



Transcerebellar Diameter/Abdominal Circumference Ratio in Normal and Asymmetric Growth Restricted Fetuses: A Cross-sectional Analysis in a Tertiary Care Hospital

Khyati P. Vadera¹ · Chetan M. Mehta¹ · Kartik S. Morjaria² · Arpita Fernandez¹

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Abstract Assessment of correct gestational age (GA) is vital in the management and prognosis of any pregnancy. The cerebellar size tends to remain unaffected or minimally affected in mild and moderate growth restriction. Measurement of fetal transcerebellar diameter is a marker for estimation of GA. In government tertiary care centers, there are a lot of patients who would visit for the first ultrasound in the third trimester wherein there is a wide variation in calculation of GA as per ultrasound parameters. So to assess correct GA and diagnose asymmetric intrauterine growth restriction (IUGR), TCD/AC ratio can be included in routine antenatal scan apart from other parameters used. To evaluate the ratio between transcerebellar diameter (TCD) and abdominal circumference (AC) as a GA independent parameter in this study population in second and third trimester and diagnose asymmetric IUGR of fetuses based on it. This was a cross-sectional study where TCDs and AC of fetuses of 250 pregnancies between 16 and 40 weeks with single fetus were measured and TCD/AC ratios were calculated. In 242 normal fetuses, the ratio was 0.138 (± 0.02) with a standard deviation of 0.010 irrespective of the GA. In eight fetuses in the present study the ratio was more than two standard deviations which indicate asymmetric IUGR. TCD/AC ratio is a reliable GA independent marker to assess growth of the fetuses and for near accurate diagnosis of asymmetric IUGR. The limitation of this study is the short sample size for IUGR fetuses.

Keywords Transcerebellar diameter · Abdominal circumference · Asymmetric IUGR · Gestational age independent · Fetal ultrasound

Introduction

Assessment of correct gestational age (GA) is vital in the evidence-based management of any pregnancy. It is true that Doppler parameters are used for the management of intrauterine growth restricted fetuses, but the prognosis and long-term outcome of catch up growth is better with asymmetric group [1]. Though there is little/no difference in management of symmetric and asymmetric intrauterine growth restriction (IUGR), their classification is important to know the etiology and prognosis. Before the advent of ultrasound, the last menstrual period (LMP) was taken into consideration for calculation of GA. With advent of ultrasound, the crown rump length in first trimester and head circumference in second trimester is taken into consideration for calculating gestational age when LMP is not reliably known. But in government tertiary care centers, there are a lot of patients who would visit for the first ultrasound in the third trimester wherein there is a wide variation in calculation of gestational age as per ultrasound parameters. So the study was designed to assess a marker which would be GA independent and reliably measurable in second and third trimester to assess growth status apart from the most frequently used biometric parameters for the estimation of gestational age i.e. the fetal bi-parietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL).

Since cerebellum lies in the posterior cranial fossa surrounded by the dense petrous ridges and the occipital bone, it can withstand deformation by extrinsic pressure better

✉ Khyati P. Vadera
dr.khyati30@gmail.com

¹ Department of Radiodiagnosis, S.S.G Hospital, Vadodara, Gujarat, India

² Scan Center, Rajkot, Gujarat, India

than the parietal bones. Blood supply from posterior circulation leads to cerebellar sparing effect in growth restriction. Thus, the cerebellar size tends to remain unaffected or minimally affected in mild and moderate growth restriction. Conversely, fetal AC is the earliest affected parameter in the process of impaired fetal growth. The fetal cerebellum can be visualized with ultrasound easily therefore, imaging the posterior fossa is becoming an integral part of many routine fetal sonogram [2, 3]. Transcerebellar diameter (TCD) measurement have been correlated with GA, even in the presence of growth retardation [4] and found it as a better marker for GA estimation as compared to other clinical and biometric parameters [5]. Thus, a ratio of TCD/AC is very useful in predicting growth restriction in fetus.

