Section: Obstetrics & Gynaecology

Original Research Article

ASSESSING THE ASSOCIATION OF ABNORMAL UTERINE ARTERY DOPPLER WAVEFORM IN HIGH-RISK PREGNANCIES AND SUBSEQUENT ADVERSE PREGNANCY OUTCOMES

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ABSTRACT

Background: Among high-risk females, doppler assessment of uterine circulation might help estimate preeclampsia and small for gestational age infants compared to risk prevalence and assessment. Hence, risk prediction in these complications can improve outcomes with proper antenatal surveillance. The present study was aimed at assessing the association of abnormal uterine artery Doppler waveform in high-risk pregnancies and subsequent adverse pregnancy outcomes.

Materials and Methods: In high-risk pregnant females, uterine artery Doppler was done in 18-24 weeks and reported to the Institute within the defined study period. The presence of bilateral uterine artery notching and PI (pulsatality index) >1.45 were taken as abnormal Doppler waveforms. Outcomes assessed were intrauterine fetal death, abruption, SGA (small for gestational age <10th centile, and preeclampsia.

Results: Doppler assessment was done in 230 high-risk pregnant females where abnormal Doppler waveforms were seen in 34.8% of females. Preeclampsia and small for gestational age infants were seen in 26.95% (n=62) and 36.52% (n=84) subjects respectively with 70% and 76% females with abnormal Doppler waveform. Negative predictive value (NPV), PPV (positive predictive value), specificity, and sensitivity of bilateral uterine artery notching and PI >1.45 in preeclampsia prediction was 88%, 55%, 78.57%, and 70% respectively with p<0.0001 and for SGA prediction was 86.67%, 80%, 89.04%, and 76.19% respectively (p<0.0001).

Conclusion: The present study concludes that uterine artery Doppler waveform analysis in mid-trimester for high-risk pregnant females leads to a high negative predictive value. Hence, females having normal Doppler waveform are not likely to result in adverse pregnancy outcomes.

Keywords: Abnormal doppler, preeclampsia, pulsatility index, small for gestational age, uterine artery doppler, uterine artery notching.

INTRODUCTION

One of the most common and major risk factors associated with adverse pregnancy outcomes is being attributed to impaired implantation. This can be attributed to a failure in the trophoblastic invasion in the muscular spiral arteries and their conversion to wide nonmuscular low-resistance vessels from narrow nonmuscular low-resistance vessels.[1]

In human pregnancy, direct evaluation of trophoblastic invasion is not feasible and possible. Doppler imaging allows a non-invasive assessment of uteroplacental circulation by comparison of systolic and diastolic waveforms. The physiological

process of trophoblastic invasion is seen in in assessment of Doppler ultrasound studies that PI (impedance) of flow in uterine arteries decreases with gestation in 18-24 weeks and remains stable thereafter. Impedance to flow is assessed by either abnormal Doppler waveform or persistence of the uterine artery diastolic notch. This led to the use of uterine artery Doppler as a screening modality for adverse pregnancy outcomes.[2]

Alterations in Doppler techniques, study protocols, and assessment parameters have led to poor outcomes for the prediction of poor pregnancy outcomes in low-risk pregnant females with positive predictive values of 4 and 20. In high-risk pregnant females, doppler assessment of uterine circulation double positive predictive value in estimation of small for gestational age or preeclampsia in comparison to prevalence or clinical risk assessment. Hence, the prediction of the risk of these complications can improve outcomes by providing therapeutic intervention and antenatal surveillance appropriately.[3,4] The present study was aimed at assessing the association of abnormal uterine artery Doppler waveform in high-risk pregnancies in 18-24 weeks of gestational age and subsequent adverse pregnancy outcomes.

MATERIALS AND METHODS

The present prospective assessment study was aimed at assessing the association of abnormal uterine artery Doppler waveform in high-risk pregnancies in 18-24 weeks of gestational age and subsequent adverse pregnancy outcomes. Verbal and written informed consent were taken from all the subjects before study participation.

