DIAGNOSTIC ACCURACY OF CEREBRAL-UMBILICAL RESISTANCE INDEX RATIO IN THE PREDICTION OF BIRTH ASPHYXIA

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ABSTRACT

Background: Doppler velocimetry is a useful non-invasive investigation to assess the status of feto-placental circulation. Cerebral Umbilical Resistance Index ratio is a useful predictor of birth asphyxia and adverse perinatal outcome. The objective of the study was to determine the diagnostic accuracy of Cerebral Umbilical Resistance Index ratio in the prediction of birth asphyxia.

Subjects and Methods: This was a cross sectional (Validation) study of 09 months duration (01/05/2012 to 31/01/2013) conducted at Radiology department, Khyber Teaching Hospital, Peshawar. All pregnant ladies at high risk for birth asphyxia, referred to Radiology department for Doppler ultrasound were recruited. Demographic characteristics were recorded and C/U RI ratio was calculated for all patients and then they were followed at delivery. Of total 213 patients, 27 lost follow up and APGAR score of 186 new borns at 5 minutes of birth was recorded in a structured proforma. Sensitivity, Specificity, Positive predictive value, Negative Predictive Value and Diagnostic accuracy of C/U RI for the prediction of Birth asphyxia (low APGAR score) were calculated by cross tabulation using SPSS-16.

Results: The mean age of the patients was 30.25(±5.53 Sd.) years. Abnormal C/U RI ratio was found in 30% patients on Doppler ultrasound, while APGAR score recorded at 5min of birth was low in 28.64%.The Sensitivity, Specificity, PPV, NPV, and diagnostic accuracy of C/U RI ratio was found as 55.35%, 79.92%, 50.81%, 80% and 70.4% respectively.

Conclusion: Cerebral-Umbilical Resistance Index ratio is a very good predictor of low APGAR score and birth asphyxia in women with high risk pregnancies.

Key words: Doppler, Cerebral-umbilical ratio, high risk pregnancies, APGAR score.

INTRODUCTION

Birth asphyxia is an important obstetric problem on account of the high associated peri-natal mortality and morbidity.[1] It refers to inadequate oxygenation of the baby and is assessed by APGAR score at birth which takes into account five simple parameters like Activity (muscle tone), Pulse, Grimace (reflex irritability), Appearance (skin color) and Respiration of the new born. Its score ranges from one to ten. A score below 7 at 5 min after birth is the hallmark of birth asphyxia.[2]

Pregnancies with Hypertension, Pre-eclampsia, Ecclampsia, Diabetes Mellitus, Autoimmune disorders,Kidney disorders and Hypercoagulable states comprise the high risk group for placental insufficiency which is the most important cause of birth asphyxia. The prevalence of low APGAR score and birth asphyxia in this high risk group has been reported as 39% in one study[3]. Besides placental insufficiency, other causes of birth asphyxia include antepartum hemorrhage,

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chorioamnionitis, cord prolapse, premature rupture of membranes, prolonged labor, multiple gestations and fetus with cord around neck or structural anomalies.[4] It is essential to recognize placental insufficiency early so that its hazards can be reduced if not prevented.[5]

Doppler ultrasonography is the most important non-invasive test for placental insufficiency in high risk pregnancies. It can be credited with causing a significant decrease in peri-natal mortality and morbidity.[6] Umbilical artery (UA) Doppler is the commonly used method for assessment of placental insufficiency and prediction of birth asphyxia but a more accurate investigation is the Cerebral-Umbilical Resistance Index (C/U RI) ratio. Its sensitivity and specificity, positive and negative predictive values for prediction of adverse perinatal outcome in high risk pregnancies has been reported as 73.7%, 68.3%, 52% and 85% respectively.[7]

Cerebral-Umbilical Resistance index ratio has been shown to detect changes in fetomaternal and uteroplacental circulation accurately which seem to correlate strongly with the pregnancy outcome.[8] Systematic review with meta-analysis has provided compelling evidence that pregnant ladies at high risk for intrauterine growth restriction, including patients with pregnancy induced hypertension and preeclampsia should have easy access to Doppler ultrasonographic assessment of umbilical artery waveforms.[9] A meta-analysis of

randomized clinical trials has showed that including Doppler velocimetry in the management of high-risk pregnancies lowers the perinatal mortality.[10]

C/U RI is simple but less commonly practiced investigation due to lack of local evidence of its accuracy. Since no work has been carried out before on this issue locally, this study was designed to establish the diagnostic accuracy of C/U RI for birth asphyxia which may be recommended as a routine for all pregnancies suspected of having birth asphyxia (high risk pregnancies).

OBJECTIVE OF THE STUDY

To determine the diagnostic accuracy of Cerebral-Umbilical Resistance index ratio in the diagnosis of birth asphyxia among high risk pregnancies admitted at Khyber Teaching Hospital, Peshawar.

