ORIGINAL ARTICLE

ANNALS OF PUNJAB MEDICAL COLLEGE

Diagnostic Accuracy of Ratio of Transverse Cerebellar Diameter to Abdominal Circumference (TCD/AC) for Detection of Asymmetrical Intrauterine Growth Retardation

Sumera Bacha[1], Um-E-Kalsoom[2], Riffat Murtaza[3], Farkhanda Jabeen[4], Maliha Baseer[5], Hira Khan[6]

1 *Consultant Radiologist, Department of Radiology, Holy Family Hospital, Rawalpindi Pakistan*
Manuscript writing, Data collection

2 *Assistant Professor, Department of Radiology, Rawalpindi Medical University, Rawalpindi Pakistan*
Manuscript writing

3 *Senior Medical Officer, Divisional head Quarter, Mirpur Azad Kashmir Pakistan*
Data collection

4 *Consultant Radiologist, Federal Government Poly Clinic Islamabad, Islamabad Pakistan*
Statistical analysis

5 *Associate Radiologist, Federal Government Poly Clinic Islamabad, Pakistan*
Data interpretation

6 *Consultant Radiologist, Department of Radiology, Islamabad Diagnostic Centre, Pakistan*
Helped in discussion writing

CORRESPONDING AUTHOR
Dr. Sumera Bacha
Consultant Radiologist, Department of Radiology, Holy Family Hospital, Rawalpindi Pakistan
Email: sumerabacha@gmail.com

Submitted for Publication: 12-10-2022
Accepted for Publication 18-06-2023

How to Cite: Bacha S, Kalsoom U, Murtaza R, Jabeen F, Baseer M, Khan H. Diagnostic Accuracy of Ratio of Transverse Cerebellar Diameter to Abdominal Circumference (TCD/AC) for Detection of Asymmetrical Intrauterine Growth Retardation. APMC 2023;17(2):232-235. **DOI: 10.29054/APMC/2023.1264**

ABSTRACT

Background: Intrauterine growth restriction (IUGR) is defined as a fetus whose estimated weight is below the 10th percentile for its gestational age. Literature has reported that TCD/AC ratio is more sensitive and specific in diagnosis of IUGR as compared to other parameters. This may be helpful in early prediction of IUGR and cases can be managed on early stages and neonatal/perinatal deaths can be prevented. **Objective:** To determine the diagnostic accuracy of transverse cerebellar diameter/abdominal circumference (TCD/AC) ratio for detection of intrauterine growth retardation (IUGR) taking postnatal diagnosis of IUGR as gold standard. **Study Design:** Descriptive cross-sectional study. **Settings:** Six months (August 2017 to February 2018). **Duration:** Department of Radiology, Holy Family Hospital, Rawalpindi Pakistan. **Methods:** Female patients between age 20 to 40 years and with gestational age >28 weeks and clinically suspected for IUGR were selected for study. Patients underwent ultrasound scan. TCD measurement was obtained by placing the electronic calipers at the outer-to-outer margins of the cerebellum. The AC was measured from a trans axial view of the abdomen at the level of the junction of the umbilical vein with the left portal vein. The measurements were made along the outer perimeter of the abdomen. TCD/AC ratios were calculated. TCD/AC ratio > 0.154 was considered as positive and ≤ 0.154 was considered negative. After TCD/AC measurement, the patients were followed-up till delivery and assessed for IUGR. All the information was collected via self-designed study proforma. SPSS version 26 was used for statistical analysis. **Results:** In this study involving 135 female patients with clinical suspicion of intrauterine growth restriction (IUGR), the average age was 30.3 years, and the mean gestational age was 32.8 weeks. Ultrasound findings indicated that 62.2% of the patients showed positive signs of IUGR. Postnatally, IUGR was confirmed in 63.7% of cases. Study's results revealed a sensitivity of 83.7%, indicating the ratio of correctly identified cases of IUGR, and a specificity of 75.5%. Additionally, the positive predictive value (PPV) 85.7% and the overall diagnostic accuracy was 80.7%. **Conclusion:** Ultrasonography measurements of TCD/AC ratios allows non- invasive detection of IUGR in second and third trimester of pregnancy with good accuracy.

