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Diagnostic Accuracy of Fetal Transverse Cerebellar Diameter as Independent Parameter in Diagnosis of Intrauterine Growth Restriction

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ABSTRACT

Background: A recently discovered measurement called transverse cerebellar diameter (TCD) is used to estimate a fetus's gestational age (GA). When determining GA, the measurement of TCD is incredibly accurate, especially when the last menstrual period (LMP) date is uncertain. **Objective:** This study aimed to assess the diagnostic accuracy of fetal TCD as independent parameter in diagnosis of intrauterine growth restriction (IUGR). **Patients and methods:** This prospective observatory study was conducted in Obstetrics and Gynecology Department, Menoufia University Hospital and Berket El-Sabaa Central Hospital through the period from November 2022 to February 2024. 200 pregnant women attended to Antenatal Care Outpatient Clinic for follow up with a mean age of 26.43 ± 6.115 years old, singleton pregnancy, GA more than 13 weeks and clinically suspected intra uterine fetal growth restriction (FGR) were enrolled. **Results:** The study included individuals with a mean parity of 1.47 ± 1.5, a mean BMI of 26.32 ± 5.028 kg/m^2, and 19% of patients were obese. There was a highly statistically significant lower mean value of GA by TCD in IUGR was 27.18 ± 7.454 compared to Non-IUGR that was 34.95 ± 3.502 ($p<0.001$). **Conclusion:** TCD is a critical measure for identifying IUGR and appropriately measuring GA. This is especially crucial for patients who arrived at the hospital without any medical records or prior prenatal care visits, particularly those from low-income families. These individuals frequently do not recall their LMP or estimated date of delivery (EDD), making it difficult for clinicians to precisely determine the GA of the fetus, especially in situations of IUGR.

Keywords: Transverse cerebellar diameter, Gestational age, Abdominal circumference, Intrauterine growth restriction.

INTRODUCTION

Precise pregnancy date determination is critical in the care of obstetric patients, as the GA influences many therapeutic choices during the pregnancy [(1)]. Evaluating fetal development is critical in deciding whether to continue or to terminate the pregnancy, especially in the face of complications such as fetal distress, pregnancy-induced hypertension, diabetes, and Rh incompatibility [(2)]. The several metrics currently utilized to estimate GA encompass the biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) [(3)]. Furthermore, as the gestation time progresses, the variability in determining the GA using these indicators increases [(4)]. TCD is a freshly established measurement for determining a fetus's GA. Because it is surrounded by thick petrous ridges and the occipital bone in the posterior cerebral fossa, the cerebellum can withstand external pressure-induced deformation [(5)]. TCD measurement is a highly precise method for evaluating GA, particularly in situations when the LMP is unknown [(6)].

Fetal growth restriction (FGR), also known as IUGR, is a disorder in which the fetus is smaller than expected for its developmental stage. This disease is usually brought on by problems resulting from inadequate placental functioning. A baby whose weight is below the 10th percentile for their GA is referred to as small for gestational age. For GA, the words FGR and small are commonly used synonymously [(7)]. Antenatal identification of IUGR is crucial due to its correlation with elevated rates of perinatal morbidity and mortality, including fetal death, brain damage, fetal distress, neonatal hypothermia, high levels of bilirubin in the blood, low blood sugar, and weakened immunological function. IUGR caused by inadequate blood supply from the uterus and placenta or lack of oxygen leads to a redistribution of blood flow in the fetus, prioritizing the brain over other body organs [(8)]. The cerebellum remains relatively unaffected even during acute hypoxia due to the preservation of blood supply to this region [(9)].

IUGR causes the rapid depletion of glycogen in the liver and the reduction of subcutaneous fat, leading to a decrease in adipose tissue mass. Therefore, AC is considered a crucial factor for the early identification of IUGR [(10)].

SUBJECTS AND METHODS

Study area and subjects: This prospective observatory study was conducted at Obstetrics and Gynecology Department, Menoufia University Hospital and Berket El-Sabaa Central Hospital through the period from November 2022 to February 2024.

