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SONOGRAPHIC EVALUATION OF CEREBROPLACENTAL DOPPLER INDICES AND FETAL ABDOMINAL CIRCUMFERENCE FOR FULL-TERM PREGNANT WOMEN'S FETAL MACROSOMIA PREDICTION

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Conflicts of Interest: Nil

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BACKGROUND: Unfavorable outcomes for mothers and newborns are linked to fetal macrosomia. The antenatal diagnosis of macrosomia is frequently unreliable. For this, a range of ultrasonic measures have been employed. The accuracy of two-dimensional (2D) ultrasound biometry for the prediction of macrosomia was evaluated in a systematic review published in 2005. The results showed that ultrasound was generally a poor predictor of fetal macrosomia, regardless of whether fetal AC alone or estimated fetal weight (EFW), which is calculated from measurements of fetal head circumference (HC), abdominal circumference (AC), and femur length (FL), was used. Therefore, it is not advised to use ultrasonography to evaluate pregnant women in general who are thought to be large for dates based on clinical assessment. The assessment of high-risk pregnancies now includes an integrated component for the evaluation of cerebral blood flow in the fetus.

AIM: The aim of the study was to explore the relationship between cerebroplacental Doppler ratio and birth weight in cases of suspected fetal macrosomia.

MATERIAL AND METHOD: This is a prospective cohort study that the Obstetrics and Gynecology Department is conducting. Following their written agreement, consecutive parturient women with well-dated term pregnancies P>37 gestational weeks were admitted and recruited during the study period. The cohort of enrolled women was divided into two groups according to the fetal birth weight (FBW) i.e., >4 kg. Group I (LGA; n = 30) with large weight for gestational age babies and Group II (AGA; n = 50) with average weight for gestational age. Charts were reviewed for demographic and medical forms in thirteen patients. Fetal macrosomia and arterial cord pH, as well as maternal and perinatal problems, were the features, labor and delivery events, Apgar scores, and reason for elective CS in eight of these instances. prior voluntary cesarean delivery.

RESULTS: 80 pregnant women consented to participate in the study. The cohort of enrolled women was divided into two groups according to the fetal birth weight (FBW) i.e. >4 kg. Group I (LGA; n = 30) with large weight for gestational age babies and Group II (AGA; n = 50) with average weight for gestational age. BMI was significantly higher in the LGA than in AGA (32.3 vs. 25.1). The mean gestational age at the time of labor was around 38 gestational weeks and the median age was significantly higher in the LGA group than the AGA (3072 vs. 21557 g,). There is a significant difference between groups in abdominal circumference (AC), head circumference (HC), Biparital diameter (BPD), estimated fetal weight (EFW), and actual fetal weight with a mean difference of 82.7 g in the LGA group and 74 g in the AGA group.

CONCLUSION: To sum up, the sonographic examination is a sensitive and exact method for determining the weight of the fetus and, by extension, macrosomia. When it comes to predicting large-sized newborns and fetal macrosomia, AC is the most crucial sonographic marker. The only important parameters in the macrosomia prediction are the Doppler indices in the middle cerebral arteries; the Doppler indices in the umbilical arteries and the cerebroplacental Doppler ratio are not significant in the macrosomia prediction.

KEYWORDS: Fetal macrosomia; Shoulder dystocia and Caesarean section.

Introduction

When neonatal sex and ethnicity are taken into account, fetal macrosomia is defined as a birth weight of at least 4000 g or more than the ninetieth percentile for gestational age.[1] These definitions indicate that 1–10% of pregnancies are affected by macrosomia.[2] Numerous problems linked with fetal macrosomia can lead to morbidity and mortality in both the mother and the fetus.[3] In 0.15–1.7% of vaginal deliveries, shoulder dystocia—one of the worst obstetric emergencies—occurs. Macrosomic newborns get shoulder dystocia in about half of cases.[4,5]

Macrosomia occurs as a result of excessive intrauterine fetal growth. A number of thresholds of birthweight have been used to define macrosomia, including >4000 g, >4500 g, >90th or >95th centile on a population nomogram.[6,7] Macrosomia is linked to a higher incidence of shoulder dystocia and delivery trauma, both of which have detrimental effects on the mother and the newborn. These include hemorrhaging after giving birth, fractures, rips of the third and fourth degrees, Erb's palsy, and hypoxia injuries to the baby.[8] These have an effect on the participants' health in addition to costing the NHS a lot of money for long-term care and resolution of legal disputes.[9]

