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Study of transcerebellar diameter to abdominal circumference ratio in prediction of foetal growth restriction in high risk pregnancies

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Abstract---Background: The high incidence of IUGR and its low recognition lead to increasing perinatal morbidity and mortality for which prediction of IUGR with timely management decisions is of paramount importance. Many studies have compared the efficacy of several gestational age independent parameters and found that TCD/AC is a better predictor of asymmetric IUGR. Aims: To study the trans cerebellar diameter / abdominal circumference ratio values in clinically suspected FGR and high-risk cases of pregnant women after 28 weeks. Materials and methods: A prospective study consisting of 100 antenatal women was conducted in pregnant women with clinically suspected FGR and high risk pregnancies after 28 weeks. Results: The most common gestational age group taken for evaluation of TCD/AC ratio was in between 30-36 weeks. Preeclampsia is the major predisposing factor of FGR i.e. 46%, and 30 % of cases were under unknown cause. The mean TCD/AC ratio in FGR cases is 17 .33 +/- 0.23. The cut-off value of TCD/AC ratio was 15.77. TCD/AC ratio has 98% positive predictive value when compared to FL/AC and HC/AC. LSCS rate is high in FGR cases (58 %). Meconium stained liquor was seen in 38 % of FGR cases. The mean birth weight after

delivery was 1.933 +/- 1.48 kg. Conclusions: To conclude, the TCD/AC ratio can be used in assessing fetal growth independent of gestational age. Hence, TCD/AC ratio can be a screening test to diagnose FGR in the antenatal period. So, that early intervention could be attempted to improve the perinatal outcome.

Keywords---fetal growth, transverse cerebellar diameter (TCD), fetal growth restriction (FGR).

Introduction

Fetal Growth Restriction accounts for a significant increase in perinatal mortality rate as well as immediate neonatal morbidity & continuing long term disability in some of survivors. The Process of birth is the most dangerous journey an individual undertakes. A healthy new born is the goal of every expectant mother and her obstetrician. It is estimated that the incidence of fetal growth restriction is 3-7 %. Intrauterine fetal demise, birth asphyxia, meconium aspiration, increased cesarean section rate, neonatal hypoglycemia and hypothermia, metabolic and haematological disorders, cognitive dysfunction and cerebral palsy are all increased in growth restriction. In addition, it has been found that these growth restricted infants have increased infant mortality rate.¹ The desire to prevent such complications during pregnancy has prompted the clinician to develop various methods of assessing the fetal condition in utero. Ideally the best investigation must be simple, safe, reliable, reproducible non- invasive, accurate and should cause no damage to the mother and fetus.

Prenatal ultrasonography, which fulfils almost all these prerequisites plays an important role in antepartum fetal surveillance. An accurate assessment of gestational age, evaluation of fetal growth, identification of major congenital anomalies, assessment of fetal wellbeing and maturity are all possible due to the availability of ultrasound. The most commonly used parameters in ultrasound to evaluate fetal growth are biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). Of all the ultrasound derived biometric parameters, the AC seems to be the best predictor of fetal growth restriction (FGR). But all these parameters can be correlated only if gestational age is accurately known. But uncertainty of the gestational age occurs frequently and makes the differentiation between the appropriate for gestational age and the small for gestational age fetus difficult. Measurement of transverse cerebellar diameter (TCD) is an accurate method of estimating gestational age in cases of uncertain dates and variations of fetal head shape such as dolichocephaly or brachycephaly where biparietal diameter could not be used.^{2,3,4}

TCD is the maximum transverse diameter of the fetal cerebellum. The fetal cerebellar hemispheres are located in the posterior cranial fossa, which is resistant to external pressure and growth variations. Even during hypoxia the blood flow to the cerebellum is maintained even after a decrease in blood flow to the cortex. Fetal AC is the earliest affected parameter in the process of impaired fetal growth.⁵ Thus a ratio of TCD/AC which is gestational age independent is

very useful in predicting FGR. Hence, TCD/AC ratio increases in fetal growth restriction which fairly remains constant throughout normal pregnancy. This study was primarily planned to study the TCD among high-risk pregnancies and to find whether TCD/AC ratio can diagnose fetal growth restriction.

