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Fetal Trans-Cerebellar Diameter and Fetal Trans-Cerebellar Diameter to Abdominal Circumference [tcd/ac] Ratio in Assessment of Gestational Age for the Prediction of Normal Fetal Growth and Intrauterine Growth Restriction

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Abstract

Background: Accurate estimation of the gestational age [GA] is crucial for the appropriate management of pregnancy. Inaccurate GA estimation is associated with adverse perinatal outcomes. Precise knowledge of the expected date of delivery has a vital role in the management of pregnancies. Amongst the several clinical measures employed to assess the GA, the date of the last normal menstrual period [LNMP] is acknowledged to relate best with the GA. However, this method may not be always reliable and can sometimes be misleading. Foetal Abdominal Circumference [AC] is one the important foetal parameters to be affected early in the process of impaired foetal growth. So, Trans cerebellar Diameter/Abdominal Circumference [TCD/AC] ratio has been found to be constant and a gestational age independent parameter to assess foetal growth and can be useful in predicting foetal growth restriction. The aim of the present study was to evaluate accuracy of fetal trans-cerebellar diameter and fetal trans-cerebellar diameter to abdominal circumference [TCD/AC] ratio in assessment of gestational age for the prediction of normal fetal growth and intrauterine growth restriction. Methods: This was a prospective case control study conducted at the Obstetrics and Gynecology Department, Benha University Hospital, Benha – Egypt on 300 pregnant women [Group A]: included healthy pregnant women with morphologically normal fetuses between 14-40 weeks of gestation who came for routine antenatal sonography, [Group B]: included patients of suspected IUGR clinically. Results: HC, AC, and TCD were significantly lower in IUGR compared to controls. Meanwhile TCD/AC was significantly higher in IUGR compared to controls. Conclusion: In IUGR fetuses, the fetal TCD was less affected than fetal HC suggesting preferential preservation of cerebellar growth relative to other cranial structures. The TCD/AC ratio was helpful in recognizing abnormal fetal growth. Even when the GA was uncertain since this ratio was gestational age independent.

Key words: Trans cerebellar diameter [TCD], Trans cerebellar diameter to abdominal circumference ratio [TCD/AC].

1. Introduction

The most important parameter needed for appropriate management of pregnant women is accurate Gestational Age [GA]**.** The determination of true gestational age is undoubtfully very important in the management of pregnancy affecting major decisions like time of labour induction, caesarean section**.** The commonly used fetal biometric parameters like BPD, HC, AC, FL are nonspecific as they depend upon the proper fetal growth as well on true menstrual age. [1]

High incidence of perinatal mortality has been noted in patients whose accurate gestational age is not known. Uncertain gestational age is associated with preterm delivery, low birth weight and post maturity**.** Naegele's rule, a well-accepted method for estimating date of delivery, depends only on date of LMP, has some problems as some of women don't recall LMP accurately**. [2]**

Ultrasonography [USG] remains cornerstone for evaluation of fetal growth**.** Most commonly used growth parameters include biparietal diameter [BPD], head circumference [HC], abdominal circumference [AC] and femur length [FL].However, these parameters are gestational age dependent, which limits their utility at extremes of growth**.** Several studies have reported FL to AC ratio [FL/AC] and transcerebellar diameter to AC ratio [TCD/AC] as age independent growth parameters**. [3]**

There are some limitations with these parameters as BPD after 26 weeks becomes unreliable in conditions altering the shape of skull. Femur length is shortened in cases of achondroplasia making it unreliable parameter in estimating GA**.** [4]

TCD a new parameter for determining gestational age was developed. Cerebellum is located in the posterior cranial fossa surrounded by the dense petrous ridges and the occipital bone making it withstand the deformation caused by extrinsic pressure**. [5]**

Cerebellar normal development and growth in some studies have shown a reflection of fetal growth pattern. Therefore transcerebellar diameter is implemented to determine fetal age **[**6**].**

