

# DIAGNOSTIC ACCURACY OF TCD/AC RATIO IN PREDICTION OF ASYMMETRIC IUGR AFTER 20 WEEKS IN SINGLETON PREGNANCY

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PJR October - December 2021; 31(4): 226-231

## ABSTRACT

**BACKGROUND:** Many pregnancies with intrauterine growth restricted (IUGR) fetuses remain undiagnosed due to limited antenatal care. IUGR if identified before birth and delivered timely causes fourfold reduction in morbidity and mortality. Among the ultrasound parameters the trans cerebellar diameter (TCD) is most reliable predictor of not only gestational age but also of normal or growth-retarded fetuses. **AIM:** To determine the validity of TCD/AC ratio as an indicator of intrauterine growth restriction after 20 weeks gestation taking neonatal birth weight as gold standard. **MATERIALS AND METHODS:** A Cross sectional validation study, carried out in of Radiology Department of KRL hospital, Islamabad from January 2018 to July 2018. Sample size as calculated by WHO sample size calculator was 285, were included in the study. In addition to routine parameters, TCD and AC obtained at the time of scan were used to provide TCD/AC ratio. Neonatal birth weight was compared on standard gestational age growth chart keeping it as a gold standard. **STATISTICAL ANALYSIS:** The TCD/AC ratios were correlated with Neonatal birth weight. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy (DA) for TCD/AC ratio in the prediction of IUGR fetuses were calculated. **RESULTS:** Age range in this study was from 20 to 35 years with mean age of  $28.000 \pm 2.89$  years and mean gestational age was  $29.547 \pm 3.41$  weeks. TCD/AC ratio detected IUGR in 11.9% patients and at birth it was 12.3%. TCD/AC ratio has shown sensitivity of 77.1%, specificity 97.2%, diagnostic accuracy by 95%, PPV 79.41%, NPV 96.81%, LR positive 27.5 and LR negative was 0.23 ( $p=0.000$ ) in diagnosis of IUGR. **CONCLUSION:** In conclusion, TCD/AC ratio can be used in detecting IUGR with good diagnostic accuracy.

**Keywords:** Trans cerebellar diameter/abdominal circumference ratio, IUGR, Diagnostic accuracy

## Introduction

Many pregnancies with intrauterine growth restricted fetuses remain undiagnosed due to limited antenatal care. Such infants if identified before birth and delivered timely may cause fourfold reduction in morbidity and mortality.<sup>1</sup> Incidence of intrauterine growth restriction in general population is 10% and lack of its identification (<40 %) leads to increased morbidity and mortality.<sup>2</sup> Date of last menstrual periods is most commonly used method to estimate gestational age.

This method assumes that a woman has a regular menstrual cycle. However it may be misleading as it is influenced by multiple factors such as retarded ovulation, bleeding at beginning of pregnancy, use of oral contraceptive pills. Short birth spacing and memory bias.<sup>3</sup> Moreover error of mistaken dates is more common in population with low educational levels. In countries like Pakistan many women present in third trimester. They are unsure of dates and do

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Submitted 14 August 2021, Accepted 12 October 2021

not possess any booking scan. In such a case it is a difficult task to determine exact gestational age so that to rule out any growth retardation or acceleration.<sup>4</sup> Several parameters like biparietal diameter, femur length, head circumference, abdominal circumference, transcerebellar diameter are measured but among all these transcerebellar diameter is most reliable predictor of not only gestational age but also of normal or growth retarded fetuses even more than head circumference because of preferential mechanism of preservation of cerebellar growth relative to other cerebral structures. On the other hand, abdominal circumference is the earliest affected parameter. Many studies have found TCD/AC ratio (transcerebellar diameter and abdominal circumference ratio) as most reliable in prediction of asymmetric intrauterine growth restriction. After 20 weeks increase in this ratio is suspicious and early detector of growth restriction. Many studies have documented transcerebellar diameter (mm) is equivalent to gestational age of fetus.<sup>2</sup> Study done by Faiza Naseem showed transcerebellar diameter normogram predicts gestational age with 94% accuracy in 3<sup>rd</sup> trimester.<sup>4</sup> Fetal transcerebellar diameter is measured by locating cerebellum in posterior fossa by rotating transducer approximately 30° from plane centered at thalami, cavum septum pellucidum, 3<sup>rd</sup> ventricle, cisterna magna anterior horns of lateral ventricle. Calipers are placed at outer margins of visualized cerebellum.<sup>5</sup> Because of above mentioned reason transcerebellar diameter is also important in estimating gestational age in medico legal cases especially criminal abortion, infanticides, born dead, still dead, inheritance and divorce issues.<sup>6</sup> Rationale of our study is to assess accuracy of transcerebellar/abdominal circumference ratio in case of asymmetric intrauterine growth restriction so that it should be used as a routine parameter after 20 weeks gestation as it gives better estimation of gestational age and prediction of growth restriction. Moreover it is cost effective and not even time consuming.

## Aim

To determine the validity of transcerebellar diameter/abdominal circumference ratio as an indicator of intrauterine growth restriction after 20 weeks gestation taking neonatal birth weight as gold standard.

