Original Article

Relevance of Clinical *versus* Ultrasonographic Estimation of Fetal Weight at Term — A Prospective Longitudinal Study

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A facility based prospective longitudinal study was undertaken at B.S. Medical College, Bankura, West Bengal where three hundred admitted mothers selected from a homogenous population of the district having almost similar height and weight and all of them harbouring a singleton pregnancy at term without a risk factor or fetal anomaly had undergone diligent antenatal examination and clinical estimation of fetal weight by tape measurements of fundal heights and abdominal girths and subsequently Estimated Fetal Weights (EFW) were documented by a sonologist by ultrasound measurements with a software. After delivery the newborns were weighed by a Nursing Staff to document Actual Birth Weight (ABW). Overall the mean fetal weight at term antenatally assessed by clinical measurements was 2360 ± 313g; by ultrasonography was 2415.17±314g and the Mean Actual Birth Weight was 2712±172g. The Pearson's Correlation coefficient (r) calculated taking the three sets of values in pairs were 0.816 for clinically assessed EFW Vs ABW; 0.812 for USG assessed EFW *versus* ABW and 0.933 for clinical Vs USG assessed EFW and in all the three comparisons the p values with chi-square 't' test were <0.001 indicating a strong positive statistical correlation among the pairs. When the three sets of values were placed over scatter diagrams with the fit-line drawn over the scattered dots it was found that clinical and USG assessed EFW are in closer positive correlation to ABW when the expected birth weights were in the range of 2000-3000g as compared to below 2000g and above 3000g and both clinically assessed EFW and ultrasound assessed EFW are equally good predictors of ABW among all the groups ranging 1500 to 4000g.

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Estimation of fetal weight has been incorporated into standard Antenatal evaluation. Its importance is emphasized in the management of high risk pregnancies like diabetic mother, vaginal birth after previous caesarean section, intrapartum management of fetuses presenting with breech presentation, suspected fetal growth restriction. EFW helps to decide optimal route of delivery, and level of hospital like Primary, Secondary or a Tertiary maternity care centre where delivery has to occur. A large proportion of perinatal mortality is related to birth weight which remains the single most important parameter that determines neonatal survival[2].

In day to day obstetric practice usually two methods are applied for prediction of Birth weight. Clinical methods based on tactile assessment of fetal size eg. Leopold's maneuvers followed by application of different equations to predict birth weight. The other is ultrasound measurement of fetal parts followed by use of software algorithms using various combinations of fetal parameters like fetal Abdominal Circumference (AC), Femur Length (FL), Biparietal Diameter (BPD), and Head Circumference (HC).

Editor's Comment :

- Antenatal assessment of Fetal Weight calculated from Fundal Height and Abdominal Girth is a valid and reproducible method comparable to sonographic estimates provided the pregnancy is singleton and non-risk.
- Clinical estimates of Fetal Weight during antenatal checkup by tape measurement of Symphysis Fundal Height and abdominal Girth during late third trimester best correlates with Actual Birth Weight when the later is in the range of 2000-3000 g.
- Clinical assessment of Fetal Weight is not a good predictor of actual birth weight when the fetus is small for Gestation age or growth restricted or Macrosomic.

Tactile assessment or palpation of maternal abdomen and thereby third trimester measurement of Fundal height and Abdominal girth despite its regular practice has been criticized by many as subjective and associated with significant predictive error in EFW[2]. However Sherman *et al* while comparing Clinical and Ultrasonic estimation of Fetal weight at Tel Aviv University in Israel had pointed out that before the introduction of ultrasound fetal weight was assessed clinically by external palpation of fetal parts and uterine contour and earlier studies[7,8] showed that 80-85% of

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clinical estimates were within 500 g of the Actual Birth Weight (ABW) and 69% of estimates fell within 10% of ABW. They further said that the accuracy of predicting Birth-weight by a variety of different formulae incorporating different ultrasonic measurements has been studied extensively but no particular formula or biometric measurement had shown a superior accuracy. In general the mean absolute error of sonographically predicted Birth Weight varies between 6 and 12% of Actual Birth Weight and 40-70% of estimates fall within 10% of ABW[5,6].

