ORIGINAL RESEARCH

Role of Middle Cerebral ArteryPulsatility index (MCAPI) on Doppler in Pregnancy-Induced Hypertension

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ABSTRACT
Background: A pregnant woman has the potential for risks during pregnancy, labor, and birth. Doppler ultrasoundindicates that the frequency alteration of a sound wave, as it is reflected by a moving object, offers a safe, non-invasive, and efficient technique for evaluating uteroplacental and fetal circulation. Hence; the present study was conducted for assessing the Role of Middle Cerebral Artery Pulsatility index (MCAPI) on Doppler in Pregnancy-Induced Hypertension (PIH). **Materials & methods:** A cohort of 100 pregnant individuals diagnosed with pregnancy-induced hypertension (PIH) was recruited for the study. Following the ultrasound biometry assessment, the participants underwent serial Doppler studies of the uterine artery (UtA), middle cerebral artery (MCA), and umbilical artery (UmA) between 30 and 40 weeks of gestation. For the MCA Doppler waveforms, the fetal head was imaged transversely at the level of the sphenoid bones, with the circle of Willis visualized using color flow imaging. The Doppler ultrasound measurements were analyzed to predict adverse perinatal outcomes. Abnormal findings were defined as UmA-Pulsatility Index (PI) ratios exceeding the 95th percentile and MCA-PI values falling below the 5th percentile of previously established gestational age norms.Data were analyzed using SPSS version 16. The chi-square test was applied to categorical variables. Student's t-test was applied to continuous data. **Results:** Mean age of the patients was 29.5 years. Mean gestational age was 38.6 weeks. Out of 100 subjects, 67 percent were of severe PIH while the remaining 33 percent were of PIH. Pregnancy outcome was adverse in 59 percent of the patients. Sensitivity, specificity and diagnostic accuracy of MCA RI in identifying perinatal outcome was 71.3 percent, 75.9percent and 74.9percent respectively. Sensitivity, specificity and diagnostic accuracy of MCA PI in identifying perinatal outcome was 71.3 percent, 85.8percent and 80.6 percent respectively. **Conclusion:** Doppler technology plays a significant role in the continuous noninvasive hemodynamic assessment during pregnancy. In obstetric patients who exhibit a high incidence of complications such as pregnancy-induced hypertension (PIH), Doppler indices derived from fetal circulation have been shown to effectively forecast negative perinatal outcomes.

Key words: Doppler, Ultrasound, High-risk pregnancy

INTRODUCTION

A pregnant woman has the potential for risks during pregnancy, labor, and birth. Any unexpected or unanticipated medical or obstetric condition associated with pregnancy with an actual or potential hazard to the health or well-being of the mother or fetus is considered a high-risk pregnancy.[1- 3]A high-risk pregnancy is characterized by any unforeseen or unpredicted medical or obstetric condition that poses an actual or potential threat to the health or welfare of either the mother or the fetus. The concept of risk in pregnancy lacks a singular definition, as it can be interpreted variably by both the woman and her healthcare provider. Women experiencing complicated pregnancies may necessitate modifications to their lifestyle, adherence to specific medication protocols, access to specialized support, and, in some cases, hospitalization. Nurses play a crucial role in creating a secure and trusting environment throughout the stages of preconception, antenatal, intra-partal, and postnatal care, thereby promoting the health and well-being of both mother and fetus.[4- 6]Doppler ultrasound, founded on the physical principle articulated by C.A. Doppler in 1842, indicates that the frequency alteration of a

sound wave, as it is reflected by a moving object, offers a safe, non-invasive, and efficient technique for evaluating uteroplacental and fetal circulation. This method is instrumental in investigating the correlation between compromised blood flow and negative perinatal outcome.[7, 8]Hence; the present study was conducted for assessing the Role of Middle Cerebral Artery Pulsatility index (MCAPI) on Doppler in Pregnancy-Induced Hypertension.

MATERIALS & METHODS

The present study was conducted for assessing the Role of Middle Cerebral Artery Pulsatility index (MCAPI) on Doppler in Pregnancy-Induced Hypertension.A cohort of 100 pregnant individuals diagnosed with pregnancy-induced hypertension (PIH) was recruited for the study. Comprehensive demographic and clinical information for each participant was collected. Prior to conducting Doppler ultrasound evaluations, a thorough clinical history was taken, along with assessments of ultrasound biometry, amniotic fluid levels, and placental maturity. Follow-up Doppler studies were carried out to detect any significant trends in the Doppler indices. The final Doppler ultrasound results were utilized to evaluate perinatal outcomes. Following the ultrasound biometry assessment, the participants underwent serial Doppler studies of the uterine artery (UtA), middle cerebral artery (MCA), and umbilical artery (UmA) between 30 and 40 weeks of gestation. For the MCA Doppler waveforms, the fetal head was imaged transversely at the level of the sphenoid bones, with the circle of Willis visualized using color flow imaging. The Doppler ultrasound measurements were analyzed to predict adverse perinatal outcomes. Abnormal findings were defined as UmA-Pulsatility Index (PI) ratios exceeding the 95th percentile and MCA-PI values falling below the 5th percentile of previously established gestational age norms.[6, 7]Data were analyzed using SPSS version 16. The chi-square test was applied to categorical variables. Student's t-test was applied to continuous data.

RESULTS

Mean age of the patients was 29.5 years. Mean gestational age was 38.6 weeks. Out of 100 subjects, 67 percent were of severe PIH while the remaining 33 percent were of PIH. Pregnancy outcome was adverse in 59 percent of the patients. Sensitivity, specificity and diagnostic accuracy of MCA RI in identifying perinatal outcome was 71.3 percent, 75.9percent and 74.9percent respectively.Sensitivity, specificity and diagnostic accuracy of MCA PI in identifying perinatal outcome was 71.3 percent, 85.8percent and 80.6 percent respectively.