## Material and Methods

A Cross sectional validation study, carried out in of Radiology Department of KRL hospital, Islamabad from January 2018 to July 2018. Study was approved by ethical review committee.

Women between 20 to 35 years, who were sure of LMP dates, Parity <4, beyond 20 weeks of gestation having single non anomalous pregnancy were included in the study. Patients with symmetrical IUGR, multiple gestation, medical disorders like diabetes, PIH, coagulopathy and smoking, history of any drugs intake and increased liquor volume were excluded from study. A total of 285 females fulfilling the selection criteria were enrolled in study from OPD department of Obstetrics and Gynaecology referred to department of Diagnostic Radiology, KRL hospital, Islamabad from 10<sup>th</sup> January 2018 to 10<sup>th</sup> July 2018. Non probability sampling technique was adopted for sampling. Institutional review board (ethical committee) clearance was sought at KRL hospital. Informed consents and demographics (name, age, gestational age, parity) was obtained. All patients underwent 3.5 MHz curved array ultrasound probe for better visualization of fetus. Routine parameters like BPD, AC, FL were measured for assessing gestational age and were correlated to gestational age according to last menstrual cycle. The TCD was obtained by rotating the transducer in axial plane centering on thalamus to



**Figure 1:** Measurement of Transcerebellar diameter TCD, placing the calipers at outer margins of cerebellar hemisphere



**Figure 2:** Measurement of Abdominal circumference (AC)

delineate cerebellar hemisphere. Placing the calipers at outer margins of cerebellar hemisphere TCD and AC obtained at the time of scan was used to provide TCD/AC ratio. Principle researcher under the supervision of classified radiologist took all measurements. Neonatal birth weight taken from record of department of gynecology and obstetrics KRL hospital Islamabad was compared on standard gestational age growth chart keeping it as a gold standard.

## Statistical Analysis

Data was analyzed using SPSS (version 16). Descriptive statistics were used to calculate mean and standard deviation for quantitative variables like age of the patient and gestational age. Frequencies and percentages were presented for qualitative variables like parity. Receiver operating characteristics and likelihood ratio was calculated. Effect modifiers like (gestational age, parity, age) were controlled through stratification. Post stratification diagnostic accuracy was measured. The results of accuracy of TC/AC were compared through 2 x 2 table to calculate sensitivity, specificity, PPV, NPV and diagnostic accuracy.

## Results

Age range in this study was from 20 to 35 years with mean age of  $28 \pm 2.89$  years and mean gestational age was  $29.547 \pm 3.41$  weeks.

Frequency and percentage of patients as per parity are shown in (Tab.1).

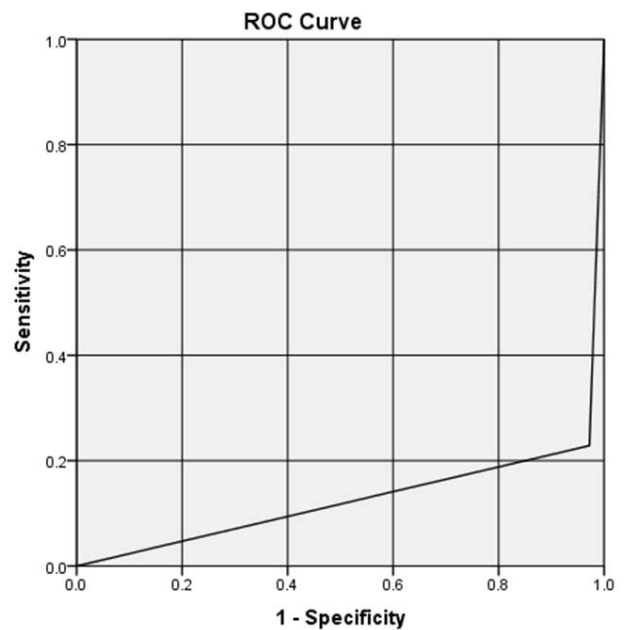
Parity	No. of patients	% age
0	113	39.6%
1	117	41.1%
2	23	8.1%
3	32	11.2%
Total	285	100%

**Table 1:** Frequency and percentage of patients as per parity

TCD/AC ratio detected IUGR in 11.9% patients and at birth it was 12.3%

TCD/AC ratio has shown sensitivity of 77.1%, specificity 97.2%, diagnostic accuracy by 95%, PPV 79.41%, NPV 96.81%, Likelihood ration LR positive 27.5 and LR negative was 0.23 ( $p=0.000$ ) in diagnosis of IUGR.

ROC curve is shown in graph in (Fig.1).



**Figure 3:** ROC CURVE OF SPECIFICITY AND SENSITIVITY

Stratification with respect to age, gestational age and parity of TCD/AC ratio versus IUGR at birth was studied.

