# COMPARISON OF TRANS-CEREBELLAR DIAMETER/ABDOMINAL CIRCUMFERENCE RATIO VERSUS HEAD CIRCUMFERENCE/ABDOMINAL CIRCUMFERENCE RATIO AND THEIR OUTCOME IN ASYMMETRICAL INTRAUTERINE GROWTH RETARDATION

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**ABSTRACT :**

**AIM** : To compare the accuracy of TCD/AC ratio with HC/AC ratio in predicting asymmetrical FGR.

**MATERIALS AND METHODS**

**STUDY DESIGN:**

Randamized, Comparative, Open label, Single centre, Prospective Parallel group Study

**STUDY CENTRE:** Department of Obstetrics and Gynaecology in Government Raja Mirasudhar Hospital , Thanjvur medical college , Thanjavur.

**STUDY POPULATION:**

200 antenatal women in two groups (100 as control and 100 as clinically suspected IUGR) was conducted in government Raja Mirasudhar hospital, Thanjvur medical college, Thanjavur during the period of January 2018-December 2018 (12 months)

**CONCLUSION :**

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.

## INTRODUCTION :

A fetus with an estimated weight below the 10 th percentile for a given gestational age is considered to have fetal growth restriction (FGR) also called as intrauterine growth restriction (IUGR). It is estimated that the incidence of fetal growth restriction is 3-10%. The growth potential of the fetus is dictated, on one hand by the fetal genome and on the other hand by the intrauterine environment. The intrauterine environment is under the influence of both maternal and placental factors. Fetal growth restriction is linked to an increased risk perinatal morbidity and mortality. Growth restricted fetuses are more prone to

intrauterine hypoxia / asphyxia. Still birth and hypoxic ischemic encephalopathy (HIE) are more likely to occur in growth restricted fetuses. In addition, it has been also found that these growth restricted infants have increased 1-year infant mortality rate and abnormal neurological development. In order to prevent such mal occurrence during pregnancy clinicians has developed various methods for assessing the fetal growth in utero. Ideal and best investigation that is simple, reliable, accurate , non invasive and safe is prenatal ultrasonography . an accurate determination of gestational age, identification of congenital anomalies , evaluation of fetal growth and assessment of fetal wellbeing and maturity are all possible due to availability of ultrasound. The most commonly used parameters to evaluate fetal growth are biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length(FL). Out of all these parameters best predictor of fetal growth restriction is AC (abdominal circumference). But all these parameters can be correlated if the gestational age is accurately known . But uncertainity of the gestational age makes the differentiation between the appropriate for gestational age and the small for gestational age fetus difficult. Transcerebellar diameter (TCD ) is the maximum transverse diameter of the fetal cerebellum . The fetal cerebellar hemispheres are located in the posterior cranial fossa which is resistant to the external pressure and growth deviations, thus making it a better indicator for the determination of gestational age .Conversely , fetal abdominal circumference (AC) is the earliest affected parameter in the process of impaired fetal growth .Thus , a ratio of TCD/AC which is gestational age independent is very useful in predicting IUGR. Head circumference is another parameter which remain minimally affected by external pressure effects causing deformation of fetal head and by growth alterations. HC/AC ratio is another gestational age independent parameter which may be used in predicting IUGR. Fetal cerebellum can be visualized as early as 10- 11 weeks by USG. From second trimester onwards , it grows with the linear correlation with gestational age .This study was primarily planned to study the efficacy of TCD/ AC ratio and HC/ AC ratio in prediction of asymmetrical IUGR .

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**STUDY PERIOD :**

1 year from January 2018-December 2018

**INCLUSION CRITERIA :**

- Singleton intrauterine pregnancies > 30 weeks
- Cases with clinical suspicion of IUGR a discrepancy of 4 weeks in period of gestation and clinical examination was taken as evidence of IUGR.

**EXCLUSION CRITERIA**:

- Multiple preganancies.
- Poly hydramnios
- Anomalies
- Irregular menstrual periods
- Symmetrical IUGR.

**SAMPLE SIZE :**

200 antenatal women in two groups (100 as control and 100 as clinically suspected IUGR)

**METHODOLOGY:**

Two groups are chosen control group ( contains 100 normal cases ) and study group ( 100 clinically suspected IUGR) . TCD/AC ratio and HC/ AC ratio of normal group are calculated . mean and standard deviation are calculated for the normal group. Then the values of the study group is compared with the normal group . The values more than 2SD are labelled as IUGR (sonographically). Then those clinically suspected IUGR cases are followed upto delivery and post delivery new ballord score and CAN score (clinical assessment of nutritional status at birth) are calculated. Number of ultrasonographically detected IUGR compared with number of true IUGR and accuracy of both TCD/AC ratio and HC/AC ratio is compared.