Inclusion criteria: Pregnant women attended Antenatal Care Outpatient Clinic for follow up aged 16 - 42 years old with singleton pregnancy, GA more than 13 weeks and clinically suspected intra uterine FGR were enrolled.

Exclusion criteria: Women with multiple gestations, history of metabolic disease or medical disorders with pregnancy, known fetal congenital anomalies, macrosomic fetuses and who were not sure of their date or with irregular periods.

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Sampling method: Convenience sampling is selecting respondents who were easily accessible or readily available to the researcher. There was no discernible pattern in the acquisition of these respondents and they might be recruited by simply approaching individuals who were present in various locations. A total of 200 pregnant women were enrolled.

Study interventions and procedures:

The demographic and maternal characteristics were extracted from a questionnaire during their first antenatal health care. In compliance with the inclusion and exclusion criteria; patients were subjected to complete history taking of clinical importance and general examination with special emphasis on obstetric abdominal examination "Leopold manoeuvres". The standard investigations include a comprehensive blood picture, liver and kidney function tests, coagulation profile (prothrombin time, partial thromboplastin time, and international normalized ratio), viral hepatitis indicators for hepatitis B and C viruses, and blood group (ABO) and Rh testing.

The antenatal ultrasound examination involved measuring classical fetal biometric parameters such as BPD, HC, AC, and FL. These measurements were taken using the MindrayDP-15 Digital Ultrasonic Diagnostic Imaging System and the GE Logiq E9 ultrasound machine, which utilized a 2-5 MHz wide band convex, curved array transducer.

Ultrasound examination of the trans-cerebellar diameter:

The patient underwent a supine examination using a real-time B-mode ultrasound machine equipped with a 3.5 MHz transducer. An image of the cerebellum was acquired by determining the position of the thalami and third ventricle, and then moving the transducer slightly below the thalamic plane to reveal the distinctive butterfly-shaped structure of the cerebellum in the back part of the skull. A trans-cerebellar Doppler (TCD) measurement was acquired by positioning the electronic calipers at the furthest edges of the cerebellum. The measurement of TCD was conducted with a vaginal probe in cases where it was challenging with a convex probe. The ultrasound examinations were conducted by highly skilled and experienced medical professionals to guarantee the precision of the examination findings. The GA was determined using certain fetal biometric measurements and then compared to the expected duration of gestation in order to analyze the fetal growth curve. This scanning was repeated every four weeks and it was increased when needed. Regarding the data that was collected, the fetuses were differentiated into normal and IUGR fetuses. In fetuses, a diagnosis of IUGR was made when their projected weight falls below the 10th percentile for their GA, and their AC was below the 2.5^{th} percentile.

Ethical approval: After being clearly explained the clinical trial's nature, scope, and potential risks, the patient gave informed permission. The case report only mentioned the patient's initials, and the investigators safely safeguarded any other records with his name. For record identification, the investigators retained a personal patient identification list with patient initials and names. In conformity with local legislation, the protocol and all related documentation were submitted to the council of Obstetrics and Gynecology Department, Faculty of Medicine, Menoufia University for ethical and research permission before starting the study. The Helsinki Declaration was adhered to at every stage of the investigation.

Statistical analysis

SPSS version 23.0 for Windows® was used to code, process, and analyze the gathered data. To determine the difference between two or more sets of qualitative variables, use the X^2-test. The mean ± SD was used to convey quantitative data. To compare two independent groups of regularly distributed variables (parametric data), the independent samples t-test was employed. Additionally, qualitative elements were presented using numbers and percentages. Data were tested for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests. When the p-value was equal to or less than 0.05, it was deemed significant.

RESULTS

The study included females aged 16-42 (mean age 26.43 ± 6.115) years, with a mean parity of 1.47 ± 1.5, a range of BMI from 17 to 38 (mean 26.32 ± 5.028) kg/m^2, and 19% of patients were obese, as shown in table (I).

