



Value of middle cerebral artery to umbilical artery ratio by doppler velocimetry in pregnancies beyond term

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OBJECTIVE(S): To determine the value of middle cerebral artery to umbilical artery (CU) ratio by doppler velocimetry in pregnancies at or beyond 40 weeks of gestation and correlate it with perinatal outcome with the aim of ascertaining a cutoff value of CU ratio for predicting adverse perinatal outcome in these pregnancies.

METHOD(S): Thirty-one pregnant women at 40 weeks or more of gestation with singleton fetus in vertex presentation were enrolled in the study. They underwent biweekly doppler velocimetry studies of the middle cerebral artery and the umbilical artery of the fetus and from this, the CU ratio was calculated. Routine antepartum tests of fetal surveillance like nonstress test, amniotic fluid index and biophysical score were done. Pregnancies were terminated if any of the routine tests of fetal surveillance were abnormal or when the period of gestation extended beyond 42 weeks. Adverse perinatal outcome was defined as fetal bradycardia or tachycardia requiring cesarean section, presence of meconium stained liquor, apgar score at 5 minutes < 7, fetal acidosis, meconium aspiration syndrome, admission to neonatal intensive care unit, and perinatal morbidity and mortality.

RESULTS: Of the 31 women included in the study, 5 (16.1%) had an adverse perinatal outcome. The middle cerebral artery pulsatility index or umbilical artery S/D ratio when used alone had poor predictive value for adverse perinatal outcome. However when the predictive efficacy of CU ratio was calculated, a cutoff value of 1.3 had a sensitivity of 80% and negative predictive value of 93.3% for predicting adverse perinatal outcome in postdate pregnancies. This assured the obstetricians of the fetal well being. The specificity and positive predictive value of CU ratio however were low, being 53.8% and 25% respectively. Its false positive rate was also high (46%).

CONCLUSION(S): Although CU ratio of 1.3 assures the obstetrician of fetal well being, its low specificity and high false positive value can lead to unnecessary tests and intervention. Hence it is not an ideal test for routine antepartum fetal surveillance in low risk postdate pregnancies.

Key words : postdate pregnancy, middle cerebral artery to umbilical artery ratio, perinatal outcome

Introduction

Postdate pregnancy is a common problem. Its incidence has been reported to be between 4-14% with an average of 10.5%¹. A safe limit for continuation of pregnancy beyond expected date of delivery cannot be established as there is little agreement as to when exactly the fetal jeopardy begins. There

is also controversy on whether risk of fetal hypoxia can be accurately predicted in these pregnancies. Rayburn and Chang² suggested that risk of postmaturity starts at 40 weeks.

Postdate pregnancies have been associated with increased perinatal morbidity and mortality which increase after 42 weeks³. Increased incidence of induction of labor, instrumental delivery, cesarean section, shoulder dystocia, lower apgar score, congenital malformations, meconium aspiration, and fetal asphyxia have been associated with these pregnancies^{3,4}. These problems can be decreased by routine antepartum fetal surveillance prior to onset of spontaneous labor^{5,6}. The current methods of fetal surveillance like non-

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stress test (NST), amniotic fluid index (AFI), biophysical score (BPS), umbilical artery (UA) S/D ratio and middle cerebral artery (MCA) pulsatility index (PI) cannot accurately predict fetus at risk of adverse perinatal outcome^{3,6}. Various studies^{7,8} have investigated MCA and UA (CU) ratio in post-term pregnancies with high risk complicating factors like chronic hypertension, pregnancy induced hypertension (PIH) and diabetes, and found it to accurately predict fetal compromise. These conditions however, are known to affect the vascular bed and placental circulation, and hence the blood flow to the fetus. Very few studies have been done on the value of CU ratio in determining the perinatal outcome in low risk postdate pregnancies. Hence this study was designed to study the doppler waveforms in UA and MCA, and CU ratio in uncomplicated postdate pregnancies, and to correlate these findings with the perinatal outcome. It also aimed to determine the cutoff value of CU ratio for predicting adverse perinatal outcome in these pregnancies.