Foetal cerebellum can be visualized as early as 10-11 weeks by USG. From second trimester onwards, it grows with a linear correlation with gestational age. TCD is least affected by external factors because it is surrounded by dense petrous bone which allows its use for assessing GA even in third trimester [Hashimoto et al., 2001]. In cases of growth restriction, the cerebellum is the least affected parameter maintaining its size in case of foetal growth restriction hence accurate GA can be predicted with TCD**. [2]**

Intrauterine growth retardation [IUGR] is a major risk factor for perinatal mortality and morbidity**.** Early detection of IUGR is useful in deciding frequency of antenatal surveillance, optimal delivery timing and early neonatal management to avoid perinatal mortality and morbidity**. [7]**

Several studies have reported FL to AC ratio [FL/AC] and transcerebellar diameter to AC ratio

[TCD/AC] as age independent growth parameters. [6] FL/AC ratio is useful in early detection of asymmetrical IUGR. However, utility in symmetrical IUGR is questionable as both FL and AC are affected. [8] TCD/AC is constant through 14 to 42 weeks with cut off values ranging from 15.4 to 15.98 in different studies. [9]

The aim of this study was to evaluate accuracy of fetal trans-cerebellar diameter and fetal trans-cerebellar diameter to abdominal circumference [TCD/AC] ratio in assessment of gestational age for the prediction of normal fetal growth and intrauterine growth restriction.

2.Type of study and study population:

This prospective case control study was conducted at the Obstetrics and Gynecology Department, Benha University Hospital, Benha – Egypt through the period from April 2020 to May 2022 and was subjected to approval by the Local Ethics Committee of the Department.

The study included 300 pregnant women from those admitted in the department and from those attended the antenatal outpatient clinic.

Period of gestation was determined by last menstrual period [LMP]. A discrepancy of 4 weeks in period of gestation and clinical examination was taken as evidence of IUGR. Multiple gestation, polyhydramnios, transverse lie, oblique lie and mistaken / unsure date were excluded from the study. In all cases fundal height was measured in centimeters after that all patients underwent ultrasonography.

Participants were divided into 2 groups:

GroupA: healthy pregnant women with morphologically normal fetuses between 14-40 weeks of gestation who came for routine antenatal sonography

Group B: patients of suspected IUGR clinically.

Sample size [139]:

$$\frac{\left(\frac{Z_{\alpha/2} + Z_{\beta}}{P_1 - P_2}\right)^2 (p_1 q_1 + p_2 q_2)}{}$$

E=0.05

Subsequent evaluation:

All subjects were issued standard antenatal cards with additional columns appended for recording the USG findings. The patients were briefed about the frequency of antenatal examinations.

Inclusion Criteria for study group:

- Singleton pregnancies of 18-40 weeks with known last menstrual period.
- Normal singleton pregnancies of 18-40 weeks having previous USG reports consistent with LMP.
- Routine obstetric ultrasound scanning:
- Patients with chronic diseases well controlled

Exclusion Criteria for groups:

- Pregnant women those are unsure of their dates.
- Presence of congenital malformation.
- Multiple pregnancies.
- Pregnant women before 18 weeks or after 40 weeks

Methods

Patients were subjected to:

Complete history taking:

1. Personal history including: Name, Age, marital state, address
2. Menstrual history: date of last menstrual period, including age of Menarche, menstrual disturbance, dysmenorrhea, related symptoms.
3. Parity
4. History of infertility
5. Present history: of chronic diseases and medication.
6. Past history of HTN, DM.
7. Family history of similar condition or diabetes.
8. Estimation of gestational age: calculated according to the date of the last normal menstrual period and confirmed by first trimester ultrasound. In case of discrepancy [more than five days], early ultrasound was used to determine gestational age.

Examination:

A.General examination:

- Vital signs [Blood pressure, Temperature, Heart rate, Respiratory rate],
- Signs of [Pallor, Cyanosis, Jaundice, and Lymph node enlargement].