Levdev[1] had developed a useful table based on linear measurements of the pregnant uterus to estimate fetal weight. He used different correlation factors for different maternal weights as well as periods of gestation and was able to achieve satisfactory results when compared to Actual Birth Weight after delivery. Following his footsteps Dare *et al* in Nigeria in 1988 followed up 498 women at term with measurement of Fundal Height and abdominal girth and found a good correlation between the EFW (3339 ±361g) and the actual birth weight (3230 ±387g) with a co-efficient of correlation 0.742 and total percentage of average-relative error of estimate was only 5.8%[1]. Johnson's formula is another method for estimation of fetal weight in vertex presentation where fetal weight (g)=height of the fundus (n Cm) X 155 n=12 if vertex is above the Ischial spine or n=11 if vertex is below the ischial spine. If the woman weighs more than 91 kg 1 Cm is subtracted from Fundal Height[2].

Today sonographic predictions are based on algorithms[2] using various ther oocombinations of fetal parameters such as abdominal circumference (AC), Femur Length (FL), Biparietal Diameter (BPD), Head Circumference (HC) both singly and in combination. Cambell, Hadlock, Warsof are the three common names in this context. Our institution uses Hadlock 2 (1985): $Log_{10}BW = 1.304 + 0.005251$ (AC) + 0.01938 (FL) 0.00004 (AC X FL).

The advantage of this technique is that it relies on linear and/or planar measurement of in-utero fetal dimensions that are definable objectively and should be reproducible. Early expectation was that this method would provide an objective standard for identifying fetuses of abnormal size for gestational age has been recently undermined by retrospective studies that showed sonographic estimates of fetal weight to be no better than clinical palpation for predicting fetal weight[2].

The current study revisits the utility of a diligent antenatal examination and clinical estimation of fetal weight when the same was challenged by ultrasound measurement with a software estimation of fetal weight done by a separate observer.

Materials and Methods

This is a facility based Prospective Observational Study undertaken at the Department of Obstetrics and Gynaecology, Bankura Sammilani Medical College, West Bengal which is a well known Tertiary Care Centre for maternity. Three hundred women who were admitted for delivery at term were selected for study with their consent. The women were all booked before their 28 wks of gestation and were followed at the Antenatal OPD. The period of study was one and a half year during 2017-18. All women were in between 18 to 45 years of age and permanent inhabitants of this district of Bankura, harbouring a singleton pregnancy without any congenital anomaly and gestational risk factor. For obvious reasons, women with obesity, multifetal pregnancy, Pregnancy Induced Hypertension,H/O Antepartum Hemorrhage, Polyhydramnios, Malpresentations like breech, transverse lie and preterm labour were excluded because Antenatal assessment of fundal height in these cases were likely to pose discrepancies to forecast anything about birth weight.

Clinical estimation of fetal weight was done in antenatal ward using a flexible tape measure calibrated in centimeters. The women emptied her bladder; lied supine; the fundal height was measured from the highest point of the uterine fundus to the midpoint of the upper border of the symphysis pubis. Measurement was made using the reverse-side of the tape up so as to forestall any bias. The Abdominal Circumference (AC) was measured at the level of the umbilicus using the same flexible tape with the reverse side up. The fundal height multiplied by the abdominal girth measurement were expressed in grams as the estimated fetal weight in individual cases (Dares Formula) Dare *et al* 1990.

The ultrasound estimation of fetal weight was done by a trained sonologist at the ultrasound room adjacent to the Antenatal ward on the same day using an abdominal sector 3.5 mHz transducer on the series 7 ultrasound machine. The patient lied in the supine position on the examination couch and the ultrasound transmission gel was poured on her abdomen. A curvilinear probe was used for fetal measured parameters ie, AC, BPD, FL. The AC was measured on a transverse section through a fetal abdomen at the level of the junction of the umbilical vein and left portal vein. The BPD was taken at the level that showed the thalami, the cavum septum pellucidum, the

intrahemispheric fissure and the third ventricle and at a point were the continuous midline echo was broken by the cavum septum pellucidum. The FL was measured by identifying the full length of the femur ; measurement was taken along the axis that showed both the round echogenic cartilaginous femoral head and femoral condyles. The fetal weight was estimated using Hadlock-2 using the observed values of HC, AC, BPD, and FL using computer software that is already installed within the ultrasound machine. The clinical estimation of fetal weight was performed by the authors using Dares formula: Cases were then followed up till delivery. After delivery the newborn was weighed by a nursing staff within 30 minutes using a standard analogue waymaster scale with a zero correction. The clinical and ultrasound estimates of fetal weight and Actual Birth Weight (ABW) of the babies were documented. Obviously the sonologist and Labour room nurse who took the actual birth weight did not have prior knowledge of clinically estimated fetal weight thus reducing the bias.

