RESEARCH

EVALUATION OF TRANSVERSE CEREBELLAR DIAMETER/ ABDOMINAL CIRCUMFERENCE RATIO- IN ASSESSING FETAL GROWTH RESTRICTION

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Received : 02/05/2022
Received in revised form : 07/07/2022
Accepted : 18/07/2022

Keywords:
Transverse cerebellar diameter (TCD), Abdominal circumference (AC), Fetal growth restriction (FGR).

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DOI: 10.47009/jamp.2022.4.4.124

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2022; 4 (4); 634-639

Abstract

Background: To diagnose fetal growth restriction by finding out cut off values of TCD /AC ratio and to evaluate the validity of transverse TCD /AC ratio in diagnosing fetal growth restriction. **Materials and Methods:** It are a prospective study consisting of 100 antenatal women were selected at gestation of 20-22weeks. **Result:** The cut-off value of TCD/AC ratio was <15 for diagnosing FGR in 62.5% while 78.9% for AGA. Sensitivity and PPV of TCD/AC ratio in diagnosing FGR was 83% and 85.7% respectively while specificity and NPV of TCD/AC ratio in diagnosing FGR was 96.1% and 93.7% respectively. Out of the total NICU admissions, majority are of FGR babies.70.8% of FGR babies were scored APGAR >7 at both 1 minute&5 minutes. The difference in APGAR scores between AGA and FGR at both 1 and 5 minutes were found significant. There was a significant difference found between perinatal morbidity of AGA and FGR pregnancies and mean birth weight of babies both groups. The TCD/AC ratio was compared for the GA weeks and a significant difference was found in the mean ratios between 20-22 weeks and 32-34 weeks. The TCD/AC ratio was also compared for AGA and FGR and the mean differences were highly significant between both groups. **Conclusion:** The TCD/AC ratio helps accurately in recognizing fetal growth restriction at an early gestational age. TCD/AC can be used to screen & diagnose FGR.

INTRODUCTION

A healthy newborn is a goal of every expectant mother and her obstetrician. Fetal growth restriction is defined as a condition in which the fetus fails to achieve its genetic growth potential and is at risk of increased prenatal morbidity and mortality.Birth weight is taken as the sole criterion to assess fetal growth. Incidence of fetal growth restriction is 3-10%. Incidence of fetal growth restriction is 6 times greater in underdeveloped/ developing countries when compared to developed countries. Large number of fetal growth restricted babies are seen in Asian continent that is 75% of all affected infants, followed by African, Latin and American continents.[1,2]

Fetal restriction accounts for significant increase in perinatal mortality rate and neonatal morbidity with long term disability for which prediction of fetal growth restriction with timely management decision is of paramount importance. In addition it has also found that these growth restricted infant have increased 1 year infant mortality rate and abnormal neurological development. Early diagnosis of FGR is very important because it enable the identification of the etiology of the condition and adequate monitoring of the fetal status, thereby minimizing risks of premature birth and intrauterine hypoxia.[3]

During intial days, caregivers relied on a combination of history and physical examination to clinically determine gestational age. The size of the uterus estimated through abdominal and pelvic examination can be roughly correlated with gestational age; however the factors that affecting uterine size (such as fibroids) and maternal body characteristics (obesity) will affect such an estimate. Assessment of fetal growth is important to the provision of optimum prenatal care. As the clinical estimation of fetal growth is not reliable, prenatal ultrasonography provides an opportunity to more accurately assess the fetal growth.

The most used parameters to evaluate fetal growth are biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). But all these parameters can be

ISSN (O): 2687-5365; ISSN (P): 2753-6556

correlated only if gestational age is accurately known. Of all the ultrasound parameters abdominal circumference is the best predictor of fetal growth restriction. IUGR leads to early exhaustion of hepatic glycogen and subcutaneous fat resulting in decrease in AC. Hence, AC is contemplated as a sensitive parameter for early detection of IUGR. An abdominal circumference within the normal range for gestational age reliably excludes growth restriction, whereas a measurement less than 5th percentile is highly suggestive of growth restriction (American college of obstetricians and gynaecology 2000).