- True positive values
- False positive values
- sensitivity
- specificity
- positive predictive value
- negative predictive value
- diagnostic accuracy

  above mentioned are calculated and interpretation is done.

PREDICTED MENSTRUAL AGE ACCORDING TO

TRANSVERSE CEREBELLAR DIAMETER MEASUREMENTS

| Cerebellum (mm) | Menstrual Age (Week) | Cerebellum (mm) | Menstrual Age (Week) |
|---|---|---|---|
| 14 | 15.2 | 35 | 29.4 |
| 15 | 15.8 | 36 | 30.0 |
| 16 | 16.5 | 37 | 30.6 |
| 17 | 17.2 | 38 | 31.2 |
| 18 | 17.9 | 39 | 31.8 |
| 19 | 18.6 | 40 | 32.3 |
| 20 | 19.3 | 41 | 32.8 |
| 21 | 20.0 | 42 | 33.4 |
| 22 | 20.7 | 43 | 33.9 |
| 23 | 21.4 | 44 | 34.4 |
| 24 | 22.1 | 45 | 34.8 |
| 25 | 22.8 | 46 | 35.3 |
| 26 | 23.5 | 47 | 35.7 |
| 27 | 24.2 | 48 | 36.1 |
| 28 | 24.9 | 49 | 36.5 |
| 29 | 25.5 | 50 | 36.8 |
| 30 | 26.2 | 51 | 37.2 |
| 31 | 26.9 | 52 | 37.5 |
| 32 | 27.5 | 53 | 38.0 |
| 33 | 28.1 | 54 | 38.3 |
| 34 | 28.8 | 55 | 38.5 |

Plane of measuring transverse cerebellar diameter

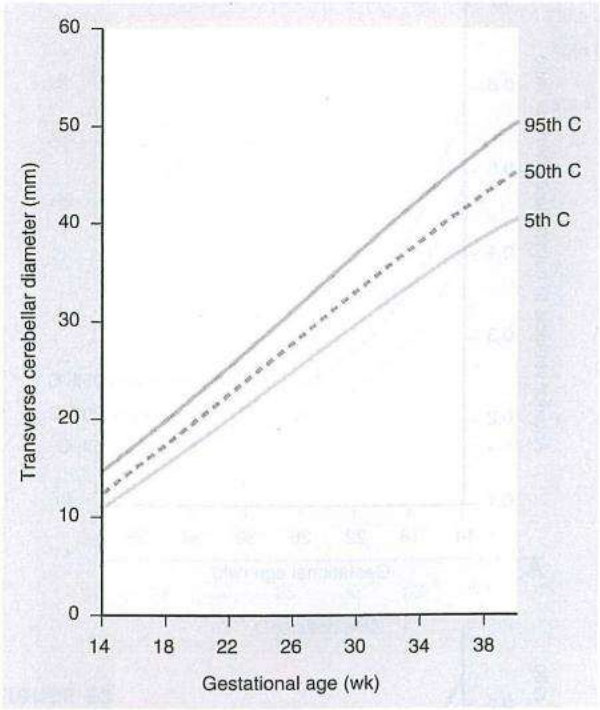

**TCD/AC RATIO**

This ratio compares the most preserved organ in the malnourished fetus, the cerebellum with the most compromised organ, liver, represented by fetal AC. In normally grown fetuses, there is a strong linear correlation with TCD measurement and AC. The TCD/AC ratio remains fairly constant throughout gestation. A value exceeding 2 SD of the mean was significantly associated with birth of small-for-gestational age infant, being abnormal in 98% and 71% of asymmetrically and symmetrically growth-retarded infants respectively[69].

CALCULATION OF THE TCD/AC RATIO%:

TCD/ AC ratio% = TCD in cm /AC in cm x 100

Centile Chart for TCD




Relationship between Birth weight percentile and perinatal mortality and morbidity in SGA

**COMPLICATIONS:**

**Fetal:** (a) Antenatal—Chronic fetal distress, fetal death (b) Intranatal—Hypoxia and acidosis (c) After birth:

Immediate: (1) Asphyxia, bronchopulmonary dysplasia and RDS

(2)Hypoglycemia due to shortage of glycogen reserve in the liver

(3) Meconium aspiration syndrome

(4) Microcoagulation leading to DIC

(5) Hypothermia

(6) Pulmonary haemorrhage

(7) Polycythemia, anemia, thrombocytopenia

(8) Hyperviscositythrombosis

(9) Necrotizing enterocolitis due to reduced intestinal blood flow

(10) Intraventricular hemorrhage

(11) Electrolyte abnormalities, hyper phosphatemia, hypokalemia due to impaired renal function

(12)Multiorgan failure

(13) Increased perinatal morbidity and mortality.