Table (I): Demographic data of the studied patients

Parameters	**No 200**	**% 100.0**
Age, years		
Mean ± SD	26.43 ± 6.115	
Min- Max.	16-42	
Age, years		
16-20	39	19.5
21-25	69	34.5
26-30	44	22.0
31-35	24	12.0
35-42	24	12.0
Parity, no		
Mean ± SD	1.47±1.5	0-6
Parity, no		
Primigravida	75	37.5
Para 1	36	18.0
Para2	42	21.0
Para 3	27	13.5
≥ 4	20	10.0
Body mass index, kg/m^2		
Mean ± SD	26.32±5.028	
Min- Max.	17-38	
Body mass index, kg/m^2		
Low weight	18	9.0
Average weight	72	36.0
Overweight	72	36.0
Obese	38	19.0

The table indicated a considerable increase in clinically suspected IUGR in established cases, with a strong agreement (p<0.001) as illustrated in tables (II).

Table (II): The relation between clinically suspected and established cases of IUGR (n=173)

Parameters	**IUGR**				**Test of significance**	***P* value**
	No IUGR		**IUGR**			
	No	**%**	**No**	**%**		
	180	**90.0**	**20**	**10.0**		
Clinically suspected IUGR						
No	**177**	**98.3**	**0**	**0.0**	**X^2**	**^{MC}P**
Yes	**3**	**1.7**	**20**	**100.0**	**171.014**	**<0.001**
K (p)	**0.922* (<0.001*) very good**					

Clinically confirmed cases of IUGR showed a statistically significant relationship with the gestational time (p-value < 0.001), but no statistically significant relationship (p > 0.05) was found between clinically established cases of IUGR and age, parity, and body mass index, as shown in table (III).

Table (III): Relation between clinically established cases of IUGR and clinical data of the studied women

Parameters	**IUGR**				**Test of significance**	***P* value**
	No IUGR		**IUGR**			
	No	**%**	**No**	**%**		
	180	**90.0**	**20**	**10.0**		
Age, years						
16-20	37	20.6	2	10.0	X^2	0.243
21-25	64	35.6	5	25.0	5.460	
26-30	38	21.1	6	30.0		
31-35	19	10.6	5	25.0		
35-42	22	12.2	2	10.0		
Parity, no						
Primigravida	63	35.0	12	60.0	X^2	^{MC}P
Para 1	34	18.9	2	10.0	6.801	0.147
Para2	38	21.1	4	20.0		
Para 3	27	15.0	0	0.0		
≥ 4	18	10.0	2	10.0		
Body mass index, kg/m^2						
Low weight (<18.9 kg/m2)	16	8.9	2	10.0	X^2	0.597
Average weight (18.9-24.9 kg/m2)	66	36.7	6	30.0	1.884	
Overweight (25-29.9 kg/m2)	66	36.7	6	30.0		
Obese (> 30 kg/m2)	32	17.8	6	30.0		
Period of gestation						
14-20 wks	44	24.4	0	0.0	28.461	<0.001
21-24 wks	27	15.0	0	0.0		
25-28 wks	23	12.8	1	5.0		
29-32 wks	20	11.1	3	15.0		
33-36 wks	56	31.1	9	45.0		
37-40 wks	10	5.6	7	35.0		

This table, with a p-value of less than 0.05, illustrated the statistically significant difference between GA by LMP and GA by TCD at 33–36 weeks, 37–40 weeks, and total GA. In the difference category of GA, this table displayed a statistically significant correlation between the GA (by TCD) and the GA (by LMP) at 14–20 weeks (r=0.998; p<0.001), at 21–24 weeks (r=0.983; p<0.001), at 25–28 weeks (r=0.948; p<0.001), at 29–32 weeks (r=0.951; p<0.001), 33–36 weeks (r=1.000; p<0.001), and at 37–40 weeks (r=0.877; p<0.001), as shown in table (IV).