Analysis of Results

In this study 97.3% mothers were of 18 to 30 years of age and 97.4% had their heights in between 150 to 169 cms ; more than 70% were primigravida and 22.7% were second gravida. All of them were at term and 82.6% had a gestational age of 37 to 40 wks and rest was post dated by one or two weeks.

Table 1 shows the distribution of clinically Estimated Fetal Weight (EFW); ultrasound assessed EFW; and Actual Birth Weight (ABW) where they could be plotted in five different groups eg, 1500-2000g; 2001-2500g ; 2501-3000g ; 3001-3500g ; and 3501-4000g. Where the clinical assessment says 170 fetuses would be in between 2001-2500g, USG says it would be 156 fetuses- so not a big difference; but ABW shows it was only 71, ie, definitely a considerable difference.

Table 1 — *Distribution of Clinical, USG Estimated Fetal Weight and Actual Birth Weight*

EFW (g)	Clinically assessed EFW n=300	USG assessed EFW n=300	Actual Birth Weight n=300
1500 - 2000	35	27	10
2001 - 2500	170	156	71
2501 - 3000	88	107	173
3001 - 3500	07	10	40
3501 - 4000	0	0	06
Mean ± 3SD	2360±313	2415±314	2712±172
Median	2353	2406	2700
Range	1560-3500	1558-3490	1700-3800

In the 2501-3000 g where clinical assessment showed it would be 88 fetuses, USG said it would be 107- again not a big difference but ABW came out to be 173 fetuses indicating a visible underestimation by both clinical and ultrasound assessment. These visible differences with ABW with antenatal EFW was more conspicuous in the groups below 2000g and above 3000g. ie, : 35 *versus* 10 ; 27 *versus* 10 ; and 7 *versus* 40; 10 *versus* 40.

Overall the Mean Fetal Weight at term antenatally assessed by clinical measurements was 2360±313g and by USG was 2415.1±314g and the Mean Actual Birth weight postnatally observed was 2712±172g.

Table 2 shows the three relevant associations where the calculated Pearson's Correlation co-efficient (r) is 0.816 for clinically assessed EFW Vs ABW ; 0.812 for USG assessed EFW Vs ABW and 0.933 for clinical *versus* USG assessed EFW and in all the three comparisons paired chi square P value was < 0.001 indicating significant positive statistical correlations among the pairs.

Figs 1,2,3 are the three relevant scatter diagrams depicting correlations among the three relevant pairs. Fig 1 is for clinically assessed EFW Vs ABW; Fig 2 is for USG assessed EFW Vs ABW and Fig 3 is for clinical Vs USG assessed EFW. Noticeable facts here that firstly the Fit-lines in all these three scatters have a positive angle of slope indicating positive correlation between the parameters plotted over the X and Y axis ie, if the value over the X axis increases the value over the Y axis also increases in almost similar fashion.

Table 2 — *Correlation between EFW and ABW*

	Pearson's Correlation Co-efficient	p value
Clinically assessed EFW *versus* ABW	0.816	<0.001
USG assessed EFW *versus* ABW	0.812	<0.001
Clinical *versus* USG assessed EFW	0.933	<0.001

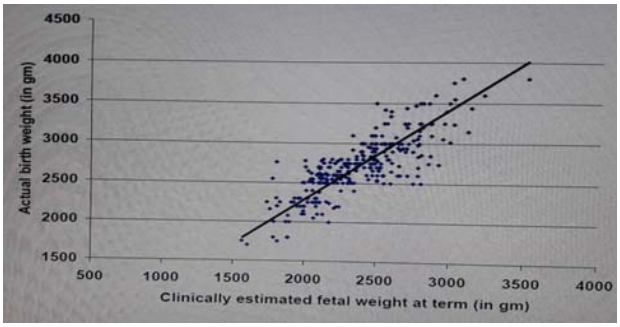

Fig 1 — Correlation of clinically estimated Fetal Weight at term and Actual Birth Weight immediately after delivery