Late: Asymmetrical IUGR babies tend to catch up growth in early infancy. The fetuses are likely to have:

(1) retarded neurological and intellectual development in infancy. The worst prognosis is for IUGR caused by congenital infection, congenital abnormalities and chromosomal defects.

Other long term complications are: (2) Increased risk of metabolic syndrome in adult life: obesity, hypertension, diabetes and coronary heart disease (CHD). (3) LBW infants have

an altered orexigenic mechanism that causes increased appetite and reduced satiety. (4) Reduced number of nephrons—causes renal vascular hypertension.

**Maternal**: Per se fetal growth restriction does not cause any harm to the mother. But underlying disease process like pre-eclampsia, heart disease, malnutrition may be life threatening. Unfortunately for a woman with a growth retarded infant, risk of having another is two fold.

**MORTALITY**: The immediate neonatal mortality is about 6 times more than the normal newborn. However, it is lower than premature AGA infants of the same birth weight. Most of the babies die within 24 hours. The morbidity rate rises about 50 %. They are at higher risk for poor postnatal growth and adverse outcome.

## WHO FETAL GROWTH CHART

| Gestational Age (Weeks) | Estimated Fetal Weight (g) by Percentile | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2.5 | 5 | 10 | 25 | 50 | 75 | 90 | 95 | 97.5 |
| 14 | 70 | 73 | 78 | 83 | 90 | 98 | 104 | 109 | 113 |
| 15 | 89 | 93 | 99 | 106 | 114 | 124 | 132 | 138 | 144 |
| 16 | 113 | 117 | 124 | 133 | 144 | 155 | 166 | 174 | 181 |
| 17 | 141 | 146 | 155 | 166 | 179 | 193 | 207 | 217 | 225 |
| 18 | 174 | 181 | 192 | 206 | 222 | 239 | 255 | 268 | 278 |
| 19 | 214 | 223 | 235 | 252 | 272 | 292 | 313 | 328 | 340 |
| 20 | 260 | 271 | 286 | 307 | 330 | 355 | 380 | 399 | 413 |
| 21 | 314 | 327 | 345 | 370 | 396 | 428 | 458 | 481 | 497 |
| 22 | 375 | 392 | 412 | 443 | 476 | 512 | 548 | 575 | 595 |
| 23 | 445 | 465 | 489 | 525 | 565 | 608 | 650 | 682 | 705 |
| 24 | 523 | 548 | 576 | 618 | 665 | 715 | 765 | 803 | 830 |
| 25 | 611 | 641 | 673 | 723 | 778 | 836 | 894 | 938 | 970 |
| 26 | 707 | 743 | 780 | 838 | 902 | 971 | 1,038 | 1,087 | 1,125 |
| 27 | 813 | 855 | 898 | 964 | 1,039 | 1,118 | 1,196 | 1,251 | 1,295 |
| 28 | 929 | 977 | 1,026 | 1,102 | 1,189 | 1,279 | 1,368 | 1,429 | 1,481 |
| 29 | 1,053 | 1,108 | 1,165 | 1,251 | 1,350 | 1,453 | 1,554 | 1,622 | 1,682 |
| 30 | 1,185 | 1,247 | 1,313 | 1,410 | 1,523 | 1,640 | 1,753 | 1,829 | 1,897 |
| 31 | 1,326 | 1,394 | 1,470 | 1,579 | 1,707 | 1,838 | 1,964 | 2,046 | 2,126 |
| 32 | 1,473 | 1,548 | 1,635 | 1,757 | 1,901 | 2,047 | 2,187 | 2,276 | 2,367 |
| 33 | 1,626 | 1,708 | 1,807 | 1,942 | 2,103 | 2,266 | 2,419 | 2,516 | 2,619 |
| 34 | 1,785 | 1,872 | 1,985 | 2,134 | 2,312 | 2,492 | 2,659 | 2,764 | 2,880 |
| 35 | 1,948 | 2,038 | 2,167 | 2,330 | 2,527 | 2,723 | 2,904 | 3,018 | 3,148 |
| 36 | 2,113 | 2,205 | 2,352 | 2,531 | 2,745 | 2,959 | 3,153 | 3,277 | 3,422 |
| 37 | 2,280 | 2,372 | 2,537 | 2,733 | 2,966 | 3,195 | 3,403 | 3,538 | 3,697 |
| 38 | 2,446 | 2,536 | 2,723 | 2,935 | 3,186 | 3,432 | 3,652 | 3,799 | 3,973 |
| 39 | 2,612 | 2,696 | 2,905 | 3,135 | 3,403 | 3,664 | 3,897 | 4,058 | 4,247 |
| 40 | 2,775 | 2,849 | 3,084 | 3,333 | 3,617 | 3,892 | 4,135 | 4,312 | 4,515 |