Materials and Methods

A prospective study consisting of 100 antenatal women was conducted in Niloufer Hospital under Osmania Medical college, Hyderabad during the period from 2019 to November 2021.

Inclusion Criteria:- Pregnant women with clinically suspected FGR and high risk pregnancies after 28 weeks.

Exclusion Criteria:- Multiple pregnancy, Anomalous pregnancy, Moderate to severe polyhydramnios and Symmetrical FGR.

Methods

Antenatal women were enrolled after written informed consent. A detailed history of the patients was taken. A thorough systemic and obstetric examination was made. All preliminary investigations were done. The antenatal women were made aware of the benefits of ultrasonogram. Measurement were obtained by using a G.E VOLUSON 730 PRO ultrasound machine in real time 2D image with 3-5 MHz abdominal curvilinear transducer. The scans were carried out by the trained sonologist. TCD & AC is measured along with HC & FL. TCD/AC ratio was calculated. These women were informed about the results of the scan and advised to come after two weeks for repeat scan. The patients were followed up till deliveries.

Results

A group of 100 cases were studied.

Table-1: Demographic distribution of patient characteristics in study

Age	No. of Cases	Percentages
<20 years	4	4%
21-25 years	54	54 %
26-30 years	12	12 %
31-35 years	28	28 %
>36 years	2	2%
Parity		
Primi Gravida	57	57 %
Gravida2	23	23 %
Gravida3	14	14 %
Gravida4	6	6%
Duration		

28-30 weeks	9	9%
30-32 weeks	22	22 %
32-34 weeks	32	32 %
34-36 weeks	19	19 %
36-38 weeks	14	14 %
>38 weeks	4	4%
Predisposing Factors		
Preeclampsia	46	46 %
Anemia	12	12 %
Hypothyroidism	4	4%
Chronic Hypertension	8	8%
Unknown Cause	30	30 %
Mode of Delivery		
Vaginal Deliveries	42	42 %
Lower segment Cesarean Section	58	58 %

54 % cases are in the age group of 21-25 years. All Primi gravidas in study group are associated with Fetal Growth Restriction, it shows that primi gravida are at risk of getting Fetal Growth Restriction. Preeclampsia is a predisposing factor which is more common in Primigravida. 32% cases of Fetal Growth Restriction were in gestational period of 32-34 weeks. 46% of cases of Fetal Growth Restriction associated with preeclampsia. This shows preeclampsia is a major cause for Fetal Growth Restriction. 58% of the FGR cases were delivered by LSCS.

Table-2: TCD/AC Ratio

TCD/AC Ratio	No. of Cases	%
15.0-15.5	6	6%
15.6-16.0	24	24 %
16.1-16.5	39	39 %
16.6-17.0	22	22 %
17.1-17.5	9	9%

The above observation was subjected to Chi-square Test and following result is obtained:

Degrees of freedom: 18

Chi-square = 59.38546924215556, p is less than or equal to 0.001. The distribution is significant.

This shows that the association between TCD/AC ratio and FGR is significant.

Table-3: HC/AC Ratio

HC/AC Ratio	No. of Cases	%
1-1.05	9	9%

>1.05	91	91 %
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Applying Chi-square Test to the above observations, the following result is obtained: Degrees of freedom: 3

Chi-square = 22.566826334286148563

p is less than or equal to 0.001. The distribution is significant. Hence this method is also a predictor of FGR.

Table-4: FL/AC Ratio

FL/AC Ratio	No. of Cases	%
22-23	36	36%
>23	64	64%

Chi-square Test was applied to above observation. Degrees of freedom: 3

Chi-square = 38.579962548521474.

p is less than or equal to 0.001. The distribution is significant.

Hence this method is also significant to use as a parameter for detection of FGR.