B.Abdomen palpation during pregnancy:

- Symphysial fundal height [SFH] measurement in pregnancy for detecting fetal growth, For fetuses after 24 weeks' gestation, the measurement is made by identifying the upper border of the symphysis pubis and the uterine fundus and measuring the distance between with a tape measure. The measurement in centimetres is then applied to the gestation by a simple rule of thumb [Belizan 1978].

C.Auscultation:

- Auscultation of the fetal heart sound is done by using a fetal stethoscope or a sonicaid.

D.Routine obstetric ultrasound scanning:

- Trans-abdominal ultrasound for gestational age, fetal biometry, presentation, amniotic fluid volume, placental location and exclusion of fetal anomalies ***[using 7-10 MHZ probe – Voluson 730 PRO, GE Healthcare, USA]:***

Fig .(1) Routine USG**.**

AC view :

A longitudinal view of the fetus that demonstrates both the fetal heart and the fetal bladder. Slide the transducer laterally until the fetal spine is visualized. Rotate the transducer through 90° at the level of the fetal stomach to obtain a cross-section. The outline should be circular, if it is ovoid make a small adjustment of the rotation or the angle of the transducer. If the umbilical vein is not visualized as described above, make small sliding movements of the transducer to change the level of the section. Freeze the image. [Goldstein et al., 2013].

Fig. (2) AC measurments.

TCD

TCD view is the suboccipitobregmatic view, in which the anterior horns of the lateral ventricles and cavum are visualized at the front of the head together with the cerebellum at the back. Obtain the lateral ventricle view required for the BPD then rotate the probe slightly downward, toward the fetal neck. The posterior horns of the lateral ventricles will disappear from view to be replaced by the cerebellum. Ensure you do not rotate the probe too far toward the neck. Although this might not affect the TCD measurement, it will give a false impression of an enlarged cisterna magna and/or nuchal skinfold thickness. The TCD is measured at 90° to the long axis of the cerebellum across its widest point, using the 'outer to outer' method **[Goldstein et al., 2013]**

Fig. (3) TCD measurments**.**

All measurements were quantified in millimetres.
TCD/AC ratio was calculated by dividing TCD by the AC and multiplying by 100.

E.Subsequent evaluation*:*

Follow up visits accordingly every 3:4 [group 1] or every 1:2 weeks [group 2] until delivery

Outcome measures:

- **Primary outcome measures:**

Study of difference between Fetal trans-cerebellar diameter and fetal trans-cerebellar diameter to abdominal circumference [TCD/AC] ratio in assessment of gestational age for the prediction of normal Fetal growth and intrauterine growth restriction based on discrepancies between actual and expected sonographic biometric measurements for a given gestational age].

- **Secondary outcome measures:**

Study of the neonatal outcome [Apgar score, Fetal distress, Meconium aspiration, Admitted to NICU, Stillbirth and Dead fetuses] between the two studied groups.

Data management and Statistical Analysis

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences [SPSS version 20.0] **[**Statistical Package for the Social Sciences] software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD , the following tests were used to test differences for significance correlation by Pearson's correlation or Spearman's . P value was set at <0.05 for significant results & <0.001 for high significant result.

3. Results

This table shows that there is no significant difference between the groups regarding maternal age, BMI, and parity **Table [1]**.

This table shows that there is a significant difference between the groups regarding HTN, DM and gynecological history **Table [2]**.

This table shows that HC, AC, and TCD were significantly lower in IUGR compared to controls. Meanwhile TCD/AC was significantly higher in IUGR compared to controls **Table [3]**.

There is a significant difference between the groups in term of EFW **Table [4]**.

There is a significant difference between the groups in term of low APGAR, fetal distress, meconium aspiration, NICU admission, stillbirth, and death **Table [5]**

TCD/AC achieved significance at cutoff point of 13.2 for predicting IUGR with sensitivity of 97.3% and specificity of 86.5% with PPV 63.3% and NPV 99.3% **Table [6]** & **Figure [4]**.

