Clinical Estimation of Fetal Weight: An Evaluation of Accuracy and Predictive Value

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Abstract

Objective: To determine the diagnostic accuracy of clinical method in estimating fetal weight at term by taking actual birth weight as reference standard.

Material and Method: This was a cross sectional validation study, conducted in the Department of Obstetrics & Gynaecology, Central Park hospital, between February 2024 to July 2024. Consecutive non-probability sampling technique was used to include term pregnancies after inclusion and exclusion criteria. Demographic profile including age, parity, duration of pregnancy was recorded. Dare's formula was applied for estimation of fetal weight clinically. All data was entered in SPSS version 26 for analysis. A 2x2 table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and accuracy.

Results: Total 225 patients with term pregnancy were included in study. Mean age of patients was 31.44 years with standard deviation of 5.573. Mean gestational age was 37.88 + 0.687 weeks. Mean clinical fetal weight was 2947.55 grams with Standard deviation of 502.232. Mean actual fetal weight was 2978.22 grams with Standard deviation of 506.314. Clinical estimation of fetal weight had sensitivity of 85.3% and specificity of 81.8% in predicting fetal birth weight. Positive predictive value was 93.5% and negative predictive value was 64.3%.

Conclusion: Clinical fetal weight estimation was near to accuracy in pregnant women with normal fetal weight ranges. However, the clinical estimation was significantly low in cases of fetal weight less than 2.5 kg and more than 4 kgs.

Keywords: Actual birth weight, Term Pregnancy, Clinical estimation of fetal weight.

How to cite: Zafar K, Sultana N, Sikandar MZ, Khalid S. Clinical Estimation of Fetal Weight: An Evaluation of Accuracy and Predictive Value. Esculapio - JSIMS 2024;20(04): 520-525

DOI: https://doi.org/10.51273/esc24.251320414

Introduction

Estimation and monitoring of fetal weight are essential components of antenatal care. It has become an important parameter for routine antepartum evaluation of normal as well as high-risk pregnancies. In clinical practice, it is crucial to estimate fetal weight accurately as it provides valuable information for obstetric manage-ment and decision-making.[1] Early obstetric intervention can be planned if the fetuses are correctly categorized into small or large for gestation and it in turn will reduce perinatal mortality and morbidity[2]. In developing count-ries like Pakistan, high perinatal mortality is still a major concern and birth-weight is an important parameter that determines neonatal survival. Therefore, correct fetal weight estimation helps in better management of labor and newborn care is planned accordingly in the neonatal period thus decreasing perinatal morbidity and mortality.[3] The two main methods for estimating fetal weight in current obstetrical practice are: (a) clinical estimation by abdominal palpation and calculating fetal

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Submission Date: 02-09-2024
1st Revision Date: 15-11-2024
Acceptance Date: 13-12-2024

weight based on fundal height and abdominal circumference (b) ultrasonographic method involving measures of fetal skeletal parts and then derive fetal weight by inserting these measures into regression equations.[4] The clinical method typically relies on maternal factors, such as fundal height measurement, symphysis-fundal height, and palpation. These measurements are influenced by various factors, such as maternal body mass index and amniotic fluid volume, which may introduce inherent limitations and potential sources of error.[5] These limitations make it important to critically evaluate the accuracy of the clinical method and its potential impact on obstetric practice.

In Pakistan majority of population is rural while all tertiary care hospitals are in major cities. In remote rural areas of Pakistan, many obstetricians have to rely on clinical estimation for fetal weight assessment as it is economical, less time consuming and handy for those who are already working in least favorable circumstances and packed facilities.[6]

Because of limited resources ultrasound facility could not be available at every clinical setting. Therefore, clinicians have to rely on clinical fetal weight estimation to make decisions regarding mode and time of delivery. Therefore, the objective of this study is to determine the diagnostic accuracy of clinical method in estimating fetal weight at term by taking actual birth weight as reference standard.