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**Table 1.** The Nine signs for CAN Status in the Newborn[4]

| | |
|---|---|
| **Hair** | Large amount, smooth, silky, easily groomed (4).<br>Thinner, some straight, 'staring' hair (3).<br>Still thinner, more straight, 'staring' hair which does not respond to brushing (2).<br>Straight 'staring' hair with depigmented strip (flag sign) (1). |
| **Cheeks** | Progression from full buccal pads and round face (4); to significantly reduced buccal fat with narrow, flat face (1) |
| **Neck and Chin** | Double or triple chin fat fold, neck not evident (4); to thin chin. No fat fold, neck with loose, wrinkled skin, very evident (1). |
| **Arms** | Full, round, cannot elicit 'accordion' folds or lift folds of skin from elbow or tricep area (4); to a striking 'accordion' folding of lower arm, elicited when examiner's thumb and fingers of the left hand grasps the arm just below the elbow of the baby and thumb and fingers of the examiners right hand circling the wrist of the baby are moved towards each other; skin is loose and easily grasped and pulled away from the elbow. |
| **Legs** | Like arms. |
| **Back** | Difficult to grasp and lift skin in the interscapular are (4); to skin loose, easily lifted in a thin fold from the interscapular area (1). |
| **Buttocks** | Full round gluteal fat pads (4); to virtually no evident gluteal fat and skin of the buttocks and upper posterior high loose and deeply wrinkled (1). |
| **Chest** | Full, round, ribs not seen (4); to progressively prominence of the ribs with obvious loss of intercostal tissues (1). |
| **Abdomen** | Full, round, no loose skin (4); to distended or scaphoid, but with very loose skin, easily lifted, wrinkled and 'accordion' folds demonstrable. |

CAN score4 has nine superficial readily detectable signs, which are rated from 1 (worst-severe FM) to 4 (best well-nourished). The highest possible score is 36and lowest possible score is.9 A CAN score of ≤24 was taken as malnourished fetus.

RESULTS

Both groups comprised of 100 patients each between 19 to 36 years of age with mean age of 26.27 years in group A and 26.07 in group B. There was no statistically significant difference in the age between the two groups (p=0.711) (Table 2). The mean BMI in the group B was 28.97 in patients with normal neonatal growth and 28.01 in patients with IUGR. There was significant difference between the two groups in BMI distribution patients with IUGR babies had lower BMI (p=0.0002).

Table 1: Distribution of BMI, age and parity in the group B participants.

| Parity in group B | Normal baby | IUGR baby | Total | P value |
|---|---|---|---|---|
| **Mean age of mothers ± SD (Years)** | 26.27± 3.581 | 26.07± 4.051 | | 0.711 |
| **Mean BMI ± SD (kg/m$^2$)** | 28.97± 1.539 | 28.01± 2.007 | | |
| **Primi** | 14 | 20 | 34 | 0.511 |
| **Second gravida** | 16 | 22 | 38 | 0.456 |
| **Third gravida** | 12 | 16 | 28 | 0.574 |

Out of 100 patients in group B, there were no statistically significant difference between the two subgroups of patients delivering normal growth baby and IUGR baby, with respect to parity (Table 2).

Table 2: Distribution of NICU stay among the study group B.

| Group B | Normal, (n=44) (%) | True IUGR, (n=56) (%) | Significance |
|---|---|---|---|
| **Yes** | 1 (2.27) | 45 (80.36) | P<0.001 |
| **No** | 43 (97.72) | 11(19.64) | |

Out of 46 NICU admissions, 40 had been detected as IUGR by TCD/AC ratio and among the entire fetus detected as IUGR by TCD/AC (n=62), 40 neonates required NICU stay.

Table 3: Predictors of NICU admission.

| TCD/AC | No NICU stay | NICU stay | Total |
|---|---|---|---|
| **IUGR** | 22 | 40 | 62 |
| **No IUGR** | 32 | 6 | 38 |
| **Total** | 54 | 46 | 100 |

Hence, low TCD/AC ratio has relative risk of 4.08 for NICU admission of the neonate (p=0.0003)

In our test group mean APGAR score was 7 at 1 minute and 8 at 5th minute in normal growth group, and 6.6 at 1 minute and 7.8 at 5th minute in IUGR group (Figure 4).

