Original Article:
A Prospective Study on Comparison of Fetal Weight Estimation by Clinical Methods and Ultrasound and its Correlation with True Birth Weight in Term Pregnancies

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Abstract: Background: Estimation of fetal weight is at most important in effective managing of obstetric labour. Ultrasound is a standard technique to measure the weight but there is scarcity of ultrasonography at remote areas. In such situations clinical techniques can be considered for fetal weight calculation. Our study has compared both clinical methods and ultrasonography (USG) and to correlate with true weight at birth. Objective: To compare the fetal weight estimation by clinical methods and ultrasonographic method and its comparison with true birth weight in pregnancy at term. Material and Methods: A diagnostic study (Longitudinal study) was carried out at the Obstetrics and Gynaecology Department at tertiary care hospital to compare the precision of clinical and USG estimation of weight of the fetus with actual birth weight at term. One hundred pregnant women satisfying the criteria were considered and consent for the study were enlisted. Both USG and clinical methods were used. The fetal weight calculated by the above three methods was compared with true birth weight of the baby. Analysis of the precision of the various methods was done. Results: In our study population, the mean age was 25.29±4.45. The average absolute error by EFW (estimated fetal weight)-USG method was least, 117.81g. Among the clinical methods the average absolute error by EFW-Dare's was least i.e. 145.40g. The Correlation Co-efficient was highest with USG method (0.80) of estimation of fetal weight. Among clinical methods, Johnson’s formula had highest R Value of 0.79 followed by Dare’s formula at 0.76. The EFW using both Dare’s formula and Johnson’s formula had an excellent predictive validity in predicting actual weight. The EFW using Johnson’s formula had sensitivity of 76.06% and Dare’s formula had sensitivity of 73.24% in predicting actual weight. The EFW using USG method had highest sensitivity of 80.28%. It was seen in this study that clinical methods can reliably estimate EFW and can be used in settings where USG is not available. Conclusion: Estimation of fetal weight by clinical techniques has a significant role in obstetric labour and delivery. The clinical methods are easy and cost effective and applicable universally in predicting fetal weight. They can be used even by midwives and in remote areas where Ultrasonography is not readily available. It can be used as an integral part in the management of obstetric labour and delivery in remote primary health centres.

Key Words: Estimated fetal birth weight, Johnson's formula, Dare's formula, Hadlock's formula, Ultrasonography.

Introduction:
Precise assessment of the weight of fetus is foremost significance in managing the obstetric labour and delivery of fetus. It helps in preventing complications related with fetal macrosomia and low birth weight, thus helping in reducing perinatal morbidity and mortality[1]. It helps to decide the method of delivery and to anticipate intra natal complications like shoulder dystocia. The estimation of weight of the fetus is also significant in managing preterm birth babies where counselling about prognosis, survival of the baby and NICU management rely on fetal weight[2]. The two primary strategies for anticipating the birth weight in obstetrics are clinical technique [3-5] and ultrasonography technique. Different computations and formulae dependent on estimating fundal height of the uterus above the pubic symphysis are created. In addition to this technique, DARE et al utilized result of Symphysio Fundal Height (SFH) and circumference of abdomen at umbilicus level, estimated in centimetres; the results are converted to grams, the estimation corresponds almost equally with true birth weight[6]. Obstetric ultrasound has indeed changed the information on fetal medicine in the current day with its analytic methodology.
and incredible level of accuracy. But the ultrasonography isn't effectively accessible to all spots practicing obstetrics, especially in remote areas. Assessment of fetal weight utilizing ultrasonography requires proper education, mastery and a costly gear. In such situations clinical techniques assume crucial part in assessing fetal weight and help in obstetric decision making[7].

A couple of studies have concluded about the precision of fetal weight assessment by clinical and ultrasonographic estimations. A few studies concluded that ultrasonography method is superior to all, but some others concluded that both clinical methods and ultrasonography method have similar accuracy in predicting fetal weight.[8-10] Consequently, the aim of our study is to compare the assessment of weight of the fetus by clinical strategies and ultrasonographic strategies and its comparison with true birth weight.

Materials and Methods

Study Design: Diagnostic study (Longitudinal study)

Place of Study: Study was held on the patients in the department of Obstetrics and gynaecology at Dr. D.Y. Patil Medical College, Hospital and Research Center, Pimpri, Pune.

Statistical Analysis: Formula Used: n = P (1-P) Z

Sample Size: The sample size for study was 100.

Period of Study: The study was conducted from August 2019 to September 2021.

The Source for Data Collection: All women during pregnancy who visited labour room in early labour for induction or elective LSCS in the unit of obstetrics gynaecology at our hospital were enrolled in our study.

Informed Consent: Women who presented to labour room in the unit of obstetrics gynaecology at our hospital were evaluated for enlistment in the study utilizing inclusion and exclusion criteria. Informed consent was taken.

Inclusion Criteria:
The following were the inclusion criteria:
1. Age > 18yrs
2. Singleton pregnancy
3. Cephalic presentation
4. Live fetus
5. Known last menstruated period or scan with confirmed expected date of delivery
6. Gestational age > 37 weeks and <42 weeks
7. Admission of participants in early labour or for induction of labour or elective caesarean section within 1 week of admission.