Keywords: *IUGR, TCD/AC, Ultrasound.*

INTRODUCTION

Asymptomatic intrauterine growth restriction (IUGR) is a condition that occurs during pregnancy in which a developing fetus experiences restricted growth without displaying noticeable signs or symptoms. Approximately 28% of pregnancies experience intrauterine growth restriction (IUGR). IUGR is associated with a higher likelihood of fetal mortality and morbidity and plays a role in the developmental origins of health and disease.[1] The neurodevelopmental prognosis for children born

following asymmetrical intrauterine growth restriction (IUGR) is significantly compromised in many instances.[2] It is essential to give particular consideration to the long-term implications of IUGR, as these can result in diminished cognitive and language skills, learning challenges, and lower academic achievement levels.[2] In Pakistan, approximately 25% of pregnancies are affected by intrauterine growth restriction (IUGR).[3,4] Intrauterine growth restriction can arise from various factors, including maternal, placental, fetal, or genetic causes, and can also result from a combination of these factors. Approximately 70% of women experiencing early fetal growth restriction (FGR) will go on to develop hypertensive pregnancy disorders, primarily pre-eclampsia.[5] Precise identification of the IUGR-affected fetus enables the attending obstetrician to intervene promptly, leading to improved prenatal care and a reduction in delivery-related complications.[6] Proper fetal growth and development depend on the unimpeded flow of oxygen and nutrients from the maternal circulation through normal uteroplacental and fetoplacental circulation.[6] Several diagnostic modalities and techniques are employed to identify this condition.

Intrauterine Growth Restriction (IUGR) is determined when the ultrasound-estimated fetal weight falls below the 10th percentile for the corresponding gestational age.[7] A diagnosis of IUGR indicates an abnormal growth restriction that leads to reduced fetal weight.[7,8] Ultrasound serves as a dependable method for assessing both typical fetal growth and Intrauterine Growth Restriction (IUGR). It involves measuring various fetal parameters, including head dimensions like Biparietal Diameter and Transcerebellar Diameter (TCD), body measurements such as Abdominal Circumference (AC), and limb measurements like Femur Length.[9,10] The sonographic fetal TCD/AC ratio, which isn't reliant on gestational age, can prove valuable in the prenatal identification of IUGR, particularly in pregnancies where gestational age is uncertain.[11] The existing literature on the diagnostic accuracy of the ratio of Transverse Cerebellar Diameter to Abdominal Circumference (TCD/AC) for detecting asymmetrical intrauterine growth retardation (IUGR) is limited specially at local level. However, this study aimed to explore the diagnostic accuracy of transverse cerebellar diameter/abdominal circumference (TCD/AC) ratio for detection of intrauterine growth retardation (IUGR) taking postnatal diagnosis of IUGR as gold standard.

METHODS

A descriptive cross-sectional study was done at department of Radiology, Holy Family Hospital, Rawalpindi. Study was done during a period of six months from (August 2017 to February 2018). All the female patients between age 20 to 40 years and with gestational age >28 weeks, booked cases, clinically suspected IUGR (low maternal weight gain (<6 kg from baseline) oligohydramnios AFI <5cm) were included. Women with multiple gestations (twin pregnancy), fetal death or anomalies, poor imaging of TCD or AC and females with PIH (BP≥ 140/90 mmHg) or GDM (BSR≥ 186mg/dl) were excluded. After taking demographic information and informed consent, patients underwent ultrasound scan by using a real-time. 3.5-MHz curvilinear scan model 680EX: Aloka, Tokyo, Japan by a single radiologist. A cerebellar image was obtained by identifying the plane of the thalami and third ventricle, and then slightly rotating the transducer below the thalamic plane to reveal the butterfly-like appearance of cerebellum in the posterior fossa. A TCD measurement was obtained by placing the electronic calipers at the outer-to-outer margins of the cerebellum. The AC was measured from a trans axial view of the abdomen at the level of the junction of the umbilical vein with the left portal vein. The measurements were made along the outer perimeter of the abdomen. TCD/AC ratios were calculated. TCD/AC ratio was considered as positive (IUGR) if ratio was > 0.154 and if TCD/AC ratio ≤ 0.154 then it was considered negative. After TCD/AC measurement, the patients were followed-up till delivery. After delivery, neonates were assessed for IUGR and results were compared with results of TCD/AC ratio. All the information was collected via self-designed study proforma. SPSS version 26 was used for statistical analysis.