The study included all high-risk pregnant females who reported to the Institute within the defined study period. Uterine artery doppler was done as routine dental care in high-risk pregnant females in 18-24 gestation weeks. The inclusion criteria for the study were subjects with a history of oligohydramnios, intrauterine fetal demise, recurrent abortions, abruptions, eclampsia or preeclampsia, in previous pregnancies. The exclusion criteria for the study were subjects with diabetes mellitus, fetal anomalies, renal diseases, multiple pregnancies, and/or chronic hypertension.

In the procedure, using of transducer in longitudinal plane, external iliac artery was traced using the pelvic sidewalls. Transducer was medially turned towards the uterine arteries where they crossed the external iliac arteries. Various waveforms were attained from each uterine artery and mean was noted on each side. Parameters of presence or absence of notch in bilateral uterine arteries and mean PI was assessed.

In cases with PI>1.45 or bilateral notching presence was taken as abnormal Doppler forms. A preformed proforma was filled and the record was kept. Follow-up was done till pregnancy completion. No intervention was performed following the results of the Doppler. The main outcomes assessed were intrauterine fetal death, abruption, small for gestation age (<10th centile), and preeclampsia.

Preeclampsia was considered for blood pressure of higher than/equal to 140/90 mmHg on two readings taken 6 hours apart in a previously normotensive female after 20 weeks of gestation with proteinuria considered for excretion of >300mg of protein in 24 24-hour urine sample or single void protein/creatinine ratio dipstick 1+persistant or ≥0.3, or signs associated with end-organ damage with/without proteinuria including the new onset of cerebral/visual symptoms, pulmonary edema evidence, raised liver enzymes twice of normal value, serum creatinine >1.1mg/dl, and platelet count <1lakh/mm3.

In small for gestational age birth weight of <10th percentile of gestational age was considered. In abruption, premature separation of normal placenta from uterus lining before second stage labor completion, and intrauterine fetal death for fetus delivery with no signs of life at 20 weeks or greater of gestation or weight ≥350 grams in unknown gestational age.

For Doppler, validity as a predictor of small gestational age and preeclampsia was assessed depending on the NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity. The data gathered were statistically analyzed using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, Student t-test, ANOVA (analysis of variance), Fisher's exact test, Mann-Whitney U test, and Chi-square test. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered.

RESULTS

The present prospective assessment study was aimed at assessing the association of abnormal uterine artery Doppler waveform in high-risk pregnancies in 18-24 weeks of gestational age and subsequent adverse pregnancy outcomes. The study assessed 230 high-risk pregnant females, uterine artery Doppler was done in 18-24 gestation weeks and reported to the Institute within the defined study period. The presence of bilateral uterine artery notching and PI (pulsatility index) >1.45 were taken as abnormal Doppler waveforms. The mean age of the females was 23.78 years with the age range of 19-30 years.

For high-risk factors in the pregnant females in the study, the most common factor was preeclampsia seen in 40% (n=92) subjects followed by oligohydramnios in 22.60% (n=52) females, recurrent abortions in 16.52% (n=38), intrauterine fetal death in 12.17% (n=28), and abruption and eclampsia in 3.47% (n=8) study subjects each respectively [Table 1]. Doppler results were abnormal in 34.78% (n=80) females and normal

Doppler findings were seen in 65.20% (n=150) study subjects respectively [Table 2].

It was seen that for adverse pregnancy outcomes seen in study females, concerning intrauterine fetal death seen in 6 females, all 100% (n=6) females had abnormal Doppler findings. Abruption was seen in 4.34% (n=10) of females with all 10 females depicting abnormal Doppler findings. SGA was recorded in 36.52% (n=84) females where 64 showed abnormal and 20 depicted normal doppler findings. Preeclampsia was seen in 26.95% (n=62) subjects where abnormal and normal Doppler findings were recorded in 44 and 18 females respectively [Table 3].

The study results showed that for diagnostic accuracy and validity of the doppler study in pregnant females, for SGA, NPV, PPV, specificity, and sensitivity were 86.65%, 80%, 89.02%, and 76.17% respectively with relative risk and p-vale of 6.00 and 0.000. For hypertensive disorders, NPV, PPV, specificity, and sensitivity were 88%, 55%, 78.55%, and 70% respectively with relative risk and p-vale of 6.00 and 0.000 [Table 4].