No technique has proven to be adequately reliable in forecasting birth weight, even though it is not rare, with an incidence of 10% or higher.[10] A lot of work has gone into assessing how well clinical or ultrasonographic techniques can forecast birth weight. The most crucial parameter for calculating fetal weight is the abdominal circumference (AC), and only measures of the AC that are of a high enough quality may be used to determine the EFW.[11] If the AC measurement is two or more standard deviations above the mean, there is a considerable likelihood that the baby is macrosomic even if the estimated fetal weight suggests a smaller size.[2]

Antenatal prediction of macrosomia is often inaccurate.[12] For this, a range of ultrasonic measures have been employed. The accuracy of two-dimensional (2D) ultrasound biometry for the prediction of macrosomia was evaluated in a systematic review published in 2005. The results showed that ultrasound was generally a poor predictor of fetal macrosomia, regardless of whether fetal AC alone or estimated fetal weight (EFW), which is calculated from measurements of fetal head circumference (HC), abdominal circumference (AC), and femur length (FL), was used.[13] Therefore, it is not advised to use ultrasonography to evaluate pregnant women in general who are thought to be large for dates based on clinical assessment.[14]

The Doppler technique was applied to identify pregnancy difficulties, identify and characterize specific fetal anomalies, and evaluate the usefulness of Doppler in the identification and treatment of disorders affecting mothers.[15] In prenatal surveillance of high-risk pregnancies in particular, Doppler ultrasonography is utilized to evaluate the health of the fetus. It is the most effective non-invasive indicator of placental function because it measures blood flow through blood vessels, producing an analytic velocity waveform. The obliteration of the small placental arteries inside the placental vasculature is the pathogenic basis for an aberrant umbilical artery waveform. This leads to higher umbilical-placental resistance, which is observed in fetuses with intrauterine growth restriction. Numerous vascular alterations, including lumen narrowing and syncytiotrophoblast alterations, have been discovered in the placentae of the diabetes moms. Still, the most notable alteration is the increased risk of placental and fetal vascular thrombosis.[16]

Doppler ultrasound is a non-invasive monitoring technology that facilitates the examination of feto-placental circulation, hence evaluating the health of the fetus. The study's objective was to investigate, in cases of suspected fetal macrosomia, the association

between birth weight and the cerebroplacental Doppler ratio.

Material and Methods

This is a prospective cohort study carried out at the Department of Obstetrics and Gynecology. Consecutive parturient women during the study period with well-dated term pregnancies P>37 gestational weeks were admitted and recruited after giving written consent. The cohort of enrolled women was divided into two groups according to the fetal birth weight (FBW) i.e. >4 kg. Group I (LGA; n = 30) with large weight for gestational age babies and Group II (AGA; n = 50) with average weight for gestational age. Thirteen patients' charts were examined for demographic and medical information. Fetal macrosomia and arterial cord pH, as well as maternal and perinatal problems, were the features, labor and delivery events, Apgar scores, and reason for elective CS in eight of these instances. prior voluntary cesarean delivery. In addition, records of newborns with shoulder dystocia were examined. The total number of cesarean sections performed, including elective ones that resulted in birth trauma or asphyxia, was recorded. 22% of deliveries were unsuccessful labor trials. 34 birth trauma victims—including those with Erb's palsy, clavicular injuries, and labor trials—were vaginally delivered and suffered humeral fractures. The definition of birth asphyxia was given by CS as 1 minute and 23. The total incidence of A1 gestational diabetes was less than 7.0 with an umbilical artery pH of less than five.

Inclusion Criteria:

- Singleton pregnancy with gestational age correctly dated by either a first-trimester measurement of crown-rump length or a second-trimester (before 20 weeks) ultrasound examination with clinically suspected fetal macrosomia.
- Measurement of the symphysis–fundal height together with Leopold's maneuvers was done for clinical estimation.

Exclusion Criteria

- Included those with unreliable dates, twin pregnancy, gross fetal abnormalities, and pregestational diabetes or hypertensive disorders with pregnancy

Study Procedure:

All ultrasound measurements were performed by using VOLUSON E6, VOLUSON 730, MINDRAY DC3, and ACCUVIX X 8, ACCUVIX V20 ultrasound machine equipped with a 3.5-MHz convex transabdominal probe. Fetal biometry and abdominal circumference were measured and weight was calculated using the Hadlock formula16. To determine the pulsatility index (PI) and resistance index (RI), color and pulse wave Doppler tests were used to evaluate the flow velocity waveforms of the fetal umbilical artery (UA) and middle cerebral artery (MCA) at the origin of the circle of Willis, respectively. The pulse repetition frequency was 2.5 kHz, and the high-pass filter was set to the lowest possible setting. For the Doppler assessment, a minimum of three successive waveforms with comparable configurations were used. To prevent interobserver variability, a single operator performed the ultrasound examination. Within twenty-four hours of the ultrasound check, all deliveries took place. The incidence of Cesarean section and instrumental birth were among the obstetric outcomes that were documented. There have been reports of fetal issues such as shoulder dystochia, cephal hematoma, and hypoglycemia, as well as maternal difficulties such postpartum hemorrhage, cervical and vaginal laceration. It was also noted how frequently deliveries necessitated admission to a neonatal intensive care unit (NICU) and intervention for fetal distress. Neonatal outcomes were documented after delivery, including neonatal birth weight, need for NICU care, and Apgar score at five minutes.