PATIENTS AND METHODS

This was a Cross sectional (Validation) study of 09 months (01/05/2012 -31/01/2013) conducted at Radiology department, Khyber Teaching Hospital, Peshawar. All high risk pregnant ladies within 3rd trimester (who had hypertension, ecclampsia, pre ecclampsia, Diabetes mellitus, kidney diseases, hypercoagulable states, autoimmune disorders like systemic lupus erythematosis and antiphospholipid syndrome) were included. Pregnancies with multiple gestations, cord prolapse, preterm labor or antepartum haemorrage were excluded. All pregnancies were subjected to Doppler ultrasound to evaluate the middle cerebral artery resistance index and umbilical artery resistance index. This was followed by calculation of the C/U RI to predict the birth asphyxia. Careful follow up of all patients was done in coordination with the gynecology department till delivery of the fetus to detect birth asphyxia by recording APGAR score at 5min after birth. All the above mentioned information was recorded in a proforma. The collected data was analyzed via SPSS-16. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of C/U RI for the prediction of Birth asphyxia (taking low APGAR score as gold standard) were determined by using 2x2 table and formulae shown below.

RESULTS

A total of 213 pregnant ladies with a high risk for birth asphyxia of the new born were subjected to Doppler ultrasound of fetal middle cerebral artery and umbilical artery and Cerebral-Umbilical Resistance index ratios were calculated. Out of these 213 patients, 27 were excluded either because they lost follow up or gave birth to dead fetuses, and APGAR score of 186 patients was recorded after 5 minutes of birth. The mean age of the patients was 30.25 (±5.53 Sd.) years. The mean and Standard deviation of Obstetrical parameters like Period of gestation (POG), Gravida and Para were

		Birth Asphyxia on APGAR	
		Yes	No
Birth Asphyxia on C/U RI	Yes	a	b
	No	c	d

Sensitivity of C/U RI = (a / a+c) x100
Specificity of C/U RI = (d / b + d) x 100
Positive predictive value (PPV) for C/U RI = (a / a +b) x100
Negative predictive value (NPV) for C/U RI = (d / c +d) x100
Diagnostic accuracy of C/U RI = (d + a) /overall patients
a =True positive,   b = False positive,
c =False negative,   d = True negative

		Birth Asphyxia on APGAR Score		Total
		Yes	No	
Birth Asphyxia on C/U RI	Yes	31	30	61
	No	25	100	125
	Total	56	130	186

a = True positive, b = False positive, c = False negative, d = True negative

Sensitivity of C/U RI = (31/31+25) x100 = 55.35%
Specificity of C/U RI =(100/30+100) x 100 = 76.92%
Positive predictive value (PPV) for C/U RI= (31/31+30) x100=50.81%
Negative predictive value (NPV) for C/U RI=(100/25+100) x100=80%
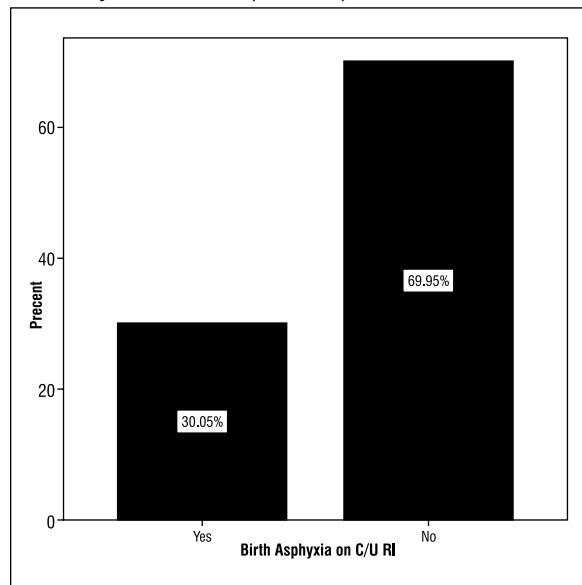Accuracy of C/U RI = (100+31)/186= 70.4%

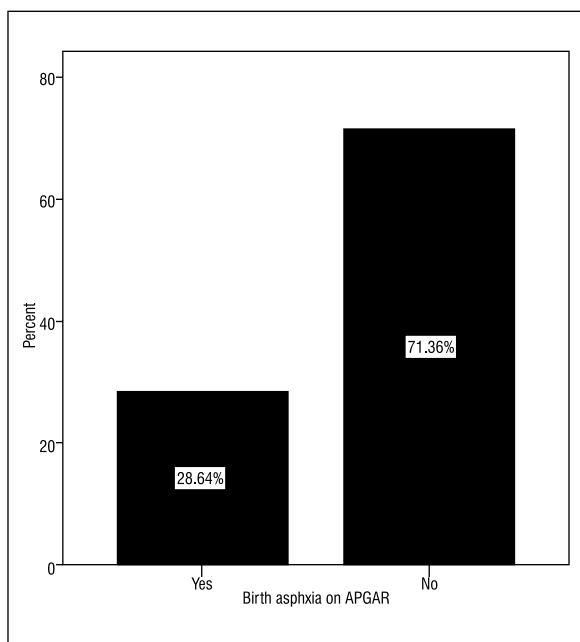FIGURE 01: Percentage of Birth Asphyxia on Cerebral Umbilical Resistance Index Ratio in high risk pregnancies.