Table (IV): Comparison of the GA (as determined by LMP) with the estimated GA determined by the fetal TCD at various GAs

Parameters	**No**	**GA by LMP**	**GA by TCD**	**Estimated - actual (week)**	**Paired t-test**	***P* value**
GA	200	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**		
14-20 wks	44	16.89±2.09	16.75±2.103	-0.136±0.76	1.182	0.244
21-24 wks	27	22.96±1.126	22.93±1.174	-0.037±0.34	0.570	0.574
25-28 wks	24	25.96±1.160	25.04±3.00	0.083±0.72	0.569	0.575
29-32 wks	23	30.48±1.534	30.43±1.562	-0.08±0.668	0.624	0.539
33-36 wks	65	34.22±1.256	34.15±1.253	-0.29±0.765	3.081	0.003
37-40 wks	17	37.76±1.786	38.53±0.943	-0.765±1.48	2.130	0.049
Total	200	27.77±7.41	27.96±7.52	-0.195±0.81	3.394	0.001

Parameters	**GA (by LMP)**	
	r	***P* value**
Gestational age (TCD)		
14-20 wks	0.998	<0.001
21-24 wks	0.983	<0.001
25-28 wks	0.948	<0.001
29-32 wks	0.951	<0.001
33-36 wks	1.000	<0.001
37-40 wks	0.877	<0.001

This table, with a p-value of less than 0.05, illustrated the statistically significant difference between GA by BPD and GA by TCD at 33–36 weeks, 37–40 weeks, and total GA. In the difference category of GA, this table displayed a statistically significant correlation between the GA measured by TCD and the BPD at the following times: At 14–20 weeks (r=0.935; p<0.001), at 21–24 weeks (r=0.955; p<0.001), at 25–28 weeks (r=0.808; p<0.001), At 29–32 weeks (r=0.901; p<0.001), at 33–36 weeks (r=0.796; p<0.001), and at 37–40 weeks (r=0.561; P=0.019), as shown in table (V).

Table (V): Comparison and correlation of estimated GA based on BPD and GA (by TCD).

	Parameters	**No**	**GA by BPD**	**GA by TCD**	**Estimated - actual (week)**	**Paired t-test**	***P* value**
	GA	200	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**		
	14-20 wks	44	16.89±2.09	17.02±2.15	-0.136±0.76	1.182	0.244
	21-24 wks	27	22.96±1.126	23.0±1.038	-0.037±0.34	0.570	0.574
	25-28 wks	24	25.96±1.16	25.88±1.15	0.083±0.72	0.569	0.575
	29-32 wks	23	30.48±1.53	30.57±1.44	-0.087±0.67	0.624	0.539
	33-36 wks	65	34.22±1.25	34.51±1.07	-0.292±0.76	3.081	0.003
	37-40 wks	17	37.76±1.78	38.53±1.07	-0.76±1.48	2.130	0.049
	Total	200	27.77±7.52	27.96±7.52	-0.195±0.81	3.394	0.001

Parameters	**GA (by BPD)**	
	r	***P* value**
Gestational age (TCD)		
14-20 wks	0.935	<0.001
21-24 wks	0.955	<0.001
25-28 wks	0.808	<0.001
29-32 wks	0.901	<0.001
33-36 wks	0.796	<0.001
37-40 wks	0.561	0.019

With a p-value of less than 0.05, this table displayed a statistically significant difference between GA by FL and GA by TCD at 33–36 weeks, at 37–40 weeks, and total GA. In the GA difference category, this table displayed a statistically significant link between the GA measured by FL and the GA measured by TCD at 14–20 weeks (r=0.926; p<0.001), at 21–24 weeks (r=0.947; p<0.001), at 29–32 weeks (r=0.896; p<0.001), at 33–36 weeks (r=0.786; p<0.001), and at 37–40 weeks (r=0.625; p<0.007). There was no statistically significant link between GA (by FL) and GA (by TCD) at the between 25 and 28 weeks (r=0.278; p0.189), as shown in table (VI).