Measurement of transverse cerebellar diameter (TCD) is emerging as a new sonographic and most reliable ultrasound parameter for growth. It is the only parameter that correlates with gestational age by the end of second trimester. Failure to observe the growth of cerebellum in the posterior fossa in the early second trimester should alert the examiner to see for possible malformations of central nervous system. Measurement of TCD is more relevant in cases of extreme growth abnormalities, variations of fetal head shape such as dolichocephaly and brachycephaly, where biparietal diameter could not be used.

It has been proposed that TCD is not affected in fetal growth restriction because of brain sparing effect. Fetal AC is affected early in the process of growth restriction hence TCD/AC ratio increases in fetal growth restriction which fairly remains constant throughout normal pregnancy.[4] TCD/AC ratio may convey more precise information regarding the fetal growth and development than bony measurements of fetal head and AC alone. This study was primarily planned to evaluate the TCD and AC among pregnant women and to find the usefulness of TCD/AC ratio in diagnosing intrauterine growth restriction.

MATERIALS AND METHODS

It is a prospective study consisting of 100 antenatal woman in the department of obstetrics and gynaecology. 100 antenatal women will be enrolled into study starting from 20-22weeks of gestation after written informed consent. A thorough systemic and obstetric examination is made. These women will be offered ultrasonogram. With ultrasonogram the transverse cerebellar diameter [TCD] and abdominal circumference [AC] were measured. The TCD/AC ratio is calculated in addition to anomaly scan, routine biometric parameters and liquor volume. These patients were followed up till delivery and repeat scans done as and when required with minimum 1 more scan at 30-34weeks. All babies at birth are assessed by neonatologist.

Inclusion Criteria

Antenatal woman with singleton live intra uterine gestation with excellent dates.

Exclusion Criteria

Antenatal woman with unreliable dates, fetal anomalies, multiple gestation, polyhydromnios.

Statistical Analysis

Prospective and inferential statistics were carried out in the present study. Result was presented as number and percentage for categorical variables, while they were presented using Mean ± SD for quantitative variables. Level of significance was fixed at P = 0.05 and any value less than or equal to 0.05 was considered to be statistically significant.

First, we apply normality test, if we found our data follow normality test (Kolmogorov Smirov & Shapiro wilk test), hence we use parametric test. T test for difference of means use to find significance of our study and ANOVA for more than two group. If our data not follow normality test then we used non parametric test. Mann – Whitney U test and Friedman test or Chi square test for categorical variables in independent groups. And the data were analysed by using statistical software, Statistical package for social sciences version 25 & data enter in Excel 2019.

RESULTS

The above tables show distribution of age in our study majority of the age group found 21 – 25 years of antenatal women that is 47(47%) out of 100. Mean and standard deviation of age is 25.42 and 3.812. Parity in our study majority of the Parity found Primi gravida that is 64(64%) out of 100. Fetal growth restriction in our study majority of the Fetal growth restriction of Asymmetrical found that is 20(70.8%) out of 24. Distribution of inutero growth status in our study majority found in AGA is 76(76%) out of 100. Rest are Fetal growth restriction 24(24%).

Table 1: Maternal variables distribution

Age	Frequency	Percentage
18 – 20	9	9.0
21 – 25	47	47.0
26 – 30	36	36.0
>30	8	8.0
Total	100	100.0
Parity		
Multi	36	36.0
Primi	64	64.0
FGR wise distribution		
Symmetrical	4	29.2

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Asymmetrical	20	70.8
Total	24	100.0
Utero growth		
AGA	76	76.0
FGR	24	24.0
Total	100.0	100.0

Table 2: Risk Factor wise distribution

Risk Factors	Number of cases	AGA		FGR	
		Frequency	Percentage	Frequency	Percentage
Preeclampsia	9	7	9.2	2	4.2
Oligohydramnios	8	6	7.9	2	8.3
Preeclampsia & Oligohydramnios	11	11	14.5	0	0.0
GDM	4	3	3.9%	1	4.2
Chronic Hypertension	3	1	1.3	2	8.3
No Risk Factor	65	48	63.2%	17	70.8
Gestation age wise distribution					
20 – 22	24	20	26.3	4	16.7
30 - 34	76	56	73.7	20	83.3
Mode of delivery					
CS	35	26	34.2	9	37.5
V	65	50	65.8	15	62.5

Risk factor in our study majority of the risk factor found Preeclampsia & Oligohydramnios that is 11(11%) out of 100 and 65(65%) found no risk factor. In our study majority of the risk factor found Preeclampsia &Oligohydramnios FGR that is 0(0.0%).Fetal growth restriction were associated with Oligohydramnios and Chronic Hypertension 8.3% both risk factor.