For age group 20-27 years, Sensitivity was 11%, Specificity: 86%, DA=49%, PPV=44%, NPV=49.1%, LR+= 0.78, LR-=1.03

for age group 28-35years, Sensitivity was 12.4%, Specificity: 88.6%, DA=51%, PPV=52.2%, NPV=50.3%, LR+= 1.09, LR-=0.98

In patients with gestational age 21-20 weeks, TCD/AC ratio had Sensitivity: 12.4%, Specificity: 87.5%, DA=50%, PPV=50%, NPV=50%, LR+= 1.00, LR-= 1.00

In patients with gestation >30weeks, TCD/AC ratio had Sensitivity: 11%, Specificity: 88%, DA=50%, PPV=47.8%, NPV=49.7%, LR+= 0.91, LR-= 1.01.

In patients with parity from 0-2, TCD/AC ratio had Sensitivity of 11.4%, Specificity: 88.1%, DA=50%, PPV=49.1%, NPV=49.8%, LR+= 1.00, LR-= 0.89.

In patients with parity more than 2, TCD/AC ratio had Sensitivity: 15.6%, Specificity: 84.3%, DA=50%, PPV=50%, NPV=50%, LR+= 1.00, LR-= 1.00

## Discussion

The trans cerebellar diameter (TCD) is a measurement in posterior cranial fossa which is relatively resistant to external compression due to its strong bony walls. It is also less affected than the head circumference suggesting a preferential mechanism in the preservation of cerebellar growth relative to other cerebral structures.<sup>7</sup> In view of this fact sonographic measurement of TCD serves as an independent and reliable correlate of gestational age (GA) against which potential deviations of growth may be compared.<sup>8</sup> In a normally developing fetus the TCD increases with advancing gestational age. Several studies demonstrated good correlation between TCD and AC.<sup>9</sup> Many studies have shown that TCD/AC ratio is a stable, gestational age independent parameter after 20 weeks of gestation.<sup>10,11</sup> Increased TCD/AC values are suspicious of fetal growth restriction<sup>12</sup> and may be useful in the early detection of fetal IUGR. It can be used to calculate gestational age in IUGR cases with better accuracy.<sup>13,14</sup>

In my study TCD/AC ratio has shown sensitivity of 77.1%, specificity 97.2%, diagnostic accuracy by 95%, PPV 79.41%, NPV 96.81%, LR positive 27.5 and LR negative was 0.23 ( $p=0.000$ ) in diagnosis of IUGR.

Bansal M et al., in their study involving 650 pregnant patients between 14 to 40 weeks, found TCD (mm) equivalent to GA of fetus. The Karl Pearson correlation coefficient between GA & TCD was 0.972305 with p-value of <0.001 (highly significant). Linear relationship of TCD was observed with advancing GA in both normal and IUGR pregnancies.<sup>15</sup> Sharma C et al., conducted a prospective study on 100 normal and 52 IUGR cases where TCD was correlated with other parameters. This revealed significant correlation between TCD and period of gestation with a correlation coefficient of +.9612. In normal pregnancies, GA predicted by all parameters was within normal range. In IUGR pregnancies all parameters including BPD, HC & FL were showing disparity of > 3 weeks except TCD which in both groups were nearer to GA.<sup>16</sup> Bansal M et al. and Sharma C et al was different from ours as they correlated previously used fetal growth parameters, they did not correlate TCD/ AC ratio with fetal growth while in our study relationship of TCD/ AC with fetal growth was observed.

Benson et al., and Divon WJ et al., in their studies have shown good diagnostic validities for HC/AC ratio in predicting asymmetric IUGR,<sup>17,18</sup> while in our study TCD/ AC was used in place of HC/AC in predicting the asymmetric IUGR.

Our study was in agreement with the conclusion of the study done by Meyer WJ et al., studied 825 low-risk obstetric patients and 250 patients having risk factors for growth retardation ( $n = 158$ ) and showed that fetal TCD/AC ratio to be an accurate, gestational age-ratios. The ratios of 34 fetuses with IUGR and 28 macrosomic fetuses to the control group were compared and it was found that, of the three ratios that were investigated, AC/TCD was the most efficacious.<sup>19</sup> However this study did not calculate diagnostic accuracy of TCD/AC ratio for IUGR determination which was mentioned in our study.

Cabbad M et al., in another 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, identifying almost all IUGR fetuses with a sensitivity of 95.6% and specificity of 96.3%. In contrast, the HC/AC ratio remained normal in more than 50% fetuses.<sup>20</sup> Although this study was carried out on suspected cases in contradiction to our study was carried out on general

population however, results are supporting each other.

Sensitivity, specificity, PPV, NOV and diagnostic accuracy of present study were correlating well with previous study carried by Bhimarao et al,<sup>21</sup> although the reference study assessed TCD/AC vs HC/ AC ratio and found TCD/ AC relatively superior in predicating IUGR.

## Conclusion

In conclusion, TCD/AC ratio is a reliable parameter for detecting IUGR with good diagnostic accuracy.

### LIMITATIONS AND FUTURE DIRECTIONS:

Although TCD/AC ratio can be superior to other used parameters for IUGR assessment , it is tedious method and is not readily available in USG machines, hence has to be manually calculated, more studies are needed on larger population for its validity.

**Conflict of Interest:** None

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