FIGURE 02: Percentage of birth asphyxia on APGAR score in high risk pregnancies.

36.19 (±2.28 Sd), 3.83 (±2.80 Sd) and 2.32 (±2.48 Sd.) We found an abnormal C/U RI in 30% of the patients on Doppler ultrasound as shown in figure 01, while APGAR score at birth of the new born babies was low suggesting birth asphyxia in 28.64% as shown in figure 02. The sensitivity, specificity, PPV, NPV and diagnostic accuracy of Cerebral Umbilical Resistance Index Ratio in predicting birth asphyxia of newborn babies was found as 55.35%, 76.92%, 50.81%, 80% and 70.4% respectively as shown in table 01.

DISCUSSION

Birth asphyxia is a pathological condition strongly related to the development and function of the uteroplacental and fetoplacental circulations. An adequate fetal circulation is necessary for normal fetal growth. Doppler ultrasonography is a useful non invasive investigation to assess the fetal circulation. Results obtained from Doppler flow velocimetry of the fetal middle cerebral and umbilical arteries may assist in the management of complicated pregnancies. A low resistance index ratio of fetal middle cerebral and umbilical arteries has been shown to be associated with fetal compromise.[11]

Because the middle cerebral artery-umbilical artery Doppler ratio incorporates data not only on placental status but also on fetal response, it is potentially more advantageous than either of the parameters alone in predicting perinatal outcome[12]

In normal pregnancies the diastolic flow in the fetal middle cerebral arteries is lower than in the umbilical arteries at any gestational age. Therefore, the cerebro-vascular resistance remains higher than the placental resistance and the MCA/UA ratio is greater

than 1.08. We have taken the cut off as 1.08, as the index becomes less than this value if the flow distribution is in favor of the brain in pathological pregnancies.

Brar et al[13] recognized that Doppler studies of the internal carotid artery or MCA/UA RI could be used to identify pregnancies with compromised fetuses. The fetuses in our study with adverse outcome (birth asphyxia) had a lower cerebral umbilical resistance index ratio, supporting their finding.

We found the percentage of abnormal Cerebral Umbilical Resistance Index Ratio as 30% which is lesser as compared to the findings of Shahinaj et al[14] who have reported it as 42.54%. This discrepancy could be due to the difference in inclusion criteria i.e they have enrolled only those patients who were having pre-eclampsia and it is a well known fact that pre eclamptic patients are more prone to complications.

Similarly, abnormal APGAR score at 5 minutes after birth was found in 28.64% of our study population. A local study conducted at Ayub Teaching Hospital has reported a low APGAR score in as many as 42.46% of patients[15] This study was also conducted on Pre-eclamptic patients which may be the reason for its higher percentage of abnormal APGAR score.

The values of Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Values were found as 55.35%, 76.92%, 50.81%, and 80% respectively, which are quite similar to the findings of Arias F.[16] who has reported it in a similar group of patients (sensitivity 57.9%, specificity of 75.6%, false-positive rate as 24.4%). In addition Ebrashy et al[17] has reported the Sensitivity as 64.1%, Specificity as 72.7%, Positive predictive value as 89.2% and Negative predictive value as 36.3%. The slight difference could be due to the lower cut off value (1.00) of C/U RI used in their study as compared to our cut off value of 1.08. In addition, they have taken a lower APGAR score (<6), as predictor of birth asphyxia.

Arduini and Rizzo[18] have found that C/U PI index ratio was the best test when compared with MCA and UA PI indices alone (sensitivity 89%, specificity 94%). The higher sensitivity and specificity as compared to our results could be due to the fact that this study was conducted on fetuses that were clinically small for gestation.

We found the diagnostic accuracy of C/U RI ratio as 70.4% which is similar to the findings of Grammellini et al[19] who have reported it as 70% in a similar group of patients with a same cut off value of 1.08.

Doppler velocimetry studies of placental and fetal circulation can provide important information regarding fetal well-being, yielding an opportunity to improve fetal outcome. Our results suggested that the C/U RI Doppler ratio of less than 1.08 was a good predictive tool for birth asphyxia in high risk pregnancies and could be used to identify fetuses at risk of morbidity and mortality.

The use of Doppler ultrasound in high risk pregnancies appears to improve obstetric outcomes.

Limitations of the study

As this is a descriptive study which was conducted in one centre so the results may not be generalizable.

Only one parameter (low APGAR score) at 5 minutes after birth was measured so no inference can be drawn from this study regarding the role of C/U RI in the prediction of other adverse perinatal outcomes like neonatal death, C-Section and metabolic acidosis.

CONCLUSION

Cerebral-Umbilical Resistance Index Ratio is a useful non invasive ultrasonographic parameter during the third trimester of pregnancy for the prediction of low APGAR score and thus Birth asphyxia in high risk pregnancies.

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