Tab 1 correlation betwn clinlcally estmd fetal wt &abw
Tab 2 corln betwn cli efw & usg efw tab3 corrln betw usg efw & abw at term

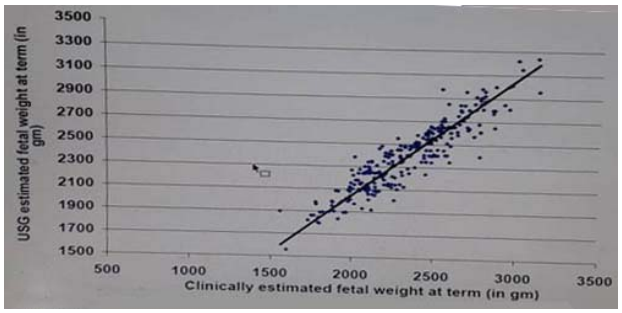

Fig 2 — Correlation between clinically estimated Fetal Weight and Ultrasound Assessed Fetal Weight at term

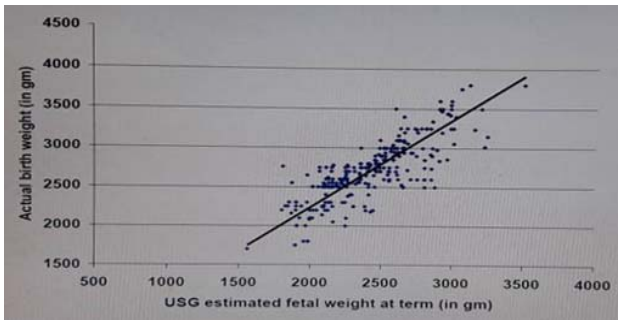

Fig 3 — Correlation between Ultrasound Assessed Fetal Weight at term and Actual Birth Weight immediately after delivery

Secondly there has been a visible crowding of dots around the fit-line in the range of 2000-3000 g in Fig 1 & 2 whereas uniform distribution of dots around the fit-line in all the weight groups can be appreciated in Fig 3 alluding to the fact that clinical and USG assessed are in closer positive correlation to Actual Birth Weight (ABW) when the expected birth weight was in the range of 2000 to 3000g as compared to below 2000g & above 3000g and both clinically assessed EFW and ultrasound assessed EFW are equally good predictors of Actual Birth Weight (ABW) among all the groups of ABW ranging 1500g to 4000g.

Discussion

Estimation of fetal weight is an important aspect of the obstetric management of high risk patients as it helps in decision making during labour to avoid complications. Estimation of fetal weight helps to identify fetuses at risk of intrauterine growth restriction which would need closer labour monitoring as well as a caesarean section in presence of a non-reassuring fetal heart rate pattern. While many obstetricians depend on ultrasound for fetal weight estimation, studies are yet to unequivocally demonstrate a significantly better accuracy for ultrasound estimated fetal weight and clinically estimated fetal weight. Moreover the paucity of ultrasonography in developing countries poses the importance of developing clinical skills for estimation of fetal weight that has been shown to be 70% accurate within 10% of ABW and compares well with ultrasound estimated fetal weight[3].

In the current study most of the participating mothers (>97%) were young (<30yrs); most of them (97%) were of average height (150-169 cms) ; more than 90% were primigravida or a second gravida and all of them were term and inhabitants of the same district – therefore they constitute a homogenous study group. Clinical and ultrasound assessment of their fetal weight correlated reasonably well when compared to Actual Birth Weight after delivery and these correlations were closer when the assessed EFW was in the range of 2000-3000g which happens to be the Actual Birth Weight in more than 80% of cases. Also clinical and ultrasound assessment were found to be statistically no different in making an antenatal forecast of fetal weight. Our correlation co-efficient (r) of 0.816 for clinical assessment and 0.812 for ultrasound assessment of fetal weight when compared to Actual Birth Weight after delivery are comparable to correlation coefficient of 0.742 for clinically assessed EFW by Dare[1] *et al* in 1988 and a correlation coefficient of 0.74 for ultrasonographically estimated Fetal Weight by Akinola *et al* at Nigeria in 2007[2].

The current study indicates that clinical estimation of birth-weight is as good as the ultrasound estimates except for low birth weight babies below 2000g.

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Conflict of Interest : None

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