Gestation age in our study majority of the Gestation age found 32 – 34 weeks that is 76(76%) out of 100. In our study majority of Gestation age 32 – 34 weeks found in Fetal growth restriction that is 20(83.7%) out of 24. Mode of delivery in our study majority of the Vaginal delivery found that is 65(65%) out of 100.

In our study majority of pregnancies need Vaginal delivery found in Fetal growth restriction that is 15(62.3%) out of 24. Rest 37.7% found in LSCS of Fetal growth restriction.

Table 3: Correlation between

Gestational age	Correlation Coefficient	P value
Correlation with GA and TCD		
20-22 weeks	0.083	.013
30-34 weeks	.815	<0.0001
Correlation with GA and AC		
20-22 weeks	.708	<0.0001
30-34 weeks	.475	<0.0001
Correlation between TCD and AC		
20-22 weeks	.151	<0.001
30-34 weeks	.556	<0.000

Significant correlation exists between gestational age and TCD.Significant correlation exists between gestational age and TCD, Significant correlation exists between gestational age and AC. Distribution of FGR/AGA fetuses with cut of value.

Table 4: Distribution of FGR/AGA fetuses with cut of value

TCD/AC ratio	AGA	FGR	Percentage
<15	60(78.9%)	15(62.5%)	75
>15	16(21.1%)	9(37.5%)	24
Total	76(100.0%)	24(100.0)	100

Significant correlation exists between TCD/AC ratio and Utero growth at 0.001 p value.

Table 5: Diagnostic value in present study

Parameter	Sensitivity	Specificity	PPV	NPV
TCD/AC	83%	96.1%	85.7%	93.7%

Sensitivity and PPV of TCD/AC ratio in diagnosing FGR was 83% and 85.7% respectively. Specificity and NPV of TCD/AC ratio in diagnosing FGR was 96.1% and 93.7% respectively

Table 6: NICU admission and morbidity wise distribution

NICU admission in days	AGA	FGR	P value
No admission	66(86.8%)	6(25.0%)	0.01 Significant

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1–5	5(6.6%)	11(45.8%)	
6 – 10	1(1.3%)	5(50.8%)	
>10	4(5.3%)	2(8.3%)	
Score < 7			
At 1 minutes	9(11.8%)	7(29.2%)	0.044 Significant
At 5 minutes	6(7.9%)	7(29.2%)	
Score > 7			
At 1 minutes			
At 5 minutes	67(88.2%)	17(70.8%)	0.007 Significant
	70(92.1%)	17(70.8%)	
Perinatal Morbidity			
Asphyxia	1(1.3%)	2(8.3%)	<0.05 Significant
Hypocalcemia	1(1.3)	1(4.2%)	
Hypoglycemia	3(3.9%)	3(12.5%)	
Hypothermia	2(2.6%)	1(4.2%)	
Meconium Aspiration Syndrome	0(0.0%)	4(16.7%)	
Not find	69(90.8%)	13(54.2%)	
Total	76(100.0%)	24(100.0%)	

There is significant difference found between NICU admission of AGA and FGR babies. 75% FGR babies need NICU admission whereas only 13.2% of AGA babies needed NICU admission. 29.2% of FGR babies were scored 1 minute APGAR score < 7 and 70.8% of FGR babies were scored 5-minute APGAR score > 7 . There is significant difference found between perinatal morbidity of AGA and FGR babies. Perinatal Morbidity found higher in FGR babies.