Table-5: Correlation of ratios with gestational age and birth weight after delivery

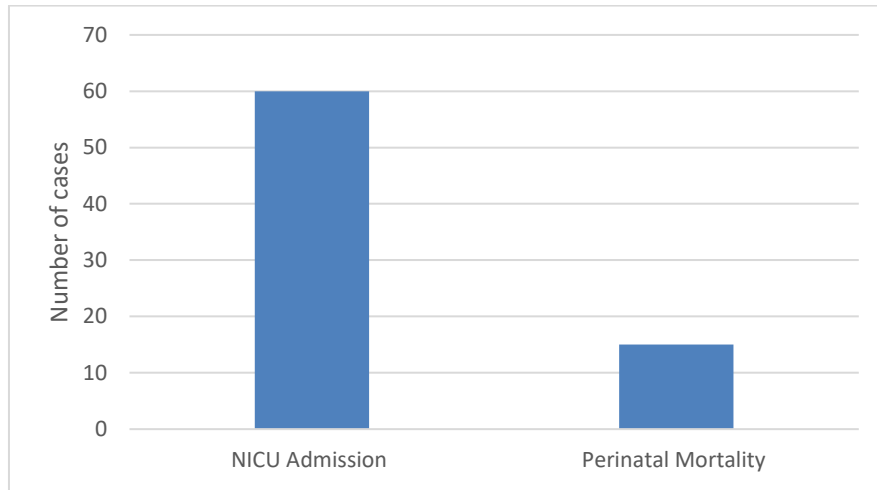
Gestational Age	Estimated Weight on Fetal USG (Mean)	TCD/AC Ratio (Mean)	HC/AC Ratio (Mean)	FL/AC Ratio (Mean)	Birth Weight after Delivery (Mean)
28-30 weeks	1.1 kg	15.1	1.01	21	1 kg
30-32 weeks	1.2 kg	15.4	1.01	22	1.1 kg
32-34 weeks	1.4 kg	16	1.02	22	1.5 kg
34-36 weeks	1.9 kg	16.4	1.05	23	1.9 kg
36-38 weeks	2 kg	16.5	1.06	23.1	2.1 kg
> 38 weeks	2.2 kg	17.1	1.06	23.4	2.3 kg

Table-6: Perinatal Morbidity

Perinatal Complications	No. of Cases	Percentages
Asphyxia	24	24 %
Meconium Aspiration Syndrome	38	38 %
Hypoglycemia	9	9%
Hypocalcemia	8	8%
Hypothermia	2	2%
Normal	19	19 %

Meconium aspiration syndrome (38 cases) and asphyxia (24 cases) is seen high in perinatal morbidity.

Figure-1: Perinatal Outcome



Perinatal outcome in NICU admission in 60 cases and perinatal mortality in 15 cases.

Table-7: Sensitivity, Specificity and Positive Predictive Value of ratios in study

	Sensitivity	Specificity	Positive Predictive Value
TCD/AC	89.50%	83.00%	98.00%
FL/AC	69.50%	61.00%	89.00%
HC/AC	97.36%	25.00%	80.43%

TCD/AC is highly sensitivity and positive predictive value in study.

Discussion

In this study 100 antenatal women were selected after fulfilling the inclusion and exclusion criteria. In the present study 54% of the women were between 21 to 25 years and most of the women were primigravida accounted for 57 %. Risk factors associated with present pregnancy were preeclampsia in 46%, chronic hypertension in 8%, anaemia 12%, hypothyroidism 4 % and with unknown cause 30 %. Most of the Study cases had preeclampsia (46%) which is in comparison with study conducted by Dr.Arora et al⁵ where the incidence of preeclampsia with FGR was found to be 38%. The duration of pregnancy ranged from 28-39 weeks of gestation and the majority i.e., 32% of cases were in the group ranging from 32-34 weeks of gestation age, 22% of cases are in the group of 30-32 weeks. 19% of cases are in the group of 34-36 weeks of gestation.

TCD/AC in study cases were determined and the observation were subjected to chi-square test to get the p value. The p value ≤ 0.001 and hence it is concluded that the association between TCD/AC ratio and FGR is significant. The TCD/AC ratio when raised above the constant value indicates FGR. The mean value of TCD/AC Ratio in 100 FGR cases is 17.73 ± 0.23 . In comparison with the Mona

Sharma, Vanita Suri, Kalavashista ⁶ they got the control group mean TCD/AC value was 13.09 +/- 0.67 and the mean TCD/AC value in study group was 15.40 +/- 2.1981. In comparison with Jose de A Barreto⁷ from Brazil had shown the positive predictive value of 96.3% which is closure to our study. In comparison with Mourya S et al , 2017 the best cutoff value of the TCD/AC ratio for predicting FGR was 15.87, giving the sensitivity, specificity, positive predictive value and negative predictive value of 81.25%, 62.25%, 89.65 % and 45.45 %., respectively. The study conducted by Asmaa Mohamoud Abd El- 5023ahab et al, 2018 Egypt the TCD/ AC ratio was more than 13.81 after 20 weeks and the positive predictive value is 93.8 % which is closure to our study.