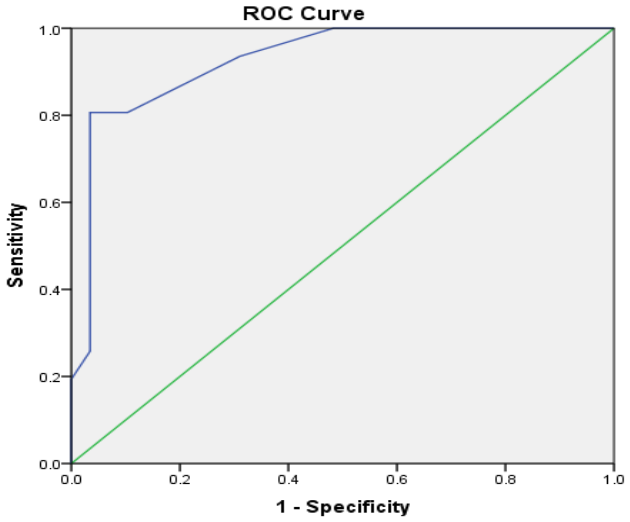

Fig. (4) ROC curve of TCD/AC as a predictor for IUGR.

Table (1) Demographic characteristics among the studied groups

		IUGR *[n=58]*	***Controls*** *[n=242]*	t/χ^2	***p***
Age *[years] Mean ± SD*		28.33 ± 4.28	27.55 ± 4.54	1.19	.236
BMI *[kg/m^2] Mean ± SD*		26.14 ± 2.38	25.73 ± 2.51	1.13	.261
Parity	*Primi*	38 [65.5%]	172 [71.1%]	.688	.407
	Multi	20 [34.5%]	70 [28.9%]		

Table (2) History distribution among the studied groups.

	IUGR *[n=58]*	***Controls*** *[n=242]*	χ^2	***p***
HTN	15 [25.9%]	25 [10.3%]	**9.8**	**.002**
DM	12 [20.7%]	18 [7.4%]	**9.13**	**.003**
- ***Type I DM***	3 [25%]	5 [27.78%]		
- ***Type II DM***	9 [75%]	13 [72.22%]		
Renal disorders	5 [8.6%]	10 [4.1%]	**1.98**	**.159**
- ***Glomerulonephritis***	2 [40%]	7 [70%]		
- ***Hypertensive nephrosclerosis***	2 [40%]	2 [20%]		
- ***Diabetic nephropathy***	1 [20%]	1 [10%]		
Gynecological history	13 [22.4%]	24 [9.9%]	**6.8**	**.009**
- ***Pre-eclampsia***	3 [23.08%]	7 [30.43%]		
- ***Gestational diabetes***	3 [23.08%]	6 [26.09%]		
- ***obstetric injury***	3 [23.08%]	6 [26.09%]		
- ***post-partum haemorrhage***	2 [15.38%]	5 [21.74%]		
- ***Miscarriages***	2 [15.38%]	0 [0%]		

Table (3) Ultrasound measurements between the two studied groups.

	IUGR *[n=58]*	***Controls*** *[n=242]*	*T*	***p***
BDP *[cm] Mean ± SD*	6.77 ± 1.81	7.19 ± 2.03	1.44	.150
HC *[cm] Mean ± SD*	28.47 ± 8.65	32.28 ± 7.21	**3.47**	**.000**
AC *[cm] Mean ± SD*	22.34 ± 2.98	26.11 ± 3.68	**7.25**	**.000**
FL *[cm] Mean ± SD*	5.27 ± 1.41	5.62 ± 1.34	1.77	.078

Table (4) TCD/AC distribution between the two studied groups.

