Fetal Transverse Cerebellar Diameter and Abdominal Circumference Ratio in Intrauterine Growth Retardation

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Summary

The present study was undertaken to find out the correlation between transverse cerebellar diameter and abdominal circumference ratio (TCD/AC) and birth weight of the baby in 50 pregnant women with the diagnosis of intrauterine growth retardation. Fifty uncomplicated pregnant women with fetal growth appropriate for gestation were taken as controls. Moderate positive correlation was seen between TCD and period of gestation and AC and period of gestation in both the groups. TCD/AC ratio and period of gestation showed poor correlation. Mean of last TCD/AC ratio in the study group was 15.40 ± 2.1981 and that in the control group 13.09 ± 0.6763. The difference was statistically significant. TCD/AC ratio in the fetuses with birth weight in –1SD group was less (14.88±1.93) than that in the –2SD group (16.41 ± 2.3766). The positive predictive value of TCD/AC ratio in diagnosing intrauterine growth retardation (IUGR) was 92.3% and the negative predictive value was 77.04%. Specificity of TCD/AC ratio in diagnosing IUGR was 94%.

Introduction

Abnormal fetal growth is one of the most important unsolved problems in modern obstetrics. Intrauterine growth retardation (IUGR) is seen in 3-10% of all pregnancies (Divon& Hsu 1992) with 3 times the perinatal morbidity and 8 times the perinatal mortality as compared to the appropriate for gestational counter part (Callan & Witter 1990).

Various ultrasound parameters are used to detect growth abnormality but most of them require exact menstrual dates while others are detected late when IUGR has reached the stage of irreversibility. Few authors have shown that transverse cerebellar diameter and abdominal circumference ratio (TCD/AC ratio) remains constant during the second half of gestation (Campbell et al 1991, Haller et al, 1995). Any value above that constant value was seen to be associated with IUGR.

During hypoxia blood flow to the cerebellum is maintained even after a decrease in blood flow to the cortex (Behman et al, 1970). Therefore the size of the cerebellum and its rate of growth is not compromised in IUGR. On the other hand abdominal circumference is the first parameter to be affected in IUGR (Divon et al 1986). TCD/AC ratio therefore aids in the early diagnosis of IUGR. It is also helpful in detecting fetal growth retardation in individuals without reliable menstrual dates. The present prospective study was undertaken to evaluate the relationship between TCD and AC in known IUGR fetuses in the second half of pregnancy.

Material and Methods

Fifty women admitted to labour room and attending antenatal clinic of the department of Obstetrics and Gynaecology, Nehru Hospital attached to the Postgraduate Institute of Medical Education and

Research, Chandigarh with diagnosis of IUGR were recruited for this study. Diagnosis of IUGR was made by clinical examination (fundal height being four or more weeks less than the period of gestation). An equal number of controls with matched gestation and anthropometric parameters were taken. Ultrasound examination was carried out serially every two weeks till delivery. Subsequently the confirmation of the diagnosis was done by the birth weight of the new born.

Inclusion criteria were, singleton pregnancy and certainty of last menstrual period with regular previous menstrual cycles. Women with mistaken dates, multifetal pregnancy and congenital anomalies of the fetus like hydrocephalous, anencephaly and cerebellar anomalies were excluded.

Detailed history was obtained from each patient with special reference to gestational age, obstetric history, weight gain and pregnancy complications followed by thorough physical and obstetrical examination. All the patients were subjected to ultrasound examination with scanner of 3.5 MHZ Sonoline (SL-2). Transverse cerebellar diameter (Mc Leary et al 1984) abdominal circumference, biparietal diameter (BPD) and head circumference in millimeter along with amniotic fluid index were measured in each case and were repeated every two weeks till delivery.

The cerebellum was visualised in the posterior fossa by slight posterior and inferior rotation of the transducer at the level of BPD. Electronic callipers were used to measure the TCD, in an outer to outer fashion Abdominal circumference was measured at the level of junction of umbilical vein with the following formula.

(D1+D2) x 1.57 = abdominal circumference
D1 – Anterior posterior diameter from outer margins of the abdomen.
D2- Transverse diameter perpendicular to D1

The ratio of TCD and AC was calculated and multiplied by 100. Patients were managed as per the protocol of obstetric and gynaecology department of PGI.

Statistical Analysis

Quantitative variables data were analysed by Student's unpaired 't' test and qualitative variables data were analysed by 'Chi square test' and or by 'regression analysis' as applicable.