RESULTS

A total of one hundred and thirty-five female patients with clinically suspicion of IUGR were studied. Their mean age was 30.3 ± 3.9 years and mean gestational age was 32.8 ± 2.2 weeks. There were 21.5% females were nulliparous and 78.5% were multiparous. Table.1

According to the ultrasound findings, 62.2% of patients displayed positive indications of IUGR, while 37.8% did not. Postnatally, IUGR was confirmed in 63.7% of cases and ruled out in 36.3% of cases. Our study results showed that sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 83.7%, 75.5%, 85.7%, 72.5% and 80.7% respectively. Likelihood ratio was calculated as 3.42, as shown in table 2.

Table 1: Descriptive statistics of demographic profile of study population n=135

Variables		Statistics	
Age		30.0 ± 3.9 years	
Gestational age (weeks)		32.8 ± 2.2 weeks	
Parity	**Nulliparous**	29	21.5%
	Multiparous	106	78.5%

Figure 1: Ultrasonography results (TCDA/AC ratio) n=135

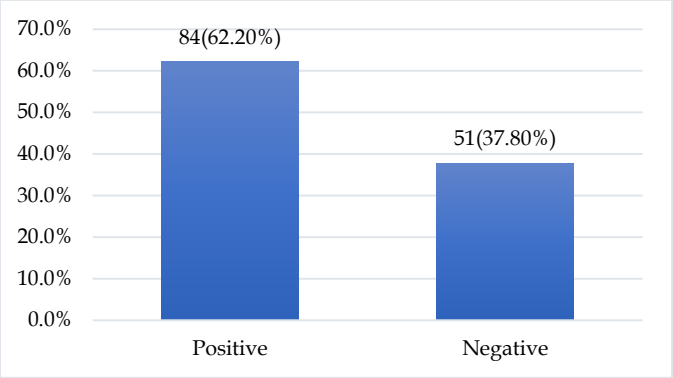

Figure 2: Frequency of post-natal IUGR (n=135)

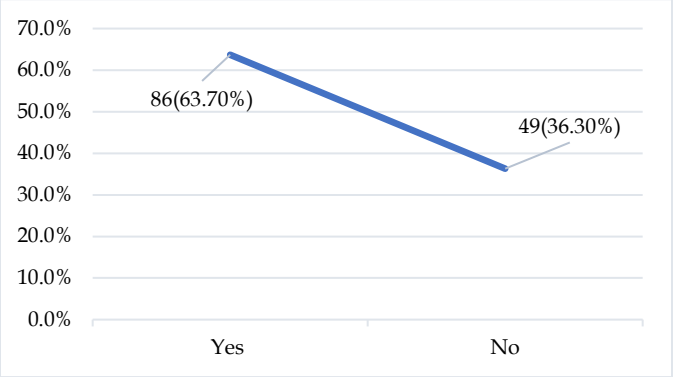

Table 2: Cross-tabulation and postnatal results n=135

Postnatal IUGR			
Ultrasound (TCD/AC)	**Present**	**Absent**	**Total**
Positive	72 (True positives)	12 (False positives)	84
Negative	14 (False negatives)	37 (True negative)	51
Total	86	49	135

***Sensitivity** = 83.7%, **specificity** = 75.5%, **PPV** = 85.7%, **NPV** = 72.5%, **over all Accuracy** = 80.7%. **Likelihood ratio**: 3.42*

DISCUSSION

Intrauterine Growth Retardation (IUGR) is a condition in which a fetus fails to achieve its expected growth potential during pregnancy. Detecting IUGR is critical for timely intervention and optimizing fetal outcomes. The effectiveness of using the ratio between the transverse cerebellar diameter and abdominal circumference (TCD/AC) to detect intrauterine growth retardation (IUGR) is being assessed among clinically suspected patients, with postnatal diagnosis of IUGR as the standard for comparison. In this study according to the ultrasound findings, 62.2% of patients showed signs of IUGR, and 37.8% did not. After birth, IUGR was confirmed in 63.7% of cases and ruled out in 36.3%. Specifically, when assessing its ability to identify cases of IUGR, TCD/AC displayed a sensitivity of 83.7%, which indicates that the ratio was successful in correctly flagging IUGR in a substantial 83.7% of instances where the condition was genuinely present, followed by

specificity at 75.5%, positive predictive value at 85.7%, negative predictive value at 72.5%, and overall accuracy at 80.7%. Our findings were supported by Ashfaq N *et al*[9] as TCD/AC ratio showed sensitivity 85.29%, 91.3% specificity, 87.88% PPV, 89.36% NPV and 88.75% diagnostic accuracy in the detection of IUGR. El Nafrawy MA *et al*[12] reported that TCD/AC demonstrated statistical significance when using a cutoff threshold of 13.2 for the prediction of IUGR. It achieved a high sensitivity of 97.3%, 86.5% specificity, 63.3% PPV and 99.3% NPV. Roy J *et al*[13] reported that TCD/AC achieves a sensitivity of 100% when predicting IUGR, indicating its ability to correctly identify IUGR in all cases where it is truly present with specificity 80.95%.