	IUGR *[n=58]*	***Controls*** *[n=242]*	*T*	***p***
TCD *[cm] Mean ± SD*	3.06 ± 1.32	3.95 ± 1.45	**4.27**	**.000**
TCD/AC *Mean ± SD*	16.02 ± 1.35	11.1 ± 1.65	**8.4**	**.000**

Table (5) Neonatal characteristics between the two studied groups.

	IUGR *[n=58]*	***Controls*** *[n=242]*	*t*	***p***
GA *[weeks] Mean ± SD*	31.47 ± 5.54	32.29 ± 5.27	1.05	.293
EFW *[g] Mean ± SD*	1831.2 ± 613.5	2189.5 ± 812.3	**3.15**	**.002**

Table (6) Neonatal outcome between the two studied groups.

	IUGR *[n=58]*	***Controls*** *[n=242]*	χ^2	***p***
Low APGAR	24 [41.4%]	43 [17.8%]	**15**	**.000**
Fetal distress	33 [56.9%]	82 [33.9%]	**10.5**	**.001**
Meconium aspiration	22 [37.9%]	39 [16.1%]	**14**	**.000**
Admitted to NICU	31 [53.4%]	48 [19.8%]	**27**	**.000**
Stillbirth	2 [3.4%]	0	**8.4**	**.004**
Death	5 [8.6%]	4 [1.7%]	**7.8**	**.005**

Table (7) Accuracy of TCD/AC as a predictor for IUGR**.**

Variables	*AUC*	*S.E.*	*Sig.*	*95% Confidence Interval*
TCD/AC	.927	.034	**.000***	0.861 - 0.995
Cutoff	***Sensitivity***	***Specificity***	***PPV***	***NPV***
>13.2	97.3%	86.5%	63.3%	99.3%

4. Discussion

Regarding the demographic characteristics among the studied groups, the current study showed that there is no significant difference between the groups regarding maternal age, BMI, and parity.

The current study was supported by **Hassan et al., [10]** who aimed to compare TCD/AC ratio in both normal and growth restricted fetuses in second and third trimesters and to find if there is any correlation between TCD/AC ratio and EFW. The study enrolled 100 singleton pregnant women the patients were divided into two equal groups. Group I included pregnant females with normally growing fetuses and Group II included pregnant females with growth restricted fetuses above 20 weeks of gestation. There was no statistically significant difference between the two studied groups [P = 0.091].

Also, in line with the current study **Roy et al., [11]** aimed at evaluating the accuracy of TCD measured by ultrasound in predicting the gestational age and asymmetric IUGR prenatally. The study enrolled 50 clinically suspected IUGR pregnancies and 50 presumably normal pregnancies. The mean age of female in normal pregnancies is 24.17 ±2.17 years, in IUGR 27.37±3.56 years. There is a significant difference between ages of these groups showing that more aged females are more prone to develop IUGR foetus. The disagreement with our results may be a result of the difference in sample size.

Furthermore, the study by **Shaaban et al., [12]** aimed to evaluate the accuracy of transcerebellar diameter/ abdominal circumference ratio [TCD/AC ratio] for the evaluation of normal fetal development. The study enrolled 500 women with uncomplicated pregnancy with mean age of 29.32±4.90 years and mean BMI was 23.74±5.57 kg/m2.

As well, **Bhimarao et al., [6]** aimed to compare the accuracy of transcerebellar diameter/ abdominal circumference with head circumference/abdominal circumference in predicting asymmetric intrauterine growth retardation after 20 weeks of gestation. The study enrolled 50 pregnant women between 18-35 years of age showing asymmetrical foetal IUGR were examined with majority of them [28%] being in the age group 27-29 years.

In addition, **Agrawal et al., [13]** aimed to evaluate the use of the transverse cerebellar diameter to abdominal circumference [TCD/AC] ratio in predicting intrauterine growth restriction [IUGR]. The study enrolled 100 women. The mean age of the women was 24.82 ± 3.31 years; 85 [85%] women were aged 21–30 years.