Results

The maternal characteristics of the 2 groups are enumerated in the Table-I. All the parameters except maternal weight were comparable in both the groups. The most common mode of delivery in both the groups was vaginal delivery (Table-II). Preterm deliveries were more in the study group. The instrumental deliveries

Table I.
Maternal Characteristics

Maternal Characteristics	Study group N=50 (mean ± 2SD)	Control group n=50 (mean ± 2SD)	p value
Age (years)	26.16 ± 2.999	26.08 ± 2.896	>0.05
Height (cm)	152 ± 5.4772	153.84 ± 4.3395	>0.05
Weight (Kg)	58.46 ± 6.9582	66.26 ± 5.8198	<0.001
Period of gestation (weeks)	33.72 ± 2.5296	33.57 ± 2.5591	>0.05

Table II
Perinatal Outcome

Mode of Delivery	Study Group (N = 50)		Control Group (N=50)	
	n	%	n	%
Vaginal	42	84	44	88
Term	22	44	40	80
Preterm	20	40	4	8
Lower segment Cesarean Section	8	16	6	12
Birth weight of the neonate (kg) (mean + 2SD)	1.72 + 4.089		2.89 ± 0.278*	

* - p < 0.001

were equal in both the groups. The number of caesarean sections was more in the study group (16%) than the control group (12%). The mean birth weight of the babies in the study group was 1.72 ± 0.4809 Kg whereas the birth weight in control group was 2.89 ± 0.278 Kg. This difference was statistically significant.

Ultrasonographic Parameters

In the study group all the 50 cases had the first ultrasound measurement (TCD_1, AC_1). Only 24 of them had second ultrasound measurement (TCD_2, AC_2) since 26 patients had their pregnancies terminated. Out of 24 patients, 11 had third ultrasound examination (TCD_3, AC_3). Only 2 had fourth ultrasound measurement (TCD_4, AC_4). In the control group all 50 cases had first (TCD_1, AC_1) and second (TCD_2, AC_2) ultrasonographic measurement. Only 34 out of 50 had the third ultrasonographic measurement (TCD_3, AC_3). Twelve out of 34 had the fourth examination (TCD_4, AC_4). All these were carried out at the interval of 2 weeks. TCD value in the study group and that in the control group did not show any statistically significant difference (Table III). Abdominal circumference measurement in the control group was more than that in the study group, the difference being statistically significant in all 4 observations ($p<0.01$) (Table IV).

All the readings of TCD/AC ratio in study group were statistically different from those in the control group. The ratio was found to be higher in all the ultrasonographic observtions in study group compared to that in the control group (Table V). These difference were statistically significant. The last TCD/AC ratio

Table III
TCD value : Study and Control Groups

TCD (mm)	n	Study group (mean± SD)	n	Control group (mean ± SD)	t value	p value
TCD_1	50	33.82 ± 4.246	50	33.80 ± 2.9067	0.027	>0.05
TCD_2	24	35.21 ± 4.3035	50	35.90 ± 3.1768	0.779	>0.05
TCD_3	11	35.91 ± 2.9818	34	36.65 ± 2.580	0.794	>0.05
TCD_4	2	35.00 ± 1.4142	12	36.58 ± 1.564	1.335	>0.05

Table IV
AC value study and control groups

AC (mm)	n	Study group (mean ± SD)	n	Control group (mean ± SD)	t value	p value
AC_1	50	224.98 ± 35.4190	50	255.60 ± 28.7261	4.474	< 0.001
AC_2	24	230.86 ± 28.1707	50	274.25 ±23.4836	6.968	< 0.001
AC_3	11	233.50 ± 21.9922	34	282.32 ± 21.3787	6.539	< 0.001
AC_4	2	226.87 ± 1.1102	12	277.89 ± 15.8279	4.408	< 0.01

Table V
TCD/AC Ratio in Study and Control Groups

TCD/AC	n	Study group (mean ± SD)	n	Control group (mean ± SD)	t value	p value
TCD_1/AC_1	50	15.28 ± 2.2674	50	13.31 ± 1.1898	5.456	< 0.001
TCD_2/AC_2	24	15.33 ± 1.4400	50	13.67 ± 2.9930	2.580	< 0.01
TCD_3/AC_3	11	15.45 ± 1.3761	34	13.00 ± 0.6245	8.206	< 0.001
TCD_4/AC_4	2	15.43 ±0.5445	12	13.18 ± 0.5787	5.095	< 0.001

Table VI
Last TCD / AC Ratio

Last TCD/AC	Study group (n=50)	Control group (n=50)	p value
mean + 2SD	15.40 ± 2.1981 14.88 ± 1.9380+ 16.421 ± 2.3766++	13.09 ± 0.6763	< 0.001

+ (TCD/AC ratio in 1SD babies n=33)
++ (TCD/AC ratio in 2SD babies n=17)

within one week before delivery in study group was 15.40 ± 0.6763.