Table (VI): Comparison and correlation between GA as determined by TCD and predicted GA based on femur length (FL) at various GAs.

Parameters	**No**	**GA by FL**	**GA by TCD**	**Estimated - actual (week)**	**Paired t-test**	***P* value**
GA	200	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**		
14-20 wks	44	16.75±2.103	17.02±2.15	-.0273±0.82	2.213	0.032
21-24 wks	27	22.93±1.174	23.0±1.038	-0.74±0.385	1.000	0.327
25-28 wks	24	25.04±3.00	25.88±1.15	-0.83±2.89	1.408	0.172
29-32 wks	23	30.43±1.56	30.57±1.44	-0.13±0.69	0.901	0.377
33-36 wks	65	34.15±1.25	34.51±1.07	-0.35±0.779	3.661	0.001
37-40 wks	17	37.59±1.77	38.53±1.07	-0.94±1.39	2.79	0.013
Total	200	27.58±7.51	27.96±7.52	-0.38±1.27	4.230	<0.001

Parameters	**GA (by FL)**	
	r	***P* value**
Gestational age (TCD)		
14-20 wks	0.926	<0.001
21-24 wks	0.947	<0.001
25-28 wks	0.278	0.189
29-32 wks	0.896	<0.001
33-36 wks	0.786	<0.001
37-40 wks	0.625	0.007

This table, with a p-value of less than 0.05, illustrated the statistically significant difference between GA by AC and GA by TCD at 33–36 weeks, at 37–40 weeks, and total GA. In the GA difference category, this table displayed a statistically significant link between the GA measured by AC and the GA measured by TCD. There was no statistically significant link between GA (by AC) and GA (by TCD) at 25–28 weeks (r=0.278; P0.189), but there was at 14–20 weeks (r=0.926; P<0.001), at 21–24 weeks (r=0.947; P<0.001), at 29–32 weeks (r=0.896; P<0.001), at 33–36 weeks (r=0.789; P<0.001), and at 37–40 weeks (r=0.625; P<0.007), as shown in Table (VII).

Table (VII): Comparison and correlation between GA as determined by TCD and predicted GA based on AC at various GAs.

Parameters	**No**	**GA by AC**	**GA by TCD**	**Estimated - actual (week)**	**Paired t-test**	***P* value**
GA	200	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**		
14-20 wks	44	16.75±2.103	17.02±2.15	-.0273±0.82	2.213	0.032
21-24 wks	27	22.93±1.174	23.0±1.038	-0.74±0.385	1.000	0.327
25-28 wks	24	25.04±3.00	25.88±1.15	-0.83±2.89	1.408	0.172
29-32 wks	23	30.43±1.56	30.57±1.44	-0.13±0.69	0.901	0.377
33-36 wks	65	34.15±1.25	34.51±1.07	-0.35±0.779	3.661	0.001
37-40 wks	17	37.59±1.77	38.53±1.07	-0.94±1.39	2.79	0.013
Total	200	27.58±7.51	27.96±7.52	-0.38±1.27	4.230	<0.001

Parameters	**GA (by AC)**	
	r	***P* value**
GA (TCD)		
14-20 wks	0.926	<0.001
21-24 wks	0.947	<0.001
25-28 wks	0.278	0.189
29-32 wks	0.896	<0.001
33-36 wks	0.789	<0.001
37-40 wks	0.625	0.007

With a p-value of less than 0.001, this table demonstrated a highly statistically significant lower mean value of GA by LMP in IUGR, which was 27.23 ± 7.48, compared to Non-IUGR, which was 35.10 ± 3.493. Furthermore, the mean value of GA by BPD in IUGR was significantly lower at 27.17 ± 7.514 compared to 33.10 ± 3.24 in non-IUGR, with a p-value less than 0.001. Furthermore, a highly statistically significant decreased mean value of GA by FL in IUGR was found to be 26.97 ± 7.608 as opposed to 33.10 ± 3.243 in Non-IUGR, with a p-value of less than 0.001. With a p-value of less than 0.001, the mean value of GA by AC in IUGR was significantly lower than in Non-IUGR, measuring 26.97 ± 7.608 compared to 33.10 ± 3.243. Lastly, the mean GA by TCD in IUGR was 27.18 ± 7.454 compared to 34.95 ± 3.502 in Non-IUGR, a very statistically significant difference with a p-value ($p<0.001$) as shown in table (VIII).