Also, **Hussain et al., [14]** aimed to evaluate the accuracy of TCD/AC and utility of TCD/FL in normal pregnancy at varying periods of gestation and to derive a cut-off value for assessment of fetal growth. The study enrolled 200 women. Demographic characteristics not reported in this study.

In the current study regarding comorbidities among the studied groups, we found that there is a significant difference between the groups regarding HTN, DM and gynecological history.

In agreement with the present results **Mohammad et al., [15]** reported that there was statistically significant difference between women with and without IUGR as regard HTN and DM.

Also**, Lahti-Pulkkinen et al., [16]** stated that maternal HTN and DM were potential risk factors for IUGR.

This was supported by **Srinivas et al., [17]** who reported that chronic hypertension was associated with the development of IUGR.

Regarding ultrasound measurements between the two studied groups, we found that HC, AC, and TCD were significantly lower in IUGR compared to controls. Meanwhile TCD/AC was significantly higher in IUGR compared to controls.

In agreement with our results **Hassan et al., [10]** reported that the mean TCD/AC × 100 of patients in group [1 control group] was 13.436±1.0396; TCD/AC while the mean in group [2 the IUGR group] was 15.998±0.9497, and there was statistically significant difference between the two studied groups [p < 0.001].

Also, in agreement with the current results **Roy et al., [11]** reported that HC, AC, and TCD were significantly lower in IUGR compared to controls. Meanwhile TCD/AC was significantly higher in IUGR compared to controls.

As well, the study by **Shaaban et al., [12]** reported that TCD was significantly lower in IUGR compared to controls. Meanwhile TCD/AC was significantly higher in IUGR compared to controls.

Regarding Neonatal characteristics between the two studied groups, we found that there is a significant difference between the groups in term of EFW. GA was comparable between the study groups.

In agreement with our results **Hassan et al., [10]** reported that the mean EFW in group [1 control group] was 2177.717 ±806.131g, while the mean EFW in the group [2 IUGR group] was 1758.483±596.924g, there was a statistically significant difference between the two studied groups [p=0.003]. GA was comparable between the study groups.

Also, in agreement with the current results **Roy et al., [11]** reported that there is a significant difference between the groups in term of EFW. GA was comparable between the study groups.

Cabbad et al., [18] in a study with ultrasound examination in patients with suspected IUGR showed that fetal weight was affected to a greater extent than the cerebellar diameter, leading to discordance between TCD and fetal weight.

Regarding the neonatal outcome between the two studied groups, we found that there were significant differences between the groups in term of low APGAR, fetal distress, meconium aspiration, NICU admission, stillbirth, and death.

This was in line with **von Beckerath et al., [19]** who reported that Fetuses with IUGR were delivered earlier [35 vs 38 weeks] and had higher rates of mortality [8% vs 1%; odds ratio [OR], 8.3] as well as perinatal complications [24.4% vs 1.0%; OR, 31.6]. The long-term outcome was affected by increased risk for neurodevelopmental impairment [24.7% vs 5.6%; OR, 5.5] and growth delay [21.2% vs 7.4%; OR, 3.4].

IUGR is one of the leading causes of perinatal-neonatal morbidity and mortality, and contributes to long-term chronic diseases. Perinatal problems posed by IUGR include perinatal asphyxia, difficult cardiopulmonary transition after birth, meconium aspiration, and persistent pulmonary hypertension. In addition, IUGR infants are at higher risk of immediate postnatal complications, such as hypothermia, hypoglycemia, polycythemia, jaundice, feeding difficulties, necrotizing enterocolitis, and late-onset sepsis. Furthermore, changes in the fetal nutritional environment, prenatal programming, and postnatal catch-up growth in IUGR infants lead to long-term adverse consequences such as neurodevelopmental impairment, increased risk of cardiovascular disease, and metabolic syndrome that span over a lifetime [**20]**.