Statistical Analysis

Data were statistically described in terms of mean ± standard deviation (±SD), frequencies (number of cases), and percentages when appropriate. Comparison of quantitative variables between macrocosmic and non-macrosomic groups was done using Student's t-test for independent samples. For comparing categorical data, Chi-square (χ^2) test was performed.

Result:

80 pregnant women consented to participate in the study. The cohort of enrolled women was

divided into two groups according to the fetal birth weight (FBW) i.e. >4 kg. Group I (LGA; n = 30) with large weight for gestational age babies and Group II (AGA; n = 50) with average weight for gestational age.

Table 1: Demographic data among the studied population.

	LGA (*n* = 30)	**AGA (*n* = 50)**
Maternal age at inclusion (years)	30 (23–41)	24.5 (18–37)
Parity	1.0 ± 0.89	1.0 ± 0.82
Null parous	10 (30%)	20 (38%)
1–3	15 (64%)	25 (53%)
P4	3.0 (6%)	5.0 (9%)
Gestational diabetes	2.0 (12%)	0.0
Gestational age at delivery (weeks)	38.2 (37–42)	38 (37–41)
Body mass index (kg/m^2)	32.3 (29.4–45.6)	25.1 (23.8–41.5)
Actual fetal birth weight (gm)	3071 ± 550	2155 ± 388

Table 1 shows the demographic characteristics in both groups; the median age of women was 30.0 years for women with LGA and 24.5 years for women with AGA. BMI was significantly higher in the LGA than in AGA (32.3 vs. 25.1). The mean gestational age at the time of labor was around 38 gestational weeks and the median age was significantly higher in the LGA group than the AGA (3072 vs. 21557 g,). Two women had controlled gestational diabetes on diet in the LGA group.

Table 2: Intrapartum ultrasound biometry and Doppler measurements.

	LGA (*n* = 30) M ± SD	**AGA (*n* = 50) M ± SD**
Abdominal circumference (AC)	341.20 ± 10.2	321.4 ± 15
Head circumference (HC)	332.2 ± 9.5	326 ± 10
Biparital diameter (BPD)	82.5 ± 4.88	83.5 ± 2.32
Femur length (FL)	63 ± 5.1	60.2 ± 4.2
Estimated fetal weight (EFW)	2753.1 ± 213	2072 ± 241
Actual fetal weight (AFW)	3062 ± 133	3144 ± 338.3
Apgar score at 5 min	5.3 ± 0.6	5.3 ± 0.7
Doppler indices		
MCA-RI	0.5665 ± 0.10	0.6280 ± 0.06
MCA-PI	1.2011 ± 0.22	1.3512 ± 0.20
UA-RI	0.4634 ± 0.05	0.6743 ± 0.04
UA-PI	0.8060 ± 0.12	1.7055 ± 4.21
CPR-PI	1.21314 ± 0.2	1.24550 ± 0.1

Table 2 shows the means of 2D ultrasound biometry measurements and Doppler indices UA-PI and MCA-PI in the two birth weight groups. There is a significant difference between groups in abdominal circumference (AC), head circumference (HC), Biparital diameter (BPD), estimated fetal weight (EFW), and actual fetal weight with a mean difference of 82.7 g in the LGA group and 74 g in the AGA group. MCA-RI and PI were significantly lower in the LGA group with no difference in UA-RI, PI, and CPR-PI between both groups.

Discussion

Obstetricians still have challenges while managing macrosomic fetuses intrapartum because of potentially unavoidable difficulties that can arise during labor, particularly for the newborn and mother.[17] The frequency of birth weights above 4000 g falls between 5 and 8%, whereas the incidence for infants weighing more than 4500 g is estimated to be between 1.0 and 1.5%. Previous investigations have revealed that high maternal weight gain during pregnancy, previous delivery of a large infant,

and maternal weight are factors associated with huge fetuses.[18]

Spellacy et al.1985[3] reported a frequency of macrosomia of 1.7%, which was similar to the rates noted in other studies. In Doc's series, 0.8% weighed more than 4500 g. In our series, 0.95% weighed more than 4500 g.[19]

Klebanoff et al.1985[20] demonstrated that a mother's birth weight has a strong influence on her child's birth weight. However, the predictive potential of these parameters was not sufficient to identify individual cases. **Boyd et al.1983**[21] found that a weight gain of 20 kg is additive to the risk factors of obesity and postdate gestations of seven days. The risk of excess weight gain has been detailed by **Doc et al.1984**[19] but was questioned by **Parks and Ziel 1978**[22] Excessive weight gain increases the incidence of macrosomia from 1.4 to 15.2%.