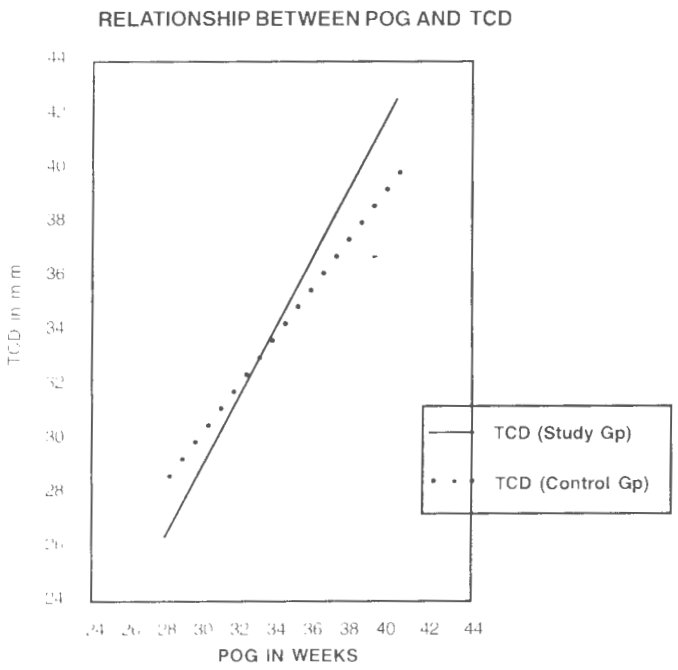

Fig. 1

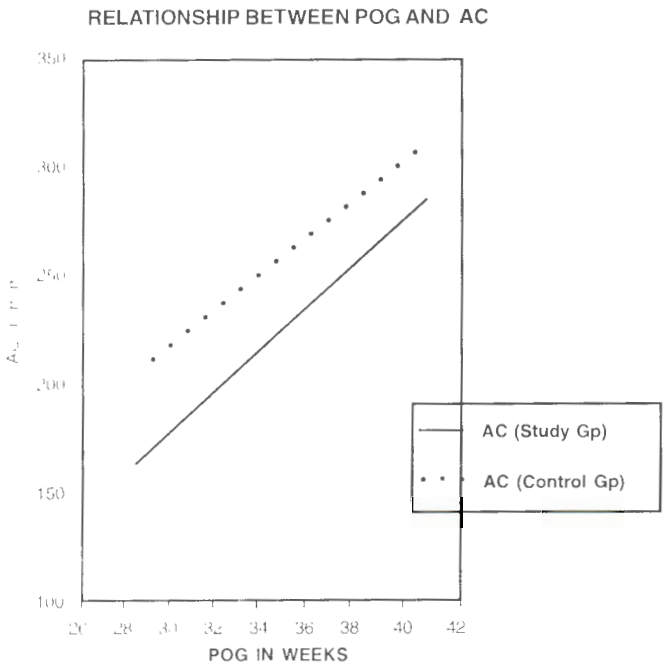

Fig. 2

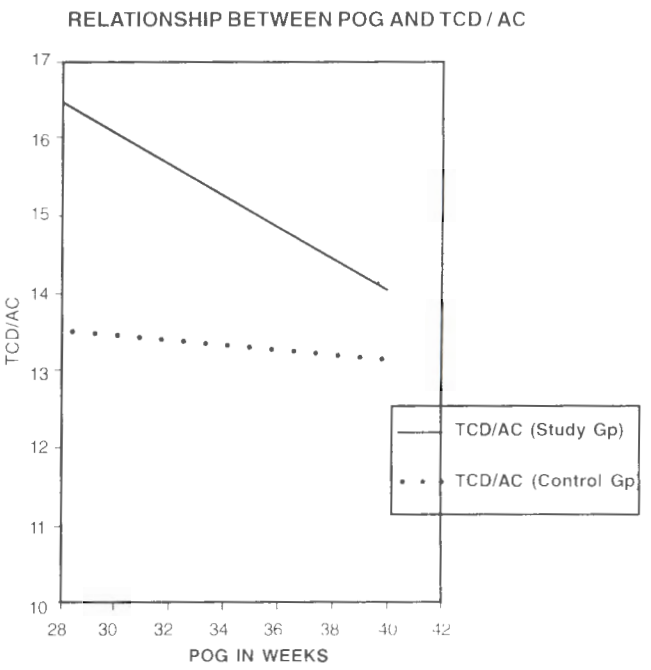

Fig. 3

The last TCD/AC ratio within one week of delivery in the fetuses which were less than -1SD was 14.88 ± 0.9380 and that of -2SD fetuses was 16.46 ± 2.3766. This difference was statistically significant (Table VI). Taking 13.09 ± 0.6763 as constant TCD/AC ratio, 36 out of 50 cases (72%) of IUGR were outside this range. In cases of severe IUGR i.e. birth weight <-2SD, 15 out of 17 cases (88.24%) were outside the +2SD range, whereas in mild IUGR i.e. birth weight <-1SD, 21 of 33 cases (63.64%) were outside +2SD of the mean. Positive correlation was seen between period of gestation and TCD (r=0.77843). This correlation was statistically significant (Fig. 1). Period of gestation and AC had moderately positive correlation with each other (r=0.71386) which was statistically significant (Fig. 2). Negative correlation was seen between TCD/AC ratio and period of gestation but this correlation was not statistically significant (Fig. 3).