In this study patient's mean age was 30.3 ± 3.9 years and mean gestational age was 32.8 ± 2.2 weeks, along with 21.5% females were nulliparous and 78.5% were multiparous. These findings were corelated by the Naeem MA *et al*[14] as overall average age of women was 28.69 ± 4.46 years and average gestational age was 35.29 ± 2.50 weeks. Usman M *et al*[15] found average age 25.15 ± 3.49 years among women with IUGR, additionally 63% women were nulliparous, 35% were primiparous, and 2.6% were multiparous. In the study by Ashfaq N *et al*[9] also found consisting findings as patients average age was 28.61 ± 5.72 years and average gestational age was 21.96 ± 1.50 weeks. In the comparison of this study Awan MW *et al*[17] observed that the age of the participants ranged from 20 to 35 years, with an average age of 28.000 years and a standard deviation of 2.89 years and the average gestational age was 29.547 weeks. These are findings closely corelated with our findings. However, like this study they also done diagnostic performance of the TCD/AC ratio for IUGR, which exhibited a sensitivity of 77.1% with higher its specificity 97.2%, followed by overall diagnostic accuracy 95%. Some other studies also found similar findings.[18-20] Findings of current study have important clinical implications, as they suggest that clinicians can use TCD/AC ratios as a non-invasive and cost-effective screening tool to identify IUGR during routine prenatal ultrasound examinations. Early detection of IUGR is crucial for timely intervention and management, as it can help mitigate the potential adverse outcomes associated with this condition, such as preterm birth and neonatal complications. To further establish the utility of TCD/AC ratios in clinical practice, future research should involve larger and more diverse populations, conduct longitudinal analyses, and compare the method with existing diagnostic approaches.

Nevertheless, these results offer a significant step forward in improving the early detection of IUGR, potentially leading to better outcomes for both expectant mothers and their infants.

CONCLUSION

The findings of this study provide compelling evidence that ultrasonography measurements of the transverse cerebellar diameter to abdominal circumference (TCD/AC) ratios can serve as a non-invasive and reliable method for the detection of intrauterine growth restriction (IUGR) during the second and third trimesters of pregnancy. The sensitivity of 83.7% and specificity of 75.5% indicate that this measurement can accurately distinguish between cases of IUGR and non-IUGR pregnancies. Moreover, the overall accuracy of 80.7% further underscore the reliability of TCD/AC ratios as a diagnostic tool for IUGR.

LIMITATIONS

There were no significant limitations in the study.

SUGGESTIONS / RECOMMENDATIONS

To confirm the further effectiveness of TCD/AC ratios in medical practice, future studies should include a wider range of participants, track measurements over time, and should compare it with other valuable diagnostic methods.

CONFLICT OF INTEREST / DISCLOSURE

None.

ACKNOWLEDGEMENTS

The authors want to express their sincere thanks to the hardworking staff and fellows who helped complete this manuscript, and they are especially grateful to the patients who generously took part in the study.