Posner et al. 1955[23] stated that macrosomia should be suspected if, at term, the distance from the superior surface of the symphysis pubis to the fundus exceeds 40 cm. It has previously been questioned whether the symphysis-fundal height measurements are useful for identifying infants who are macrosomic.

Ratchanikon 2006[2] conducted a study that included 361 singleton pregnant women who were admitted to the labor room. The results indicated that the best sensitivity and specificity for predicting macrosomia were obtained with a cut-off value for AC of >35 cm. An abdominal circumference of 35.0 cm was found to have the following characteristics: 87.50% sensitivity, 84.74% specificity, 41.67% positive predictive value, 98.19% negative predictive value, 85.04% accuracy, 5.73 positive likelihood ratio, and 0.15 negative likelihood ratio for a macrosomic fetus.

Chen et al.1993 [24] conducted a prospective study with a total of 1056 fetuses using fetal abdominal circumference as a single parameter to detect fetal weight. For each parameter (BPD/AC/FL), the ideal cutoff value was determined based on factors such as accuracy, specificity, and sensitivity. Whether FL was included or not, the estimated body weight equations did not result in higher prediction values. In terms of sensitivity (71.9% vs. 71.9%), specificity (92.1% vs. 93.8%), and accuracy (91.5% vs. 93.2%), both had the same prediction values at > or = 3700 g. The best single parameter for predicting macrosomia, according to the data, was AC.

Al-Inany et al.2001 [25] conducted a prospective clinical trial, which included one hundred pregnant females presenting in early labor with a clinical impression of macrosomia who were examined by ultrasound, and those babies with abdominal circumference more or equal to 35 cm were recruited for the study. Fetal weight was calculated using the formula of [26] (which uses AC + BPD in the estimation of fetal weight) A cutoff value of AC P 37 cm was found to have a sensitivity of 77%, a specificity of 75%, and a positive likelihood ratio of 3.1 and a negative likelihood ratio of 0.3 in predicting or diagnosing fetal macrosomia

Ebbing et al.2011[27] concluded that non-diabetic macrosomic growth is associated with augmented hemodynamics, particularly on the venous side, with a maintained increase in flow till term, where the umbilical venous (UV) flow velocity and UV distribution to the right lobe of the liver was higher in fetuses that became macrosomic, however, the relationship between birth weight and placental weight was normal. Thus, suggesting that abnormal placental metabolism and transport were not the primary causes for extreme growth.

Acker et al.1985[28] further identified arrest disorders as predictive for infants weighing 4500 g or more. A trial of labor aims to achieve a safe vaginal delivery while avoiding the problems related to cord clamping. The optimal course of action is to perform cesarean birth on every prospective patient at risk for shoulder dystocia in order to avoid the rare instance of delivery if the goal is to prevent persistent infant morbidity. It must be recognized that in extremely rare cases, a macrosomic fetus may suffer harm or even pass away upon delivery (especially from shoulder dystocia), in which case CS would have avoided these aftereffects. However, a lot of CSs would need to be carried out to stop one of these cases. But since elective CSs have a very low maternal death rate, doing more CSs to lower the risk of baby harm by one would be reasonable. The challenge for obstetricians is to strike a balance between the

low risk of CS for the mother and the low risk of fetal birth via vaginal delivery.

Conclusion:

To sum up, the sonographic examination is a sensitive and exact method for determining the weight of the fetus and, by extension, macrosomia. When it comes to predicting large-sized newborns and fetal macrosomia, AC is the most crucial sonographic marker. The only important parameters in the macrosomia prediction are the Doppler indices in the middle cerebral arteries; the Doppler indices in the umbilical arteries and the cerebroplacental Doppler ratio are not significant in the macrosomia prediction. Regardless of birth weight, macrosomic infants were described by researchers conducting anthropometric investigations on them after delivery as having a larger shoulder-head and chest-head disproportion. Other publications employ an ultrasound index to identify macrosomia in antepartum macrosomic newborns by using ultrasonography. Fetal macrosomia presents a number of issues. First, fetal macrosomia needs to be defined in a way that is agreed upon by all.

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