Discussion

Prenatal diagnosis of IUGR is of considerable clinical importance because of the high risk of perinatal deaths, intrapartum asphyxia, neonatal complications and long term sequelae that inflict the IUGR infant

Diagnosis of IUGR by ultrasound is of tremendous usefulness to the obstetricians. Because of the unreliable menstural dates, interpretation of many of the ultrasonic parameters become fallacious. Therefore, the need for a diagnostic tool which is gestational age independent is invaluable in the field of obstetrics.

In the present study there was no statistically significant difference in maternal demographic profile like maternal age, height, socioeconomic status and parity between study and control groups. The weight of the patient in the study group (58.46 ± 6.958Kg) was significantly different from that in the control group (66.26 + 5.82 Kg). This is comparable to the study by (Galbraith et al, 1979).

Forty percent of the patients in IUGR group had pregnancy complications compared to none in the control group in the form of pregnancy induced hypertension, chronic hypertension, heart disease, congenital infections, anaemia, ulcerative colitis and bronchial asthma. It is comparable to the study by Mann et al, (1974) who observed that 58% of patients had high risk factors for IUGR.

There was a significant difference in the birth weight of babies in IUGR group (1.72 ± 1.4809 Kg) and in that in the control group (AFD) 2.89 ± 0.278 Kg).

Correlation of the TCD with period of Gestation

Hata et al (1989) measured TCD in 116 women with regular menstrual cycles at 17-40 weeks of gestation. TCD correlated well with gestational age (r=0.96; p< 0.001). TCD in their study was 21.3 mm at 20 weeks of gestation and 49.9 mm at term.

Smith et al (1986) in their study found the value of the TCD to be proportional to the gestational age in weeks. In the present study 50 IUGR and 50 control cases were taken. The study group showed positive correlation between TCD and period of gestation (r=0.7784) which is statistically significant. The control group also showed positive corelation with statistical significance. Therefore, the study shows that TCD increases with POG with moderate positive corelation. (Fig. 1).

Correlation between AC and POG

Steven et al (1986) found abdominal circumference to be more predictive of IUGR than either head circumference or biparietal diameter measured. In this study AC had a positive correlation with POG (r=0.7138, p< 0.05) in study as well as control group (r=0.7263; p< 0.05). The value of AC in study group was however less than that in the control group. (Fig.2).

Correlation of TCD/AC Ratio with the POG

Campbell et al (1991) in their study showed TCD/AC ratio to remain relatively constant throughout gestation, the ratio being 13.7%. In the present study TCD/AC ratio was found to have poor or negative correlation with period of gestation which was not statistically significant. (r=-0.22468; p>0.05). (Fig.3). It remained fairly constant throughout gestation.

Haller et al (1995) found TCD/AC to be greater than 15.5 in 80% of SGA infants when measurement was performed within one week of the delivery. In the present study TCD/AC in IUGR had a mean value of 15.40 ± 2.1981 and the control had TCD/AC value of 13.09 ± 0.6763. The difference between the two was statistically significant. The TCD/AC ratio was more than +2SD above the mean in 36 cases (72%) in IUGR group whereas in only 3 cases (6%) of control group was above +2SD. In the infants with birth weight less than 2SD, 15 out of 17 (88.24%) cases had TCD/AC ratio above the mean +2SD. Therefore, the sensitivity of the TCD/AC ratio in detecting IUGR was 72% if infants with birth weight less than –2SD were taken. Forty seven of 50 control cases had TCD/AC within ± 2SD. Specificity of TCD/AC in diagnosing IUGR in this study was 94%.

Dilmen et al (1996) in their study found sensitivity of TCD/AC in diagnosing IUGR (-2SD) to be 100% and specificity 99.7%. They obtained positive predictive value of 91% and negative predictive value of 100%. In the present study the positive predictive value of TCD/AC ratio in diagnosing IUGR was 92.3% and negative predictive value was 77.04%.

This study concludes that TCD in IUGR shows a positive correlation with period of gestation. It is not affected by IUGR. The TCD/AC ratio remained fairly constant in the pregnancies with IUGR and had a higher value than that in normal umcomplicated pregnancies

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