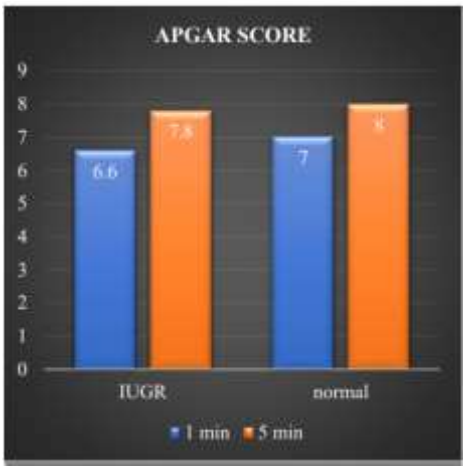

Table 4: Comparison of various parameters of TCD/AC with HC/AC in diagnosing asymmetrical IUGR.

| Parameters | TCD/AC (%) | HC/AC (%) |
|---|---|---|
| **Sensitivity** | 83.93 | 73.21 |
| **Specificity** | 65.91 | 40.91 |
| **PPV** | 75.81 | 61.19 |
| **NPV** | 76.32 | 54.55 |
| **Diagnostic accuracy** | 76 | 59 |

## DISCUSSION

IUGR due to uteroplacental insufficiency or asphyxia leads to centralisation of fetal blood flow with sparing of brain at the expense of other body parts.9 Various primate models have proven that the blood flow to cerebellum is maintained even in acute asphyxia.10 Cerebellum is least affected and TCD remains one of the most reliable parameter for measurement of true gestational age.10,11 IUGR leads to early depletion of hepatic glycogen and subcutaneous fat. This leads to early decrease in AC. 12 Hence, AC is considered sensitive parameter for early detection of IUGR.9,12-14 However, accurate date of LMP or prior 1st trimester dating scan is necessary for prediction of IUGR.13 In this study, the relationship of transverse cerebellar diameter to gestational age was considered in asymmetric IUGR foetuses only. Dhumale et al and Malik et al found that TCD/AC ratio was fairly constant throughout gestation and found it to be good tool to diagnose asymmetric IUGR in those with ratio exceeding 2SDs.15,16 Bansal et al in their study involving 650 pregnant patients between 14 to 40 weeks, found TCD (mm) equivalent to GA of fetus.17 The Karl Pearson correlation coefficient between GA and TCD was 0.972305 with p3 weeks except TCD which in both groups were nearer to GA. Lee et al observed that TCD/AC ratio is fairly constant throughout gestation and found it to be a good biometry to diagnose asymmetric IUGR.19 They also pointed out that this ratio is not sensitive in cases with symmetric growth retardation where both TCD and AC may be equally affected. Benson et al and Divon et al in their studies have shown good diagnostic validities for HC/AC ratio in predicting asymmetric IUGR.20,21 On comparing various parameters of TCD/AC in diagnosing asymmetrical IUGR with other studies, resulted significant relationships between transverse cerebellar diameter and gestational age, AC and HC. The 26% of the small-for-gestational age (SGA) foetuses showed a reduced TCD whereas 82% of them showed raised TCD/AC values and sensitivity of 52% for the detection of intrauterine growth retardation.7,22 The TCD/AC ratio identified growth retardation with a lower sensitivity of 71%, higher specificity 77%, similar positive predictive value of 79% and lower negative predictive value of 68%.23 Dhumale et al have also assessed normal fetal growth with TCD/AC ratio and gestational ratio ranging from 18 to 34 weeks and found to be constant with a mean of 13.56±1.21 (SD).24 The study findings was found to be consistent with the findings of the Meyer et al.25 On comparing various parameters of HC/AC in diagnosing asymmetrical IUGR with various studies like Belizan et al showed elevated cut off values with 82% sensitivity, 94% specificity, 62% positive predictive value and 98% negative predictive value.26 The study findings of PPV was found to be contradictory with the findings of Divon et al, Meyer et al and Kurjak et al with positive predictive values of 67%, 75.6% and 80% respectively.25,27,28

## CONCLUSION

As the TCD/AC ratio is constant throughout the pregnancy, it is a gestational age independent parameter, can diagnose FGR in antenatal women with unknown gestational age. Hence, TCD/AC ratio can be a screening test to diagnose FGR in the antenatal period. So, that early intervention could be attempted to improve the perinatal outcome. However, TCD/AC ratio had a better diagnostic validity and accuracy compared to HC/AC ratio, in predicting asymmetrical IUGR.

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