Using the ROC curve analysis of TCD/AC for the prediction of IUGR showed that TCD/AC achieved significance at cutoff point of 13.2 for predicting IUGR with sensitivity of 97.3% and specificity of 86.5% with PPV 63.3% and NPV 99.3%.

In agreement with our results **Hassan et al., [10]** reported that the ROC curve analysis suggested that the most useful cutoff value of TCD/AC × 100 was 13.75, where the sum of sensitivity [100.0%] and specificity [63.33%] was the highest. They concluded that the TCD/AC ratio was helpful in recognizing abnormal fetal growth even when the GA was uncertain since this ratio was gestational age-independent.

Also, the study by **Roy et al., [11]** reported that out of 29 true IUGR cases were correctly diagnosed by TCD/AC ratio, hence sensitivity was 88.89%, specificity 85.71%, the PPV was 88.89% and NPV was 85.71%. They concluded that TCD/AC ratio, which utilizes both the least and the most affected foetal biometric parameters, should provide a very sensitive method for detecting asymmetrical and possibly symmetrical IUGR at any gestational age.

Furthermore, **Shaaban et al., [12]** reported that Our study showed that TCD/AC seems to have an excellent predictive value in 18-34 weeks gestational age groups with Best cutoff value on TCD/AC ratio of >13 this cutoff value with 99.03% sensitivity and 83.45 % specificity, 58.0 with a positive predictive value and 99.7 with a negative predictive value. That agreed by **Bellad et al., [9]** in which they stated that the TCD/AC ratio in the gestational age group 18-34 weeks is an age independent constant parameter and a comparatively good indicator of IUGR.

Also, our results were in line with **Agrawal et al., [13]** who reported that at 20–28 weeks of gestation, TCD/AC ratio had a sensitivity, specificity, PPV, and NPV of 60.00%, 94.12%, 64.29%, and 93.02% respectively. At 30–36 weeks of gestation, it had a sensitivity, specificity PPV, and NPV of 80.00%, 90.80%, 60.00%, and 96.34%, respectively. Th accuracy of diagnosis of IUGR was 89% at both the early and late gestational ages. In the receiver operator curve [ROC] analysis of the TCD/A ratio at the early gestational age, the area under the curve was 0.758. The study concluded that the TCD/AC ratio was fairly accurate in recognizing abnormal fetal growth at an early gestational age.

The study by **Bhimarao et al., [6]** compared Transcerebellar Diameter/ Abdominal Circumference Versus Head Circumference/Abdominal Circumference, and found that the sensitivity, specificity, PPV, NPV & DA were 88%, 93.5%, 77.1%, 96.3% & 92.4% respectively for TCD/AC ratio versus 84%, 92%, 72.4%, 95.8% & 90.4% respectively for HC/AC ratio in predicting IUGR. The study concluded that Both ratios were gestational age independent and can be used in detecting IUGR with good diagnostic accuracy. However, TCD/AC ratio had a better diagnostic validity and accuracy compared to HC/AC ratio in predicting asymmetric IUGR.

Furthermore, **Hussain et al., [14]** reported that TCD with AC and FL show strong correlation throughout pregnancy. TCD/AC dispersed normally with mean value of 14.013 and SD of 0.738 and cut off value is 15.49. TCD/FL is dispersed normally throughout pregnancy with mean value 64.592 and SD of 3.998. TCD/AC, TCD/FL in subgroups also shows similar mean and SD as compared to entire study population. the study concluded a cut off value of mean +/- SD [15.49], [72.588] for TCD/AC and TCD/FL could be used as a growth parameter for detection and determine the severity of IUGR.

5. Conclusion

In IUGR fetuses, the fetal TCD was less affected than fetal HC suggesting preferential preservation of cerebellar growth relative to other cranial structures. The TCD/AC ratio was helpful in recognizing abnormal fetal growth. Even when the GA was uncertain since this ratio was gestational age independent

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