Table 1: High-risk factors in the pregnant females in the study

Risk factors	Number (n=230)	Percentage (%)
Abruption	8	3.47
Intrauterine fetal death	28	12.17
Recurrent abortions	38	16.52
Oligohydramnios	52	22.60
Eclampsia	8	3.47
Preeclampsia	92	40

Table 2: Results of uterine artery Doppler results in study subjects

Doppler results	Number (n=230)	Percentage (%)
Abnormal doppler	80	34.78
Normal doppler	150	65.20

Table 3: Adverse pregnancy outcomes seen in study females

Pregnancy outcomes	Abnormal Doppler (n)	Normal doppler (n)	Total	
			n=230	%
Intrauterine fetal death	6	0	6	2.60
Abruption	10	0	10	4.34
SGA	64	20	84	36.52
Preeclampsia	44	18	62	26.95

Table 4: Diagnostic accuracy and validity of Doppler study in pregnant females

Pregnancy outcome	NPV (%)	PPV (%)	Specificity (%)	Sensitivity (%)	Relative risk	p-value
SGA	86.65	80	89.02	76.17	6.00	0.000
Hypertensive disorders	88	55	78.55	70	4.56	0.000

DISCUSSION

The study assessed 230 high-risk pregnant females, uterine artery Doppler was done in 18-24 gestation weeks and reported to the Institute within the defined study period. The presence of bilateral uterine artery notching and PI (pulsatility index) >1.45 were taken as abnormal Doppler waveforms. The mean age of the females was 23.78 years with the age range of 19-30 years. These data were comparable to the previous studies of Onwudiwe N et al,[5] in 2008 and Papageorghiou AT et al,[6] in 2001 where authors assessed pregnant females with demographic data comparable to the present study was also reported by the authors in their respective studies.

The study results showed that for high-risk factors in the pregnant females in the study, the most common factor was preeclampsia seen in 40% (n=92) subjects followed by oligohydramnios in 22.60% (n=52) females, recurrent abortions in 16.52% (n=38), intrauterine fetal death in 12.17% (n=28), and abruption and eclampsia in 3.47% (n=8) study subjects each respectively [Table 1]. Doppler results were abnormal in 34.78% (n=80) females and normal Doppler findings were seen in 65.20% (n=150) study subjects respectively. These results were consistent with the findings of Padmalatha VV et al,[7] in 2013 and Rupnawar PB et al,[8] in 2015 where high-risk factors in the pregnant females and Doppler results reported by the authors in the present study were similar to the results of the present study.

It was seen that for adverse pregnancy outcomes seen in study females, concerning intrauterine fetal death seen in 6 females, all 100% (n=6) females had abnormal Doppler findings. Abruption was seen in 4.34% (n=10) of females with all 10 females depicting abnormal Doppler findings. SGA was recorded in 36.52% (n=84) females where 64 showed abnormal and 20 depicted normal doppler findings. Preeclampsia was seen in 26.95% (n=62) of subjects where abnormal and normal Doppler findings were recorded in 44 and 18 females respectively. These findings correlated to the results of Melchiorre K et al,[9] in 2009 and Workalemahu T et al,[10] in 2018 where adverse pregnancy outcomes similar to the present study were also reported by the authors in their respective studies.

It was also seen that for diagnostic accuracy and validity of the doppler study in pregnant females, for SGA, NPV, PPV, specificity, and sensitivity were

86.65%, 80%, 89.02%, and 76.17% respectively with relative risk and p-vale of 6.00 and 0.000. For hypertensive disorders, NPV, PPV, specificity, and sensitivity were 88%, 55%, 78.55%, and 70% respectively with relative risk and p-vale of 6.00 and 0.000. These results were in line with the findings of Brown MA et al,[11] in 2018 and Mac Dorman MF et al,[12] in 2015 where diagnostic accuracy and validity of the doppler study in pregnant females comparable to the present study were also reported by the authors in their studies.

CONCLUSION

Considering its limitations, the present study concludes that uterine artery Doppler waveform analysis in the mid-trimester for high-risk pregnant females leads to a high negative predictive value. Hence, females having normal Doppler waveform are not likely to result in adverse pregnancy outcomes.

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