Materials and Methods

The cross sectional study was done on 250 pregnancies between 16 and 40 weeks having single fetus consulting at Radiology department of SSG hospital (tertiary care hospital) for routine antenatal ultrasound with gestational age confirmed by a reliable LMP and CRL (crown-rump length) by ultrasound examination before 15 weeks of gestation. The TCD and abdominal circumference of fetuses were measured as per ISUOG guidelines [6, 7] by 3.5–5 MHz curvilinear transducer on Esaote my lab 20 ultrasound machine by a single radiologist. TCD was measured between outer margins of the cerebellum in the transcerebellar plane (Fig. 1). AC was measured in

transverse plane by ellipse at level of stomach bubble (Fig. 2).

Results

The mean value of TCD/AC ratio in the present study was 0.1380 and with a standard deviation of 0.0100 i.e., range of TCD/AC ratio in this study is 0.118–0.158 (Table 1). This result is comparable with the study by Jha et al. [8].

A total of eight cases having a TCD/AC ratio more than 0.158, which is above 95th percentile i.e., 2 SD above normal value were labeled as asymmetric IUGR (Table 2), wherein only the AC was affected as per study by R Malik et al. [9].

Doppler of both uterine arteries, umbilical artery, and middle cerebral artery was done in eight fetuses showing abnormal TCD/AC ratio for management of pregnancy. Doppler findings in uterine, umbilical, and middle cerebral arteries were normal in six out of eight cases. In two cases umbilical artery pulsatility index (PI) was more than 95th percentile with cerebro-placental ratio more than 1.

Discussion

The determination of GA is important in obstetrics for management of pregnancy and evaluation of fetal development. Higher perinatal mortality has been reported in patients whose expected date of delivery is not known. An error in the GA estimation can result in iatrogenic

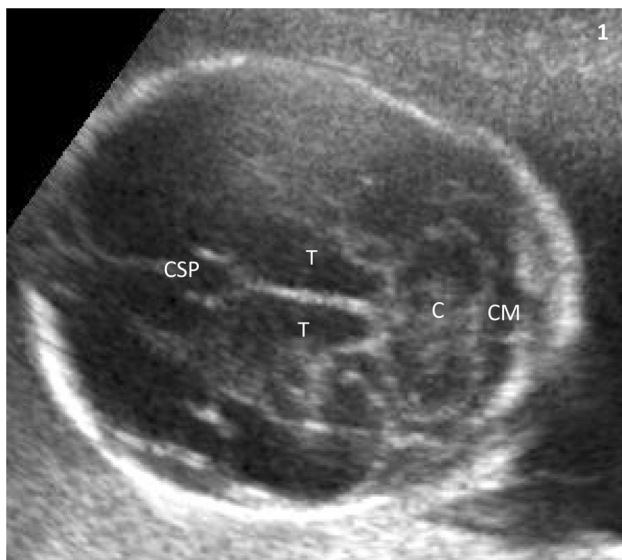


Fig. 1 Transverse plane through bilateral thalami (T) and cavum septum pellucidum (CSP), cerebellum (C) is seen in posterior fossa with cisterna magna (CM) posterior to it

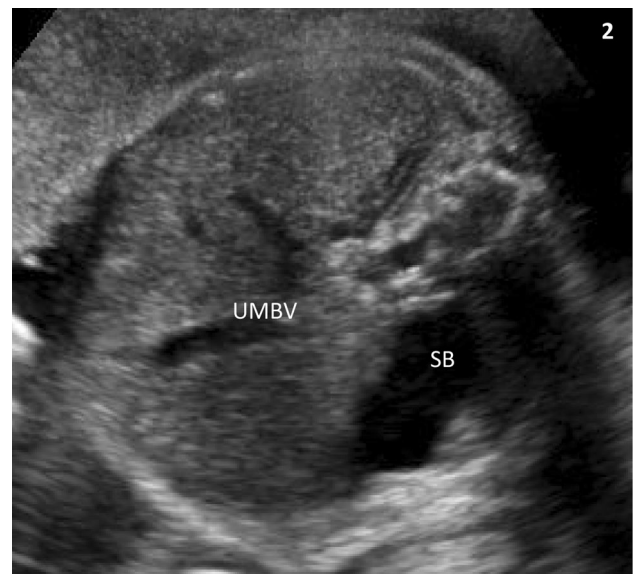


Fig. 2 Transverse plane through stomach bubble (SB), hockey-stick appearance of umbilical vein (UMBV) ideal plane for measuring abdominal circumference