Table 7: Birth weight of babies relation in utero growth status

In utero growth status	Birth weight(kg)		P values
	Range	Mean ±SD	
FGR	2.00 – 3.70	2.75±0.41	0.0001
AGA	1.60 – 4.00	2.84±0.48	

The above table show the mean birth weight of babies AGA is 2.84 kg and mean birth weight of babies FGR is 2.75 kg. There is a statistical significance difference found between mean birth weight of babies of both groups.

Table 8: Comparison of TCD/AC ratio at GA weeks

GA	TCD/AC ratio		P values
	Range	Mean ±SD	
20 – 22 weeks	13.41 – 51.92	16.43±7.61	0.0001
30 – 34 weeks	5.23 – 16.59	14.71±1.36	
AGA			
TCD	2.3 – 24.3	6.49±1.95	0.0001
AC	36.90 – 48.60	42.80±2.30	
FGR			
TCD	5.30 – 6.70	6.13±0.41	0.0001
AC	36.90 – 46.20	40.23±2.62	

There is a statistical significance difference found between TCD/AC ratio of both groups.
Comparison of TCD/AC ratio at GA weeks. There is a statistical significance difference found between TCD/AC ratio of both groups.

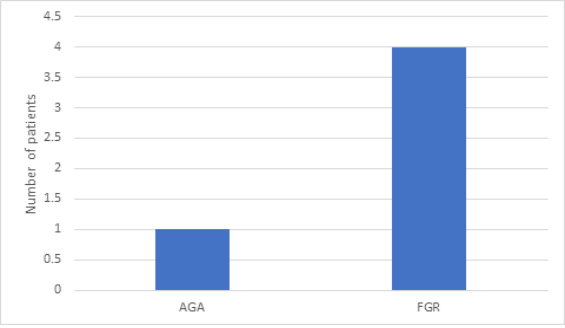

Table 1: In utero growth status and perinatal mortality

The above [Figure 1] show the perinatal mortality found 26.7% in FGR babies and 1.2% in AGA babies

DISCUSSION

In the present study, 100 antenatal women were selected and studied for the utero growth status. Ultrasonography has became a routine investigation for assessing fetal maturity. It is very important to know the inutero growth status of the fetus for proper obstetric management of a normal as well as IUGR pregnancies. The mean age of women in this study was 25.42 years, and majority were in the range 21-25 years. A greater percentage – 64% of subjects of this study were primigravida. 65 of the cases delivered babies vaginally, while 35 of them underwent C-section. Risk factors associated with the pregnant subjects of the current study were – Preeclampsia, Oligohydramnios, GDM & Chronic

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Hypertension. The incidence of FGR in women with preeclampsia was 4.2% and in women with Chronic Hypertension was 8.3%. In a similar study by Zhu YC et al. (2020), who sampled a much larger pregnant population, reported that the FGR incidence was 22.4% (433/1 937) in women with severe preeclampsia and 18.6% (68/365) in women with chronic hypertension.[5]

Late onset FGR (≥32 weeks gestation) is the more common presentation of growth restriction (up to 80% of FGR cases) as reported by Malhotra A et al., and a similar incidence was reported in our study with 83.2% cases of FGR presenting at 32-34 weeks of gestation.[6,7]

In our study out of 24 cases of FGR, 20 were asymmetrical and 7 symmetrical. Those symmetric FGR cases were diagnosed by the TCD/AC ratio with the sensitivity of 83%, which is similar to the study conducted by Meyer et al,[8] where TCD/AC ratio diagnosed symmetric FGR with a sensitivity of 71%.7 The occurrence of FGR in this study was found to be 24%, which is higher than the reported incidence of 3 – 7% by Chew LC and Verma RP.[9]

Significant linear relation of TCD with GA and a strong correlation was found between gestational age and AC in a study conducted by Sharma G and Ghode R in Wardha region of Maharashtra.[10] In the study conducted by Dilmen et al the pearson correlation r =0.9767, which is also close to our study. In the study conducted by Haller et al there was strong correlation exists between gestational age and AC (r = 0.9453) which is almost close to our study.