Material and Method:

This was a cross sectional validation study, conducted in the Department of Obstetrics & Gynaecology Central Park hospital from February 2023 to July 2023. Ethical approval was taken from institutional review board with IRB number as CPMC/IRB-No/1386A. The sample size was calculated to be 225 by taking the prevalence of normal birth weight as 80%, sensitivity as 78%, specificity as 87%, and confidence interval at 95%. Consecutive non-probability sampling technique was used. The pregnant women between 15-45 years of age, with BMI< $30Kg/m^2$, having singleton pregnancy presented at 38 weeks ± 7 days for planned delivery by either caesarean section or induction of labor were included in the study after taking informed consent. Whereas women with multiple pregnancies, medical disorders like hypertension and diabetes, intrauterine fetal demise, fetus with congenital malformation detected through antenatal ultrasound and pregnancy complications like polyhydramnios, oligohydramnios, ruptured membranes, abnormal lie, and antepartum hemorrhage were excluded from the study.

At the time of admission, the demographic profile including age, parity and gestational age and clinical fetal weight were recorded. For clinical fetal weight estimation, a post graduate registrar of the department took the measurements at two levels by measuring tape. First, Abdominal girth (measurement in centimeters by encircling woman's waist at the level of umbilicus without applying excessive pressure to tighten the tape around abdomen.) was taken at the level of umbilicus and second, fundal height was taken from pubic symphysis up to palpable fundal height. Then both measurements were entered in Dare's formula (Fetal weight in grams = fundal height in cm x abdominal girth in cm) to calculate estimated clinical weight. This weight and demographic profile were recorded on a predesigned proforma. After delivery, another postgraduate registrar of the Department recorded the weight of baby in delivery room or operation theater by means of weighing machine. In order to prevent bias, there were two different proformas to record clinical fetal weight and actual birth weight after delivery and both postgraduate registrars were blinded regarding measurement made by each other.

All data was entered in SPSS version 26 for analysis. Age of the mother, gestational age, clinical fetal weight and actual birth weight were quantitative variables. Mean and standard deviation were calculated for all these variables. A 2×2 table (table1)was used to calculate sensitivity(The sensitivity of clinical estimation of fetal weight is its ability to estimate normal fetal weight), specificity (The specificity of clinical fetal weight estimation is its ability to estimate abnormal fetal weight), positive predictive value (to detect normal fetal weight among all normal fetal weight estimations), negative predictive value (to detect abnormal fetal weight among all abnormal fetal weight estimations) and accuracy as defined below.

True positive (TP): If clinical estimation was within 2500g to 4000g range and actual birth weight was also within the same range then this value was taken as true

positive

False positive (FP): If clinical estimation was within normal range (2500g to 4000g) but the actual birth weight was outside this range then this value was taken as false positive.

True negative (TN): If clinical estimation was outside normal weight range (less than 2500g or more than 4000g) and actual birth weight was also outside the normal range then this was taken as true negative.

False negative (FN): If clinical estimation was outside the normal range (less than 2500g or more than 4000g) but actual birth weight proved to be within normal range this was taken as false negative.

Results

Total of 225 patients fulfilling inclusion and exclusion criteria were included in the study. All the data obtained from patients documented in proformas was entered in SPSS version 26. Results were obtained which have been described in tables and charts.