Methods

This prospective study was carried out on women selected from the department of Obstetrics and Gynecology from 1st March, 1997 to 28th February, 1998. The study population consisted of 31 women who presented to the antenatal clinic at or beyond 40 weeks of gestation with singleton pregnancy in vertex presentation. All participants were sure of their date of the last menstrual period and had regular menstrual cycles previously. Their gestational age was further corroborated by first trimester or early second trimester ultrasound and by a bimanual pelvic examination in the first trimester, whenever possible. Women with leaking per vaginum, antepartum hemorrhage, abnormal presentation, multiple gestation, medical complications, and those in established labor were excluded from the study. Women selected were admitted to the antenatal wards and subjected to complete general, physical, obstetric and pelvic examinations. Routine baseline investigations, NST, AFI and BPS were done on admission and repeated biweekly till onset of labor or termination of pregnancy. Blood flow velocity waveforms of UA and MCA were obtained with pulsed doppler ultrasound equipment and repeated as above. The peak systolic, end diastolic, and mean velocity were recorded from these vessels, and UA S/D ratio and MCA PI were calculated. The average of three waveform analyses was used to calculate CU ratio. Doppler results were not available to the attending obstetrician for clinical management. Pregnancies were terminated if NST was nonreactive, AFI was ≤ 5 cm, BPS was $\leq 8/10$ or if the period of gestation extended beyond 42 weeks. Adverse perinatal outcome was defined as presence of one or more of the following conditions – fetal distress as evidenced by fetal bradycardia or tachycardia requiring cesarean section or instrumental delivery, presence of moderately thick or thick meconium stained liquor, apgar score of < 7 at 5 minutes, fetal acidosis (umbilical artery pH of < 7.20), neonatal complications

like meconium aspiration syndrome or respiratory distress syndrome, admission to neonatal intensive care unit (NICU), and perinatal mortality. For the purpose of analysis of results, the study population was divided into two groups based on the presence or absence of adverse perinatal outcome. Variables were analysed using chi square test with corrections. A receiver operator characteristic curve was plotted to ascertain the best cutoff point of CU ratio for predicting adverse perinatal outcome. The sensitivity, specificity, negative predictive value, positive predictive value, and false positive and false negative results of CU ratio were calculated to determine perinatal outcome in low risk postdate pregnancies.

Results

Eight out of 31 women delivered between 280 and 287 days, 16 delivered between 288 and 294 days and 7 delivered after 294 days. Twenty-one women had spontaneous delivery while pregnancy was terminated in 10 either due to abnormal tests of fetal surveillance or after 42 weeks of gestation (Table 1). Vaginal delivery occurred in seven women while lower segment cesarean section (LSCS) was done in three – in two for fetal distress and in one for failed induction. Five of the 31 women had adverse perinatal outcome. These five women and 26 women with normal perinatal outcome were not statistically different as regards their age, parity, gravidity, height, and weight. Analysis of period of gestation, however revealed that four of the five women with adverse perinatal outcome had gestation of more than 287 days and only one woman had gestation between 280-287 days (Table 1). There were five pregnancies with thick meconium staining of the liquor and two of these required admission to NICU for meconium aspiration syndrome. Four babies showed evidence of postmaturity syndrome (Table 2). The value of umbilical artery S/D ratio was not statistically different in women with normal and with abnormal perinatal outcome (2.64 ± 0.84 vs 2.43 ± 0.50). Four of the five women with adverse perinatal outcome had normal UA / S/D ratio of < 3 . Similarly there was no statistically significant difference in the MCA PI values in the pregnancies with normal and adverse perinatal outcome (1.30 ± 0.27 vs 1.33 ± 0.21). The sensitivity of MCA PI for predicting adverse perinatal outcome was found to be nil as all the women with adverse perinatal outcome had normal MCA PI values. The mean CU ratio was 1.39 ± 0.26 and 1.23 ± 0.12 in pregnancies with normal and adverse perinatal outcome respectively, the difference being not significant. An attempt was made to establish cutoff point for predicting adverse perinatal outcome. (Figure 1). With a cutoff value of 1.1, its sensitivity was 40%, specificity 77%, positive predictive value 25% and negative predictive value 87%. By increasing the cutoff value to 1.3, it was observed that sensitivity and negative predictive value increased to 80% and 93.3% respectively but the specificity fell to 53.8% and positive predictive value remained at 25%. Its false positive rate was also very high viz., 46%.

Table 1. Period of gestation, mode delivery and perinatal outcome (n=31).

Period of gestation (days)	Number	Spontaneous labor	Induced labor	Cesarean delivery	Forceps delivery	Normal perinatal outcome	Adverse perinatal outcome
280-287	8	5	3	2	-	7	1
288-294	16	14	2	1	14	2	
295-301	6	2	4	2	-	5	1
>301	1	0	1	1	-	0	1
Total	31	21	10	6	1	26	5

