CEREBROPLACENTAL DOPPLER RATIO IN EVALUATION OF SMALL FOR GESTATIONAL AGE AND PREDICTION OF ADVERSE PERINATAL OUTCOME

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ABSTRACT

Small for gestational age fetuses often shows adverse perinatal outcome. In this study evaluated the clinically suspected cases of small for gestation age and adverse perinatal outcome by pusatility indices of umbilical, fetal middle cerebral artery and cerebroplacental doppler ratio.

MATERIAL AND METHODS

The study population is of 80 pregnancies of 30-41 weeks' gestation had diagnosed clinically as small for date over a period of one year. The UA PI, MCA PI and cerebroplacental doppler ratio were calculated.

RESULTS

Of the 80 pregnancies in the study 28 showed abnormal UA PI. Among these 20(71.42%) were SGA and 18(64.28%) had adverse perinatal outcome. Of the 30 out of 80 pregnancies that showed abnormal MCA PI, 21(70%) were SGA. Abnormal cerebroplacental doppler ratio (<1.08) noted in19 out of 80 pregnancies, all 19(100%) were SGA and had adverse perinatal outcome.

CONCLUSION

Cerebroplacental doppler ratio is a better pedictor of SGA fetuses and adverse perinatal outcome than the MCA PI or UA PI used alone.

KEYWORDS

Cerebroplacental Doppler Ratio, Umilical Artery Pulsatility Index, Middle Cerebral Artery Pulsatility Index.

HOW TO CITE THIS ARTICLE: Desai Sanjay D, Jyotsna A. Deshmukh. "Cerebroplacental Doppler Ratio in Evaluation of Small for Gestational age and Prediction of Adverse Perinatal outcome." Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 95, November 26; Page: 16084-16086, DOI: 10.14260/jemds/2015/2350.

INTRODUCTION

Intrauterine Growth Restriction (IUGR) is associated with adverse perinatal outcomes. The use of Doppler velocimetry has been shown to reliably predict these adverse outcomes.[1] Recent studies suggest that the Cerebroplacental Doppler Ratio (CPR), which is a ratio of the pulsatility indices of the Middle Cerebral Artery (MCA) to the pulsatility indices of the umbilical artery, is a better index for predicting adverse outcomes in IUGR when compared with using either the umbilical artery Doppler values or the MCA values alone.[2,3]

The purpose of our study was to evaluate the usefulness of the Pulsatility Index (PI) of the Umbilical Artery (UA) and the Middle Cerebral Artery (MCA), Cerebroplacental Doppler Ratio (CPR) as the ratio of MCA PI to the UA PI in the diagnosis of Small-for-Gestational-Age (SGA), fetuses and prediction of adverse perinatal outcome. The present study was conducted to evaluate the clinically suspected cases of small for gestational age and to negative predictive value of pusatility indices and cerebroplacental Doppler ratio in predicting adverse find out the sensitivity, specificity, positive pedictive value, perinatal outcome in clinically suspected cases of small for gestational age.

Financial or Other, Competing Interest: None.
Submission 30-10-2015, Peer Review 31-10-2015,
Acceptance 06-11-2015, Published 26-11-2015.
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DOI:10.14260/jemds/2015/2350.

MATERIALS AND METHODS

The study population consisted of 80 pregnancies of 30-41 weeks' gestation had been diagnosed clinically as small for gestational age and referred for USG over a period of one year.

Of the 80 cases, 40 showed normal fetal growth parameters forming the control group; 40 fetuses had abdominal circumferences less than the 10th percentile for their respective gestational ages along with elevated Head Circumference (HC)/Abdominal Circumference (AC) ratios, formed study group.

All the 80 patients were subjected to duplex Doppler examination using 3.5-MHz transducer. The flow velocity waveforms were recorded from umbilical artery (UA) and fetal middle cerebral artery (MCA) at proximal third.[4,5]

PI of UA and fetal MCA were recorded and ratio of MCA PI to UA PI (Cerebroplacental Doppler ratio) was calculated. The pregnancies were followed-up and the final perinatal outcome of each case was noted. Various intrapartum and neonatal indicators were used to asses the outcome with an adverse outcome defined as presence of one or more of these indicators. The Cerebroplacental Doppler Ratio (CPR) remains constant in the last 10 weeks of pregnancy.[2,6] and therefore we used a single cut off value of 1.08 throughout this study where all cases were of 30-41 weeks' gestation.

Doppler findings were considered normal when the CPR was above 1.08 and below that value velocimetry was considered abnormal. Statistical Chi square test and Fischer's test are used. P<0.05 was considered significant.

RESULTS

The results are presented in the form of tables (Table 1-5). Of the 80 pregnancies in study, 28 showed abnormal umbilical artery PI.Among these, 20(71.42%) were small for gestational age and 18(64.28%) had adverse perinatal outcome thirty of 80 pregnancies showed abnormal MCA PI and 21(70%) fetuses were small for gestational age and 2(6.66%) had adverse perinatal outcome. Perinatal death was reported in one pregnancy which showed abnormal MCA PI, abnormal UA PI and abnormal cerebroplacental Doppler ratio. Nineteen out of 80 pregnancies showed an abnormal cerebroplacental doppler ratio (<1.08). Of these 19 fetuses were small for gestational age and all had an adverse perinatal outcome.

The sensitivity and negative predictive values were higher for cerebroplacental umbilical artery PI, whereas significantly lower for MCA PI.