Exclusion Criteria:
The following were the exclusion criteria:
1. Multiple gestation
2. Non Cephalic presentation
3. Anomalous fetus
4. Fetal demise intrauterine
5. Existing uterine fibroid, cyst of ovary.
6. Currently detected liquor irregularities

The informed consent by the women who fulfilled the inclusion criteria for participation in the study was taken. After correction of dextro-rotation of the uterus, the distance between pubic symphysis and xiphisternum was measured with tape in centimetres, maintaining contact with skin. Abdominal girth was measured in centimetres at umbilicus level. The weight of the fetus WAs determined by utilizing Johnson’s formula and Dare’s formula.

This was followed by fetal weight estimation by ultrasonography method. Various measurements used were BPD - distance between two parietal eminences, HC - circumference of the head, AC - circumference of the abdomen, FL - Length of the femur.

The expected fetal weight was obtained by in-built software. The labour was conducted either by vaginal route or delivery by lower segment caesarean section. The true birth weight was calculated by using standard digital weighing machine approved by ISI.

The expected fetal weights by clinical formulae and ultrasound were compared with the actual birth weight. The average error, maximum error, percentage error and standard deviation of estimation of fetal weight in comparison with true birth weight were calculated both for clinical and ultrasound methods.

Data Analysis: Data will be collected using preformed data collection from and case record form and analysed by SPSS software.

Johnson’s Formula: Fetal weight (gm) = 155 × (fundal height - x) × 155, where x =11 at plus station, =12 at zero station = 13 at minus station

Dare’s Formula: Fetal weight (gm) = SFH × AG

Observations and Results

Demographic characteristics: Among the population under study, mean age was 25.29±4.45 years. The mean period of gestation was 38.99±0.92 weeks. The mean symphysio fundal height (SFH) in cm was 31.46±2.1 and the mean abdominal girth in cm was 91.97±3.62.

Mode of Delivery: In terms of mode of delivery, 58 (58%) of mothers underwent normal delivery and 42 (42%) of mothers underwent C-Section

| Table 1: Comparison of Fetal Weight Estimation by Clinical Methods and Ultrasonography with Actual Birth Weight by Paired T Test |
|---|---|---|---|---|
| | (Mean±STD) | Mean Difference | Standard deviation | P-value |
| Actual weight | 2900.9 | | | |
| USG EFW | 2947.01 | -46.110 | 286.04 | 0.008 |
| EFW by Johnson’s formula | 3091.08 | -190.180 | 340.96 | <0.001 |
| EFW by Dare’s formula | 2902.24 | -1.340 | 274.85 | 0.948 |

The calculated mean of actual weight after birth was 2900.9±308.57gms. The mean of estimated fetal weight by ultrasonography was 2947.01±286.04gms. The difference among the estimated fetal weight by ultrasonography method and actual birth weight was significant statistically.

The calculated mean of fetal weight estimation by Dare’s Formula was 2902.24±274.85gms. The difference in between fetal weight estimation by Dare’s formula and true birth weight was statistically not significant.

The calculated mean of estimation of fetal weight by Johnson’s Formula was 3091.08±340.96gms. The difference in between estimated fetal weight by Johnson’s formula and actual weight was found to be statistically significant.(Table 1)

| Table 2: The error of fetal weight estimation (EFW) (Ultrasonography, Dare’s Formula, Johnson’s formula) with actual birth weight (N=100) |
|---|---|---|---|
| | Statistic compared | EFW-Johnson’s | EFW-Dare’s | EFW-USG |
| Mean Absolute Error | 221.48 | 145.40 | 117.81 |
| Mean Absolute Error Percentage | 7.8% | 5% | 4.2% |

The average absolute error in estimated fetal weight by USG was 117.81 g and percentage error were 4.2%. The average absolute error in estimated fetal weight by Dare’s formula was 145.40g and percentage error was 5%. The average absolute error in estimated fetal weight by Johnson’s formula was 221.48g and percentage error was 7.8%. (Table 2)
There was a strong positive relationship between true birth weight and fetal weight estimation by Johnson's formula with correlation coefficient (R) value of 0.79. There was a strong positive relationship between true birth weight and fetal weight estimation by Dare's formula with correlation coefficient (R) value of 0.76. There was a strong positive relationship between true birth weight and fetal weight estimation by ultrasonography method with correlation coefficient (R) value of 0.840 which was highest among the 3 methods. (Table 3)

The estimated fetal weight (EFW) using Johnson's formula had sensitivity of 76.06% and the specificity was 79.31%. The estimated fetal weight (EFW) using Dare's formula had sensitivity of 73.24% and the specificity was 93.10% in predicting actual weight. The sensitivity was more in Johnson's formula followed by Dare's Formula. The fetal weight estimation (EFW) using ultrasonography method had highest sensitivity of 80.28% and the specificity was 100% in predicting actual weight. (Table 4)

**Discussion**

Estimation of fetal weight has become increasingly important for obstetric decision-making regarding induction of labour, evaluation of feto-pelvic disproportion, mode of delivery especially in vaginal birth after C-section (VBAC) and detection of IUGR. The final goal of every obstetrician is to conduct delivery of healthy baby with least maternal morbidity.