Table-8: Comparative Studies

TCD/AC	Mona Sharma Kala Vasista, 2001, India. ⁶	Jose De A Barreto August (2004) Brazil	Mourya S Mourya HK Sharma 2017 ⁸	Asmaa Mohamoud Abd El- wahab et al, 2018 ,Egypt. ⁹	Niloufer Hospital. (2021)
Sensitivity	84.40 %	78.2 %	81.25 %	88.2 %	89.50 %
Specificity	94.00%	82.6 %	62.25%	97 %	83.00%
Positive Predictive Value	92.30%	96.30 %	89.65%	93.8 %	98.00%
Negative Predictive Value	77.04 %	66.03 %	45.45 %	94 %	62.40 %

The study conducted by Mona Sharma (2001)⁶ and by Mourya S (2017)⁸ had 44 shown the positive predictive value of 89.65% had shown the positive predictive value of 92.3% which is closer to our study done at Niloufer Hospital (2021), Hyderabad which has 98% positive predictive value. HC/AC ratio was studied in this study group and Chi-Square test was applied to the observations and the P value ≤ 0.001 and the association was significant. FL/AC ratio was measured in this study group and chi-square test was applied to the observation and the P value ≤ 0.001 was obtained which shows that the association is significant. Sensitivity, specificity & positive predictive value of all the 3 methods were compared. TCD/AC ratio when compared was more specific (83 %) and had a positive predictive value of 98 % as against the positive predictive value of 89 % for FL/AC & 80.43 % for HC/AC.

When the above values were compared TCD/AC ratio has a predictive value of 98% as against 80% HC/AC ratio and 89% of FL/AC ratio. Hence TCD/AC ratio is more predictive compared to other methods. As regards TCD/AC in prediction of asymmetric FGR, our results showed high diagnostic validities for TCD/AC with sensitivity 89.50% and specificity 83.00% which was in agreement with (Bhimarao et al, 2015)¹⁰ and (Meyer et al 1995)¹¹ who stated that TCD/AC ratio was an age independent parameter that can be used in diagnosis of

asymmetric FGR with sensitivity 88 %, and 83.9 % and specificity 93.5 and 96.2 % respectively.

Khan NA et al¹² 2013, in their study which involved 30 high risk patients with known accurate gestational age and singleton pregnancy, found that raised TCD/AC ratio was observed in 15 patients out of 30 (50 %) with sensitivity, specificity of 77.78 % and 83.34 % respectively which was close to our results. The 100 FGR cases were followed till delivery and FGR was conformed. Majority of the cases of FGR (58 %) were delivered by LSCS, most of the cases at delivery had meconium staining of liquor (38%) reflecting intrauterine hypoxia. The mean birth weight in FGR cases was 1.933 kg. As comparable to the study conducted by Mona Sharma et al ⁶ (2001). In FGR group they had observed the birth weight of 1.72+/-1.3 and that in control group they had birth weight if 2.89 +/-0.278 kg.

Conclusion

The most common gestational age group taken for evaluation of TCD/AC ratio was in between 30-36 weeks. Preeclampsia is the major predisposing factor of FGR i.e. 46%, and 30 % of cases were under unknown cause. The mean TCD/AC ratio in FGR cases is 17.33 +/- 0.23. The cut-off value of TCD/AC ratio was 15.77. TCD/AC ratio has 98% positive predictive value when compared to FL/AC and HC/AC. LSCS rate is high in FGR cases (58 %). Meconium-stained liquor was seen in 38 % of FGR cases. The mean birth weight after delivery was 1.933 +/- 1.48 kg. To conclude, the TCD/AC ratio can be used in assessing fetal growth independent of gestational age. Hence, TCD/AC ratio can be a screening test to diagnose FGR in the antenatal period. So, that early intervention could be attempted to improve the perinatal outcome.

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