Descriptive statistics of age of patients showed that mean age of patients was 31.44 years with standard deviation of 5.573. Minimum age of patients included in study was 22 years and maximum age of patients included was 43 years. Descriptive statistics of gestational age of patients showed that out of 225 patients included in study, minimum gestational age was 37 weeks and maximum gestational age was 39 weeks. Mean gestational age was 37.88 + 0.687 weeks. Descriptive statistics of clinical fetal weight of patients depicted that minimum clinical fetal weight of patients was 2200 grams and maximum fetal weight of patients was 4300 grams. Mean clinical fetal weight was 2947.55 grams with Std. deviation of 502.232. Frequency statistics of clinical fetal weight category of patients showed that out of 225 patients 155 patients (69%) had fetal weight in normal category while 70 patients (31%) had fetal weight in abnormal category. (Chart No. 01) Descriptive statistics of actual fetal weight of patients depicted that minimum actual fetal weight of patients was 2100 grams and maximum fetal weight of patients was 4200 grams. Mean actual fetal weight was 2978.22 grams with Std. deviation of 506.314. Frequency statistics of actual fetal weight category of patients showed that out of 225 patients 170 patients (76%) had fetal weight in normal category while 55 patients (24%) had fetal weight in abnormal category. (Chart No. 02) N =225 Sensitivity and specificity were calculated through SPSS. Results were shown in 2x2 table. (Table No. 02) Results showed that 145 patients were true positive, 10 patients were false positive, 25 patients were false negative and 45 patients were true negative. Results showed that clinical estimation of fetal weight had sensitivity of 85.3% and specificity of 81.8% in predicting fetal birth weight. Results obtained also showed that positive predictive value was 93.5% and negative predictive value was 64.2%. Diagnostic accuracy was 84.4%. Positive likelihood ratio determined by formula was 4.49 and negative likelihood ratio was 0.185. (Table No. 03)

Table 1: *Sensitivity and specificity calculation of fetal weight*

		Actual Birth weight in grams		Total
		2500– 4000 (Normal)	<2500 or >4000 (Abnormal)	
Clinical Estimation of Fetal weight in grams	2500-4000 (Normal)	True Positive (TP)	False Positive (FP)	TP+FP
	<2500 or >4000 (Abnormal)	False Negative (FN)	True Negative (TN)	FN+TN
	Total	TP+FN	TN+FP	

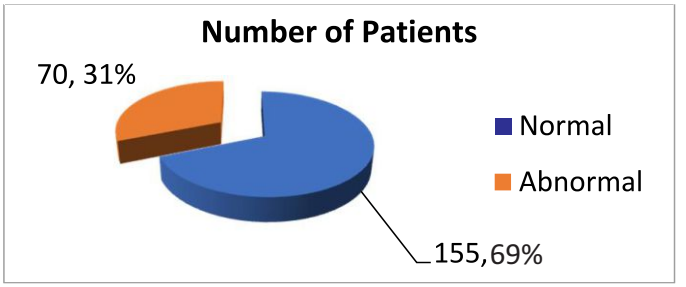

Fig-1: *Frequency Statistics of Clinical Fetal weight category of patients*

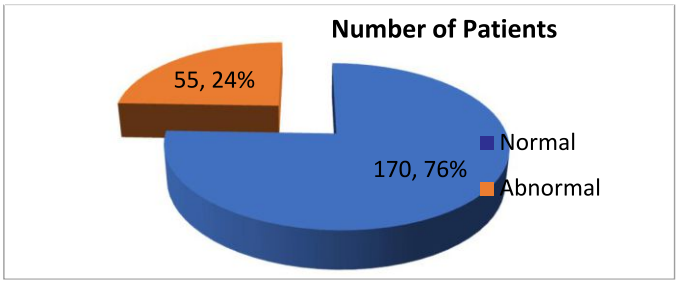

Fig-2: *Frequency Statistics of Actual Fetal weight category of patients*

Table 2: *Sensitivity and Specificity Statistics of Clinical weight assessment of patients*

		Actual Birth weight in grams		Total
		2500–4000 (Normal)	<2500 or >4000 (Abnormal)	
Clinical Estimation of Fetal weight in grams	2500-4000 (Normal)	145 (64.44%)	10 (4.44%)	155(68.9%)
	<2500 or >4000 (Abnormal)	25 (11.1%)	45 (20%)	70 (31.1%)
	Total	170 (75.55%)	55 (24.44%)	225