During the last decade, calculation of weight of the fetus is practiced as a standard routine in the evaluation of complicated deliveries and high-risk pregnancies. The fetal weight cannot be directly measured. It requires both fetal and maternal anatomical measurements. Most researchers utilized different techniques for the same. Of various methods, clinical and ultrasonographic methods are most commonly used. In the present study we have attempted to compare 2 clinical formulae and ultrasound estimated fetal weight with true birth weight.

The mean age of the population in our study was 25.29±4.45 years. In the present study age group of subjects is comparable to Tiwari and Sood[11], Bhandaryet al[12] study. Age of the subject had no effect in estimating the fetal weight. The mean period of gestation was 38.99±0.92. The mean symphysis fundal height (SFH) in cm was 31.46±2.1 and the mean abdominal girth in cm was 91.97±3.62. The gestational age and SFH of our study are in consonance with Watchree et al study[13]. The measurement of SFH is affected in extremes of birth weight, maternal obesity, abdominal wall edema, liquor volume, lie of the fetus.

The mean of actual weight after birth was 2900.9±308.57gms, the mean of estimated fetal weight by USG method was 2947.01±286.04gms. The difference between estimated fetal weight by USG and actual weight was statistically significant. The mean of estimated fetal weight by Dare's formula was 2902.24 ± 274.85gms. The difference between estimated fetal weight by Dare's formula and actual weight was not statistically significant. It shows that the mean weight by Dare's formula was almost accurate to the actual weight. The mean of estimated fetal weight by Johnson’s formula was 3091.08±340.96gms and the difference between estimated fetal weight by Johnson's formula and actual weight was statistically significant, suggesting that it overestimated the fetal weight. The mean estimated results of Johnson’s formula, Dare's formula and USG in our study are comparable with studies done by Watchreeet al[13] and Aruna et al[14].

The absolute error and percentage error was least for estimated fetal weight by ultrasonography method among all, whereas the absolute error and percentage error was least for Dare’s formula followed by Johnson’s formula among the clinical methods. The results of our studies are in correlation with studies done by Tiwari et al [11] and Shittoo et al [1]. In our study, along with statistical analysis of all methods with true birth weight, we have conducted correlation analysis by Karl Pearsons coefficient (R Value). It was observed that both clinical methods and ultrasonography manifested a strong positive correlation with true weight at birth. The correlation coefficient with true birth weight was accurate in all methods. Among clinical methods, Johnson’s formula had highest R Value of 0.79. The Dare’s formula had R value of 0.76. Our
results of correlation co-efficient are comparable with the studies done by Aruna et al[14].

Estimated fetal weight using Johnson's formula, Dare's formula and ultrasonography method in predicting actual weight was assessed by ROC-receiver operative curve analysis. An ideal ROC curve for the accurate method should rise exponentially and remain aligned along with X Axis. Among clinical methods, fetal weight estimated with both the Dare's formula and Johnson's formula had an excellent predictive validity in predicting actual weight. The area under the curve was higher for Dare's formula of 0.905 than Johnson's formula of 0.865. The area under the curve was highest for estimated fetal weight using USG of 0.950 among all methods.

The sensitivity and specificity of clinical methods were comparable with USG method with Johnson's formula having higher sensitivity and Dare's formula with higher specificity. The estimated fetal weight using clinical methods is as precise as ultrasonographic technique of fetal weight estimation within actual birth weight range. The ultrasound was found to be the most accurate with respect to sensitivity, specificity, positive predictive value, and negative predictive value. The present findings of our study are in consonance with studies done by Bajaj P et al[15] and Roy AJ[16] A et al. Limited research has been conducted in comparing the accuracy of estimation of weight of the fetus by both clinical methods and ultrasonographic methods. After comparing both clinical methods and ultrasonography method in estimating weight of the fetus at term, we found that clinical method of estimation is as accurate as ultrasonographic method. But ultrasonographic method has significant role in estimating fetal weight in above or below the normal range of fetal birth weight. Our study results are in consonance with studies reported byGajendra Singh Tomar[17] et al and Parvathavarthini K[18] et al, that the fetal weight estimation by clinical methods is similar to the ultrasonographic method of fetal weight estimation. Johnson's formula and Dare's formula methods can reliably estimate fetal weight and can be used in settings where USG is not available.

Conclusion

The major conclusion from our prospective study is that the fetal weight estimation by clinical methods is as accurate as ultrasonography used fetal weight estimation within normal birth weight range. The midwives, nursing staff and intern students can be easily trained in using the clinical methods of fetal weight estimation which helps in taking proper decision about the conductance of delivery in obstetrics labour room. They can even refer the complicated case like fetal macrosomia, intra uterine growth restriction for expert care management.

Our study has significant value in developing nations where ultrasonography facility is not readily available, especially in remote areas and primary health centres in peripheries. The clinical methods are simple, easy, cost effective and accurate. They can be used by paramedical staff and midwives.

References