Table 1: Demographic data

Variable	Number	Percentage
Mean age (years)	29.5 years	
Mean Gestational age (weeks)	38.6 weeks	
Mild PIH	33	33
Severe PIH	67	67

Table 2: Maternal outcome

Variable		Number	Percentage
Duration of gestation at termination	Term	79	79
	Preterm	21	21
Pregnancy outcome	Uneventful	61	61
	Adverse	59	59

Table 3: Doppler indices among patients with PIH

Doppler indices	Mild PIH group	Severe PIH	p-value
MCA RI	0.73	0.66	0.001 (Significant)
MCA PI	1.35	1.18	0.000 (Significant)

Table 4: Diagnostic accuracy of doppler indices in identifying perinatal outcome

Doppler indices	Sensitivity	Specificity	Diagnostic accuracy
MCA RI	71.3	75.9	74.9
MCA PI	71.3	85.8	80.6

MCA RI: Middle cerebral artery Resistive index
MCA PI: Middle cerebral artery Pulsatility index

DISCUSSION

The role of Doppler ultrasound in assessing pregnancies at risk for preeclampsia, intrauterine growth restriction, fetal anemia, and umbilical cord abnormalities has become essential. Recent research has facilitated the timing of delivery for severely growth-restricted fetuses by advocating for the application of ductus venosus Doppler. Initially, it was

believed that abnormalities in the ductus venosus waveform served as a definitive endpoint for pregnancies affected by intrauterine growth restriction. However, emerging data suggest that these abnormalities may represent a plateau preceding further fetal decline, as indicated by alterations in the biophysical profile.In developing countries, a significant proportion of adverse perinatal outcomes are linked to placental-related conditions. Evidence indicates that uterine Doppler assessment is a reliable predictor of early-onset preeclampsia and intrauterine growth restriction, and its implementation in these cases enhances various perinatal outcomes. Furthermore, the Doppler evaluation of the middle cerebral artery, when used in conjunction with umbilical artery assessment, appears to enhance the prediction of adverse outcomes in near-term pregnancies.[7- 9] Hence; the present study was conducted for assessing the Role of Middle Cerebral Artery Pulsatility index (MCAPI) on Doppler in Pregnancy-Induced Hypertension.

Mean age of the patients was 29.5 years. Mean gestational age was 38.6 weeks. Out of 100 subjects, 67 percent were of severe PIH while the remaining 33 percent were of PIH. Pregnancy outcome was adverse in 59 percent of the patients. Sensitivity, specificity and diagnostic accuracy of MCA RI in identifying perinatal outcome was 71.3 percent, 75.9percent and 74.9percent respectively.Sensitivity, specificity and diagnostic accuracy of MCA PI in identifying perinatal outcome was 71.3 percent, 85.8percent and 80.6 percent respectively.Messawa Met al determined the effectiveness of Doppler velocimetry results in the management of high-risk pregnancy.A total of 200 high-risk pregnant women with gestational age >28 weeks were selected for the study and divided into group A (100) subjected to Doppler velocimetry and group B (100) without Doppler velocimetry. Standard management protocols were followed in all cases. Preterm deliveries, preterm as well as full-term neonatal admissions were more frequent in group A than those in group B. Similarly preterm and full-term neonatal deaths were rare in group A than those in group B. Emergency caesarean section rate was rare in the subjects with normal Doppler than those with abnormal Doppler as well as in group B.Doppler studies in high-risk pregnancies are more beneficial in the management of perinatal as well as neonatal management.[10]

Konwar R et al. investigated the significance of Doppler waveforms in the context of pregnancy-induced hypertension (PIH) and their correlation with perinatal outcomes. The study involved 50 pregnant women diagnosed with PIH, with gestational ages ranging from 30 to 40 weeks, focusing on Doppler waveforms of the Umbilical Artery (UmA), Middle Cerebral Artery (MCA), and Uterine Artery (UtA). The researchers assessed various Doppler indices, including the Pulsatility Index (PI), Resistive Index (RI), and S/D ratio, in relation to the severity of the condition and the resulting perinatal outcomes. Notably, 50% of the participants were within the 26 to 30 years age bracket and were at 38 to 40 weeks of gestation. Among the 50 subjects, 68% were primigravida, and 74% experienced severe PIH. Significant differences were observed in the mean values of UmA PI, MCA PI, MCA RI, and the Cerebro Placental Ratio (CPR) between patients with mild and severe PIH. Adverse perinatal outcomes were recorded in 33 cases (66%). Abnormalities in UmA RI, MCA RI, MCA PI, and MCA S/D were found to be significantly associated with negative pregnancy outcomes. Furthermore, PIH cases exhibiting an early diastolic notch in the UtA, along with abnormal PI CPR and S/D CPR, were linked to a higher incidence of adverse outcomes. The PI CPR demonstrated the highest sensitivity (84.8%), while the presence of an early diastolic notch in the UtA and MCA-PI showed the greatest specificity for predicting adverse perinatal outcomes. Overall, CPR-PI serves as a crucial indicator for assessing adverse perinatal outcomes in cases of PIH.[11]

CONCLUSION

Doppler technology plays a significant role in the continuous noninvasive hemodynamic assessment during pregnancy. In obstetric patients who exhibit a high incidence of complications such as pregnancy-induced hypertension (PIH), Doppler indices derived from fetal circulation have been shown to effectively forecast negative perinatal outcomes.

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