Likewise, our study has also reported a significant positive correlation to exist between GA of 30-34 weeks and TCD. Moreover, highly significant correlation is found to exist between GA and AC as well. Strong correlation existed between gestational age and transcerebellar diameter (R2 = 0.9464), between gestational age and AC (R2 = 0.9685), and between TCD and AC (R2 = 0.9561) in a study conducted by Meyer WJ et al,[8] is a supportive evidence to the significant correlation found between TCD and AC is the present study.

Agrawal C, Agrawal KK and Gandhi S (2016) has a similar sample size like the present study (n=100), and they reported a significantly lower TCD/AC ratio (13.50 ± 0.97) for appropriate-for-gestational-age neonates and 13.80 ± 0.97 at early and late gestation, respectively (P<0.05 for both). In the current study, TCD/AC ratio is found to be less than 15 in majority of fetuses born appropriate for gestational age, incidence being 78.9%.[11] Similar to study conducted by Campbell et al,[12] where strong linear correlation (r =0.918) noted between TCD and AC.

With regards to the NICU admission rates, in the present sample, 28 of 100 neonates required NICU admission, of which majority (n=16) were admitted for 1 to 5 days, while n=12 were admitted for more than six days. As per literature, large population studies of small but otherwise healthy infants at birth (Apgar ≥ 7 at 5 min of life) demonstrates that severely growth restricted infants. In the present study, APGAR score of <7 at 5 minutes was found in 29% of FGR neonates. Additionally, the difference in APGAR scores at both 1 and 5 minutes were significantly different between AGA and FGR. Garite TJ, Clark R and Thorp JA,[13] have reported that Fetal growth restriction (FGR) is associated with an increased risk of perinatal and neonatal morbidity and mortality. In this present study, FGR was associated with a 45.8% incidence of perinatal mortality. Meconium Aspiration Syndrome & Hypoglycemia accounted for a major percentage of it. Furthermore, the incidence of perinatal mortality was more in FGR (26.7%) growth status when compared to AGA (1.2%).

In this study, the FGR babies were born with a mean weight of 2.75 ± 0.41 kg while the mean weight of AGA babies was 2.84 ± 0.48 kg and the difference in weights between the two is found statistically significant. Verkauskiene R et al., have also reported in their study, a significant difference between birth weights of FGR (mean = 2.48 kgs) and AGA (mean = 3.22 kgs) in their study sample.[14]

In our study the TCD/AC ratio was 16.43±7.61 at 20 – 22 weeks and 14.71±1.36 at 32 – 34 weeks and the difference in the two gestational ages is found significant. When comparison was conducted between AGA and FGR, the TDC/AC shows significant differences in the two utero growth patterns. Agrawal C, Agrawal KK and Gandhi S,[11] have reported similar values among 15 neonates, where the mean TCD/AC ratio was 14.17 ± 0.89 at early gestation and 15.61 ± 1.18 at late gestation. It is close to the study conducted by meyer et al 8 in which the cut-off value for fetal growth restriction was15.9, and also with the study of haller et al. In another study conducted by Tongsong et al,[15] the cut-off value is 15.4 which is also close to our study.

As regard to diagnostic value, the present study shows, sensitivity and positive predicative value of TCD/AC ratio in diagnosing FGR is 83% and 85.7% respectively while specificity and negative predictive value of TCD/AC ratio in diagnosing FGR iss 96.1% and 93.7% respectively. In another study by Chakarvarty N, Srivastav K &Khanduri S, the diagnostic accuracy of TCD/AC ratio as a marker of FGR was found to be most efficient with 81.5% sensitivity and 68.6% specificity and overall diagnostic accuracy of 77%.[16,17]

CONCLUSION

More commonly seen among growth restriction cases is the late onset FGR presenting at gestational age > 32 weeks. Preeclampsia, Oligohydramnios, GDM & Chronic Hypertension continue to be the risk factors associated with FGR. There is a strong correlation between TCD & AC and the gestational age. Majority of FGR babies require NICU

ISSN (O): 2687-5365; ISSN (P): 2753-6556

admission of lesser than 5 days. The TCD/AC ratio helps accurately in recognizing fetal growth restriction at an early gestational age. TCD/AC can be used to screen & diagnose FGR.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556