Table 1 No. of patients in each gestational age with measured values of mean TCD, 5th percentile, 50th percentile, and 95th percentile of TCD/AC ratio in 242 normally growing fetuses

Gestational age in weeks	No. of patients	Mean TCD/AC	5th percentile of TCD/AC	50th percentile of TCD/AC	95th percentile of TCD/AC
16	10	0.144	0.136	0.144	0.154
17	10	0.141	0.129	0.141	0.150
18	10	0.144	0.130	0.145	0.155
19	10	0.138	0.126	0.138	0.155
20	10	0.135	0.124	0.134	0.146
21	10	0.133	0.119	0.138	0.143
22	10	0.135	0.123	0.134	0.141
23	10	0.138	0.124	0.134	0.150
24	10	0.140	0.124	0.131	0.146
25	10	0.139	0.127	0.134	0.141
26	10	0.138	0.125	0.137	0.147
27	10	0.140	0.126	0.135	0.152
28	10	0.139	0.126	0.135	0.149
29	10	0.140	0.122	0.135	0.146
30	10	0.139	0.126	0.137	0.153
31	10	0.138	0.123	0.132	0.146
32	9	0.137	0.129	0.140	0.151
33	9	0.139	0.126	0.139	0.146
34	9	0.134	0.126	0.139	0.146
35	9	0.136	0.125	0.142	0.147
36	9	0.138	0.125	0.137	0.146
37	9	0.137	0.130	0.140	0.149
38	9	0.135	0.134	0.137	0.147
39	9	0.137	0.115	0.134	0.157
40	9	0.138	0.123	0.137	0.149

Table 2 No. of patients in each gestational age with measured values of mean TCD/AC ratio in eight asymmetric growth restricted fetuses

Gestational age in weeks	No. of patients	Mean TCD/AC ratio
32	4	18.5
34	2	17
36	2	17.9

prematurity and postmaturity. Extremes of fetal growth contribute disproportionately to overall perinatal and infant morbidity and mortality [10].

TCD is another new and unique parameter, well established in the ultrasound literature as a reliable parameter for estimating the duration of gestation [11] and it is consistently superior in predicting GA in both singleton and twin gestation [12–14]. Nomograms are available for predicting GA from TCD [15] as well as percentile-wise distribution of TCD measurement [16]. Thus, inspite of no linear correlation, we can incorporate the ratios in clinical practice.

Other markers like distal femoral and proximal tibial epiphysis can be used in third trimester GA estimation but distal femoral and proximal tibial epiphysis appeared at a mean gestational age of 34 and 38 weeks, respectively [17] hence, in third trimester patients less than 34 weeks gestation these markers would not be useful.

Measurement of the TCD can be done on most of the fetuses, irrespective of the fetal head shape. In this study, TCD/AC ratio remains almost constant 0.138 ± 0.020 irrespective of GA. Thus, TCD/AC ratio would be an important marker in the assessment of fetal growth and good tool to diagnose asymmetric growth restriction. The limitation of this study is the short sample size for IUGR fetuses.

Conclusion

TCD/AC is a gestational age independent marker to assess fetal growth and correctly diagnose asymmetric growth restriction in fetuses.

It is a marker for the differentiation between asymmetric and symmetric IUGR fetuses which in turn would be helpful to prognosticate the outcomes.

TCD measurement is recommended in the routine second and third trimester as a measure of fetal growth along with the routinely assessed parameters.

Compliance with Ethical Standards

Conflict of interest None.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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