Discussion

Our study included 225 patients with pregnancies at term. Fetal weight was estimated through clinical method using Dare's formula and compared to actual fetal weight after birth. Results showed that clinical estimation of fetal weight had sensitivity of 85.3% and specificity of 81.8% in predicting fetal birth weight with positive predictive value of 93.5% and negative predictive value of 64.3%. In our study, the discrepancy in estimation clinical weight and actual birth weight was more in extremes of birth weight. Similar results were described by Srisarada Devi.[7] She also used the same Dare's formula to do clinical estimation of fetal weight. Another study conducted in Nigeria showed similar results by using Dare's formula. Gurung SD et al. used Johnson formula for clinical assessment of fetal weight and compared both clinical and ultrasound fetal weight estimation with actual birth weight.[8] They described that accuracy of clinical estimation was highest in normal birth weight ranges between 2.5-4kg, whereas clinical estimation was less accurate in extremes of birth weights. Yet another study assessed four different methods of clinical fetal weight estimation and compared them with ultrasonic assessment of fetal weight and actual birth weight. It was found that the weights of fetuses that were later determined to be low birth weight were significantly exaggerated, whereas the weights of bigger fetuses were significantly underestimated. Evidence from above literatures showed that accurate estimation becomes more challenging in cases of extreme birth weights, such as very low birth weight or macrosomia by using any of the available clinical methods. When a high degree of accuracy is essential, such as when planning for cesarean section, relying solely on clinical estimation may not be advisable.[9] However, some studies have shown that in experienced hands clinical estimation of fetal weight was found close to accuracy even in extremes of body weight.[10] This emphasizes the importance of clinical skills and methods for more accurate estimations. A study in khatmandu showed that the management of labor and delivery can benefit from the use of clinical fetal weight estimation in comparison to ultrasound estimation.[11]

Table 3: *Formula Determination of Sensitivity, Specificity, Positive predictive value, Negative predictive value, Diagnostic Accuracy, Positive Likelihood Ratio and Negative Likelihood Ratio. N = 225*

Sensitivity	(TP/TP + FN) x 100	145/145 + 25 x 100	85%
Specificity:	TN/TN + FP) x 100	45/45 + 10 x 100	81.1%
Positive Predictive Value	(TP/TP + FP) x 100	145/145 + 10 x 100	93.5%
Negative Predictive Value	(TN/TN + FN) x 100	45/45 + 25 x 10	64.2%
Diagnostic Accuracy	(TP + TN/TP + TN + FP + FN) x 100	145 + 45/ 145 + 45+10+25x100	84.4%
Positive Likelihood Ratio	(Sensitivity/ 100 – Specificity)	85/ 100 – 81.1	4.49
Negative Likelihood Ratio	(100- Sensitivity/ Specificity)	100 – 85/ 81.1	0.185

The personality characteristics and conditions of the mother have a big impact on precision of clinical estimation of fetal weight. For instance, it has been discovered that the accuracy of fetal weight estimation is influenced by the mother's body mass index (BMI) and the results are frequently less accurate in obese women.[12] Maternal obesity may also lead to poor obstetric outcome in terms of increased cesarean section rate and instrumental delivery.[13] Clinical estimations may also be less accurate in cases of gestational diabetes due to the possibility of polyhydramnios. In our study we eliminated this factor by not including obese women and women with any medical disorder especially diabetes which is associated with polyhydramnios.

The accuracy of fetal weight estimation may be increased by the use of ultrasound. In extremes of birth weights

ultrasound should be considered by clinicians in order to improve accuracy. However, expertise is again required for accurate estimation. As in experienced hands the chances of errors are low especially concerning extremes of body weight.[14] Studies have proved that ultrasound by trained medical professionals has more accurate predictive value than less experienced hands.[15]

Conclusion

Clinical fetal weight estimation was near to accuracy in pregnant women with normal fetal weight ranges. However, the clinical estimation was significantly low in cases of fetal weight less than 2.5 kg and more than 4 kgs.

Conflict of Interest: *None*

Funding Source: *None*

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Authors Contribution

KZ, NS: Conceptualization of Project
KZ, NS, SK: Data Collection
KZ, NS, MZS, SK: Literature Search
KZ, NS, MZS: Statistical Analysis
KZ, NS, MZS, SK: Drafting, Revision
KZ, NS, MZS, SK: Writing of Manuscript