Normal pregnancies: The association between GA (by TCD) and GA (by LMP) was statistically significant ($r = 0.999$; $P < 0.001$), as was the case with BPD ($r = 0.997$; $P < 0.001$), FL ($r = 0.988$; $P < 0.001$), and AC ($r = 0.988$; $P < 0.001$) as shown in table (VIII).

IUGR pregnancies: The table showed statistically significant correlation between GA (by TCD) with GA by LMP was r=0.995; P<0.001, by BPD was r=0.960; P<0.001, by FL was r=0.960; P<0.001 and by AC was r=0.960; P<0.001, as shown in table (VIII).

Table (VIII): Comparison and correlation between different fetal biometric diameters in detection of IUGR cases.

Parameters	**IUGR**				**t-test**	***P* value**
	Yes		**No**			
	No	**%**	**No**	**%**		
	180	**90.0**	**20**	**10.0**		
GA						
LMP Mean ± SD	27.23±7.48		35.10±3.493		4.637	<0.001
BPD Mean ± SD	27.17±7.514		33.10±3.24		3.486	0.001
FL Mean ± SD	26.97±7.608		33.10±3.243		3.563	<0.001
AC Mean ± SD	26.97±7.608		33.10±3.243		3.563	<0.001
TCD Mean ± SD	27.18±7.454		34.95±3.502		4.595	<0.001

Parameters	**GA (by TCD)**	
	R	***P* value**
GA		
Normal pregnancies		
LMP	0.999	<0.001
BPD	0.997	<0.001
FL	0.988	<0.001
AC	0.988	<0.001
IUGR pregnancies		
LMP	0.995	<0.001
BPD	0.960	<0.001
FL	0.960	<0.001
AC	0.960	<0.001

DISCUSSION

TCD is a novel sonographic metric that shows promise in diagnosing severe development abnormalities and differences in the form of the fetal head, such as brachycephaly and dolicocephaly [11].

Our study revealed that TCD is a crucial measure in diagnosing IUGR patients and determining gestational age in normal instances. A substantial association was found between GA by TCD and GA by LMP, BPD, FL, and AC. **Maher *et al.*** [12] agree that TCD is needed for IUGR and gestational age assessment. TCD's mean gestation age was equivalent to normal and IUGR patients, and it had the highest diagnostic accuracy of 95% in IUGR gestational age diagnosis within 2 weeks. If above the 95th percentile, TCD/AC ratio identified IUGR with 91.43% accuracy. **El-Sayed *et al.*** [13] found that TCD can determine GA through the third trimester. Ultrasonographic features and GA as assessed by LMP differed greatly from the normal group. TCD was the biggest difference, with a P value of 0.000. In IUGR, only TCD, AC, and FL demonstrated positive GA correlations. TCD showed strong correlations with BPD, HC, AC, and FL in healthy pregnancies, according to **Kumar *et al.*** [14]. In both IUGR and normal pregnancies, TCD had the greatest correlation with GA ($r = 0.993$, $p < 0.001$).

TCD, GA, BPD, and HC were found to have curvilinear connections by **Goldstein *et al.*** [15], suggesting that cerebellar measurement is independent of fetal head shape and can determine GA. According to a **Hadlock *et al.*** [16] study including thirty fetuses with growth restriction, AC was the most sensitive indicator. This study also showed that a sensitive indicator of growth restriction was estimated fetal weight. In both normal and IUGR fetuses, **Elkafrawy *et al.*** [17] discovered a significant correlation between GA and TCD. **Naseem *et al.*** [18] found that TCD was more accurate than BPD for third-trimester gestational age estimation in 228 normal patients. In another investigation conducted by **Naseem *et al.*** [19], TCD outperformed FL in estimating gestation age in 327 third-trimester pregnant women.

