	
	N	%
Fetal distress	33	60
Severe pre-eclampsia	5	9
Others	17	31

Hence out of 110 Patients: 55(50%) patients underwent vaginal delivery,50% underwent caesarean section (60% were done for fetal distress).The results are comparable with those of Lakkhar et al, in which 62% patients underwent caesarean section.

5. Conclusion

- Use of Doppler ultrasound in high risk pregnancy appears to improve the obstetric care & outcome. It helps in reducing perinatal deaths.
- Increasing UA PI and decreasing MCA PI are early marker for detection of fetal compromise.
- Ratio of indices between MCA PI & UA PI reflects brain sparring effects as well as placental insufficiency and these are more specific in detection of IUGR than individual arteries.
- We recommended that Doppler study should be integral part of fetal surveillance in suspected and proved growth restricted baby in high risk pregnancy to improve perinatal outcome as well as to manage high risk mothers.

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