The specificity and positive predictive value of cerebroplacental Doppler ratio and MCA PI were equal to each other, but higher than that of UA PI.

DISCUSSION

Umbilical artery and middle cerebral artery Doppler ultrasound clearly depicts the information about placental resistance and the changes in the fetal hemodynamic in response to it. Middle cerebral artery Doppler has enabled the confirmation of "Brain sparing" effect in IUGR. It is possible to use a single cut off value for cerebroplacental ratio after 30th week because cerebral-umbilical Doppler ratio does not vary significantly between 30th and 40th week.[2,6]

The cardiovascular response to hypoxia is co-ordinated to centralize blood flow to organs such as the fetal brain, heart and adrenals. This process is well known as the brain-sparing effect. The most important adaptive reactions responsible for maintaining fetal homeostasis are probably the cardiovascular responses to hypoxia.[7] Jain et al. found that the CPR ratio is a better predictor of perinatal outcome than the umbilical artery velocimetry alone.[8] In general, SGA fetuses had a four-fold increased risk for adverse fetal outcome (Including hypoxic encephalopathy, intracranial haemorrhage, low Apgar score, neonatal convulsions, low umbilical pH, cerebral palsy, neurodevelopmental delay and perinatal mortality).

Unrecognized SGA fetuses had a four-fold higher risk of adverse outcome compared with those that were recognized antenatally. Furthermore, research on the long-term outcome of children born small shows higher rates of cerebral palsy and suboptimal neurodevelopmental outcome.[9,10] The CPR appears to be more strongly influenced by abnormally elevated umbilical artery blood flow resistance, which may be due to the fact that placental arterial and venous blood flow changes may be interdependent affecting afterload and preload.[11]

In the cerebral circulation, examination of the middle cerebral artery is readily achieved at optimal insonation angles and therefore appears the preferred method in recent years.

When examining the middle cerebral artery, the sampling site has significant effects on the Doppler measurements when the PI is used. Measurements from the middle and distal thirds have significantly higher indices than those from the proximal third.,[4] but the proximal third appears to be less variable during changes in fetal behavioral state.[5]

The sensitivity of the CPR from our study is similar to those previously reported for predicting adverse perinatal outcomes in IUGR.[2]

In conclusion, CPR should be used in prenatal monitoring of pregnancies with suspected SGA.

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No.	Normal PI n=52	Abnormal PI n = 28	P Value
Adverse Perinatal Outcome	3(5.8)	18(64.28)	<0.0001
Caeserean Section for fetal distress	6(11.5)	11(39.3)	<0.0001
APGAR Score < 7 at 5 min	1(1.9)	8(28.57)	<0.0001
NICU Stay > 8 days.	3(5.76)	12(42.85)	<0.0001
Stillbirth/Perinatal Death	-	1(3.57)	<0.01
Small for gestational Age.	16(30.7)	20(71.42)	<0.0001

Table 1: Perinatal Outcome in Study Group according to Umbilical Artery Pulsatility Index

No.	Normal PI n=50	Abnormal PI n=30	P Value
Adverse Perinatal Outcome	19(38)	2(6.66)	<0.001
Caeserean Section for fetal distress	13(26)	4(13.33)	<0.05
APGAR Score < 7 at 5 min	8(16)	1(3.33)	<0.01
Stay in NICU > 8 days.	11(22)	4(13.33)	<0.05
Stillbirth / Perinatal Death	-	1(3.33)	<0.001
Small for gestational Age.	15(30)	21(70)	<0.05

Table 2: Perinatal Outcome in Study Group according to Middle Cerebral artery Pulsatility Index

No.	Normal CPR >1.08 n=61	Abnormal CPR <1.08 n=19	P Valve
Adverse Perinatal Outcome	2(3.27)	19(100)	<0.0001
Caeserean Section for fetal distress	2(3.27)	15(78.94)	<0.0001
APGAR Score <7 at 5 min	2(3.27)	7(36.84)	<0.0001
Stay in NICU >8 days.	3(4.91)	12(63.15)	<0.0001
Stillbirth/Perinatal Death	-	1(5.26)	<0.01
Small for gestational Age.	17(27.86)	19(100)	<0.0001

Table 3: Perinatal Outcome in Study Group according to Cerebroplocental Doppler Ratio (CPR)

N=80	No. of findings				Sensitivity %	Specificity %	PPV %	NPV %
	TP	FN	FP	TN				
Umbilical Artery	20	16	4	40	55.5	90.9	83.3	90.9
MCA	21	15	0	44	58.3	100	100	74.5
Cerebroplocental Doppler ratio	19	17	0	44	52.8	100	100	72.1

Table 4: Diagnostic Evaluation of Pulsatility Index and Cerebroplocental Doppler Ratio for Small for Gestational Age

TP-True positive FN-False Negative FP-False positive TN-True negative

N=80	No. of Findings				Sensitivity %	Specificity %	PPV %	NPV %
	TP	FN	FP	TN				
Umbilical Artery	18	3	3	56	85.7	94.9	85.7	94.9
MCA	2	19	0	59	9.5	100	100	75.6
Cerebroplocental Doppler ratio	19	2	0	59	90.4	100	100	96.7

Table 5: Diagnostic Evaluation of Pulsatility Index and Cerebroplocental Doppler Ratio for Adverse Perinetal Outcome

TP-True positive FN-False Negative FP-False positive TN-True negative