Our research of 180 normal cases showed no difference between the mean true GA and the mean GA obtained by TCD and FL, showing that both procedures were accurate in normal pregnancy. BPD, HC, and AC varied significantly. **Bhimaro *et al.*** [20] examined 50 likely IUGR pregnant women and compared the TCD/AC ratio to HC/AC. There was 88% TCD/AC sensitivity found. There was 93.5% specificity. Diagnostic accuracy, NPV, and PPV were 92.4%, 96.3%, and 77.1% respectively. Thankfully, 97.14% sensitivity, 85.71% specificity, 87.18% NPV, 96.77% PPV, and 91.43% accuracy were reported in our study. TCD/AC was examined by **Agrawal *et al.*** [21] to diagnose IUGR in 100 pregnant women who were at risk. They discovered that in 80% of cases, the TCD/AC ratio can identify growth restriction even at an early GA. In our study, the accuracy of the TCD/AC ratio in detecting IUGR above the 95th percentile was 91%. **Ravindernath *et al.*** [22] tested TCD's gestation age detecting accuracy in 100 pregnant women, 80 of whom were normal and 20 suspected of IUGR. TCD was superior at predicting gestational age and unaffected by IUGR. Thankfully, we were able to confirm their findings that the TCD was a more reliable GA indicator in IUGR instances than other approaches. **Mourya *et al.*** [23] tested TCD/AC's IUGR prediction' accuracy in 80 pregnant women suspected of IUGR. TCD/AC had 81.25% sensitivity, 62.50% specificity, 89.65% PPV, and 45.45% NPV. They agree with our findings that the TCD/AC ratio can diagnose IUGR. **Ismail *et al.*** [24] examined TCD/AC IUGR diagnosis accuracy in 77 pregnant women at risk. 93.5% TCD/AC sensitivity, 87% specificity, 82.9% positive predictive value, 95.2% negative predictive value, and 89.6% diagnostic accuracy were achieved. In our 140 pregnant women study, the TCD/AC ratio diagnostic accuracy tests for IUGR had sensitivity, specificity, PPV, NPV, and accuracy of 97.14%, 85.71%, 87.18%, 96.77%, and 91.43% respectively.

In order to ascertain if TCD could reliably detect gestation age in cases of IUGR and normality, **Dashottar *et al.*** [25] tested the device on 200 pregnant women. They found that in both normal and IUGR cases, there was no discernible difference between the mean real gestation age and the mean gestation age as determined by TCD. This agrees with all the results of our study, with the exception that in normal cases there was no significant difference in the mean actual gestation age and the mean gestation age detected by the TCD and FL. However, BPD, AC, and FL showed statistically significant differences in normal and IUGR cases. **Afshan *et al.*** [26] examined 100 qualified expectant mothers in their third trimester, of which 50 had fetuses growing normally and the other 50 had growth restriction. The embryo with normal growth and the foetus with restricted growth did not vary substantially in terms of mean TCD. TCD can be used to precisely determine GA in growth-restricted fetuses since researchers showed that fetal TCD values correlate well with GA in both normal and growth-restricted babies [26].

Finally, 500 pregnant women with precise dates were studied by **Ali *et al.*** [27]**.**

At 31–37 weeks, the transcerebellar diameter, biparietal diameter, and FL were measured for each patient to establish their GA. The LMP, TCD, FL, and AC-based GA did not differ significantly from one another. Based on GA, there was a highly significant difference (p-value <0.001 HS) between LMP and BPD.

CONCLUSION

TCD was an accurate, helpful, and reliable measure for detecting GA in normal 2nd and 3rd trimesters. TCD also accurately detected gestational age in IUGR-suspected pregnancies.

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