REFERENCES

1. Murmu S, Jaiswal A. A study to Evaluate the Clinical Profiles of Asymmetric and Mixed Types of Intrauterine Growth Retardation. Int J Sci Stud 2019;7(9):5-9
2. Kolundzic Z, Lencek M, Klaric AS. PO-0844 Asymmetrical Intrauterine Growth Restriction And Language: Why Is This Important? Arch Dis Child 2014;99(Suppl 2):A1–A620
3. Mohammad N, Sohaila A, Rabbani U, Ahmed S, Ahmed S, Ali SR. Maternal predictors of intrauterine growth retardation. Journal of the college of physicians and surgeons Pakistan. 2018;28(9):681.
4. Zafar H. Frequency of IUGR in pregnancy induced hypertension. JUMDC 2012; 3:8
5. Lees CC, Stampalija T, Baschat AA, da Silva Costa F, Ferrazzi E, Figueras F, Hecher K, Poon LC, Salomon LJ, Unterscheider J. ISUOG Practice Guidelines: diagnosis and management of small-for-gestational-age fetus and fetal growth restriction. Ultrasound in Obstetrics & Gynecology. 2020;56(2):298-312.
6. Parijatha T, Rao PS, Bharathi PK. Role of doppler ultrasonography in prediction of adverse perinatal outcome in intrauterine growth retardation (IUGR). International Archives of Integrated Medicine. 2022 Feb 1;9(2).
7. Gutaj P, Wender-Ozegowska E. Diagnosis and management of IUGR in pregnancy complicated by type 1 diabetes mellitus. Current diabetes reports. 2016 May;16:1-9.
8. Lausman A, Kingdom J, Gagnon R, Basso M, Bos H, Crane J, et al. Intrauterine growth restriction: screening, diagnosis, and management. J Obstet Gynaecol Can. 2013;35(8):741–57.
9. Ashfaq N, Akram U, Zafar R, Khalid R. Diagnostic Accuracy of TCD/AC Ratio in Predicting Intrauterine Growth Retardation. Pakistan Journal of Medical & Health Sciences. 2022 Apr 29;16(04):124
10. Gull N, Sarfaraz T, IftikharT, Sultana N. Trans cerebellar diameter; abdominal circumference is a reliable parameter for assessment of normal fetal growth. JSOGP 2015;5(4):208-1
11. Silvin Sofhia Mary C. Efficacy of Transcerebellar Diameter/Abdominal Circumference Ratio Versus Head Circumference/Abdominal Circumference Ratio in Prediction of Asymmetrical Intrauterine Growth Retardation (Doctoral dissertation, Thanjavur Medical College, Thanjavur). Int J Reprod Contracept Obstet Gynecol. 2022Sep;11(9):2470-2475
12. El Nafrawy MA, El Mashad AI, Edris YS, Amer WM, Gouda AG. 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. Benha Journal Of Applied Sciences, 2022;10;1-5
13. Roy J, Sanyal P, Saboo V, Saha RG, KA S, Raj R, DuttaRay C. Role of the Ratio of Trans Cerebellar Diameter and Abdominal Circumference in Detecting Asymmetrical Intra Uterine Growth Restriction. Journal of Evolution of Medical and Dental Sciences. 2019;23;30:3858-63.
14. Naeem MA, Rauf H, Aftab SK, Mahrukh F, John A, Kiran W. Prevalence of Intrauterine Growth Retardation on Antenatal Ultrasound Scan in Lahore, Pakistan. Lahore Garrison University Journal of Life Sciences. 2022 Nov 15;6(04):350-9.
15. Usman M, Rajper KZ, Parkash J, Fahim A, Ahmed S, Kumar M. Factors Leading to Intra Uterinegrowth Restriction in Termneonates. Pakistan Journal of Medical & Health Sciences. 2022 Dec 9;16(10):477-.
16. Ashfaq N, Akram U, Zafar R, Khalid R. Diagnostic Accuracy of TCD/AC Ratio in Predicting Intrauterine Growth Retardation. Pakistan Journal of Medical & Health Sciences. 2022 Apr 29;16(04):124.
17. Awan MW, Ahmed F, Ahmad CM. Diagnostic Accuracy of TCD/AC Ratio in Prediction of Asymmetric IUGR After 20 Weeks in Singleton Pregnancy. PJR. 2022 Feb 1;31(4).
18. Agrawal C, Agrawal KK, Gandhi S. Assessment of fetal growth using the ratio of the transverse cerebellar diameter to abdominal circumference. International Journal of Gynecology & Obstetrics. 2016 Oct 1;135(1):33-7.
19. Bhimarao, Nagaraju RM, Bhat V, Gowda PV. Efficacy of transcerebellar diameter/abdominal circumference versus head circumference/abdominal circumference in predicting asymmetric intrauterine growth retardation. Journal of clinical and diagnostic research: JCDR. 2015 Oct;9(10):TC01.
20. El Garhy IT. Transcerebellar Diameter to Abdominal Circumference Ratio in Assessment of Normal Fetal Growth. Al-Azhar International Medical Journal. 2020 Dec 1;1(12):266-71.