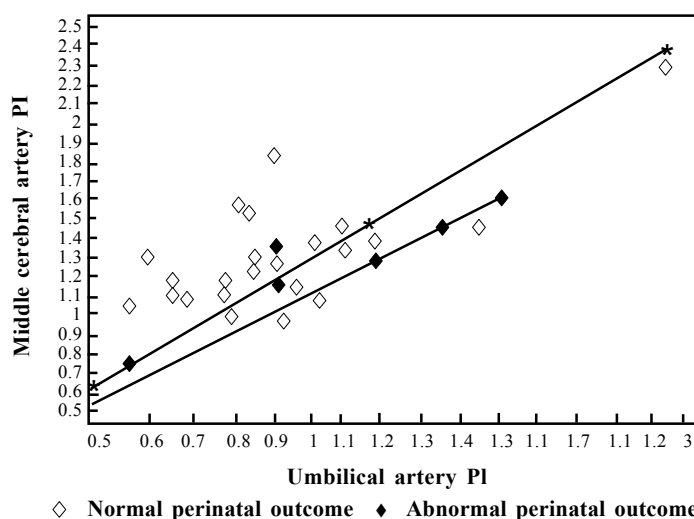
Table 2. Relationship of period of gestation at delivery and adverse perinatal outcome (n=31).

Period of gestation (days)	Number	Percentage	Mean fetal weight (kg)	Fetal distress	Mean apgar score		Postmaturity syndrome
					At 1 min	At 5 min	
280-287	8	25.8	2.83	1	5	8	-
288-294	16	51.6	2.58	2	6	8	1
295-301	6	19.4	2.90	1	6	8	3
> 301	1	3.2	2.80	1	7	8	-
Total	31	100	2.70	5	-	-	4

Two neonates required admission to neonatal intensive care unit for meconium aspiration syndrome.

Table 3. Doppler indices in women with normal and adverse perinatal outcome.

Perinatal outcome	UA / S/D ratio Mean \pm SD	MCA PI Mean \pm SD	CU ratio Mean \pm SD
Normal	2.64 \pm 0.84	1.30 \pm 0.27	1.39 \pm 0.26
Adverse	2.43 \pm 0.50	1.33 \pm 0.21	1.23 \pm 0.13

**Figure 1.** Distribution of MCA to UA PI ratio in normal and postdate pregnancies. The diagonal line represents the best cutoff value for predicting adverse perinatal outcome.

Discussion

The mean values of UA S/D ratio, MCA PI and CU ratio were 2.46, 1.31 and 1.36 respectively. Placio et al⁹ observed mean CU ratio to be 1.36 at 41 weeks and 1.27 at 42 weeks. In the present study, a cutoff value of CU ratio of 1.3 was obtained and used for correlating perinatal outcome in these postdate pregnancies. The CU ratio of 1.3 for predicting adverse perinatal outcome in the present study was considerably higher than the value established by Devine et al¹⁰. These authors observed that CU ratio in their study had high specificity and positive predictive value for determining adverse perinatal outcome. This difference appears to be due to the fact that they included high risk postdate pregnancies with complicating factors like diabetes, chronic hypertension and PIH unlike in the present study where only uncomplicated postdate pregnancies were enrolled. The above mentioned complications can affect the vascular bed of the placenta and the fetal blood vessels, and increase the vascular resistance in umbilical artery and other fetal blood vessels which can be picked up by the different doppler indices analyzed. On the other hand, in uncomplicated postdate pregnancies, the mechanism of fetal compromise is perhaps the to decrease in the flow of nutrients across the placenta and decrease in the efficiency of utilization of nutrients by the placenta and the fetus. These changes are not reflected in increase in resistance in the blood vessels of placenta or fetus^{11,12}. This may explain the absence of any significant statistical difference in umbilical artery S/D ratio and MCA PI ratio in women with normal and adverse perinatal outcome in the present study. Similar results were observed by several workers in their studies on low risk postdate pregnancies¹³⁻¹⁵. MCA PI was normal in the present study in all women with adverse perinatal outcome, hence it is an insensitive test for predicting adverse perinatal outcome, an opinion shared by Chandran et al¹⁶. Umbilical artery S/D ratio too had low sensitivity of only 20% for predicting adverse perinatal outcome. Hence UA S/D ratio and MCA PI when used alone are poor tests for predicting adverse perinatal outcome. However when both of these are combined and CU ratio calculated from them, a value of 1.3 has high sensitivity and very high negative predictive value which reassures the obstetrician of fetal well being in utero. Palacio et al⁹ in their study on UA PI, MCA PI and CU ratio in postdated pregnancies concluded that doppler information may play a role in differentiating postdated pregnancies which may be followed by expectant management from those in whom induction is a better option. However, low positive predictive value of CU ratio can result in missing cases with fetal jeopardy and high false positive rate can result in undue concern, expensive tests and unnecessary interference. Palacio et al⁹ also felt that it was unclear whether CU ratio could improve the prediction of adverse perinatal outcome in uncomplicated postdated pregnancies.

Conclusion

Although CU ratio is a good test to reassure the obstetrician of fetal well being, its high false positive rate and low positive predictive value for adverse perinatal outcome precludes it from being used routinely in low risk postdated pregnancies.

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