ORIGINAL RESEARCH

Comparative study of various methods of fetal weight estimation at term pregnancy

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ABSTRACT
Background: The aim of a good obstetrician is to give a healthy baby to a healthy mother. The perinatal and maternal outcome grossly depends upon fetal weight at term gestation. The present study was undertaken to made a comparative evaluation of fetal weight estimation in term pregnancy using Abdominal girth x Symphysis fundal height (Insler's Formula), Johnson's formula, and Hadlock's formula using ultrasonography.
Material and Methods: Present study was single-center, prospective, comparative study, conducted in pregnant women attending antenatal clinics and maternity wards, with term, Singleton pregnancy, Cephalic presentation, had their last USG done within one week prior to delivery.
Results: The mean birth weight by symphysiofundal height * abdominal girth ± SD was 2948.90 ± 325.90 whereas mean birth weight by actual birth weight method ± SD was 2924.88 ± 360.52, difference was statistically not significant. Difference between mean birth weight by Johnson's formula (3277.23 ± 399.60) was statistically significant as compared to mean actual birth weight (2924.88 ± 360.52). Difference between mean birth weight by Hadlock's formula (3013.65 ± 390.77) was statistically significant as compared to mean actual birth weight (2924.88 ± 360.52). Birth weight calculated by SFH*AG in 45.3% of cases, by Johnson's formula in 80.6% of cases and by Hadlock's formula in 60% of cases was overestimated. Birth weight calculated by SFH*AG in 54.7% of cases, by Johnson's formula in 19.4% of cases and by Hadlock's formula in 40 % of cases was under estimated. Conclusion: AG x SFH clinical formula can be of great value in a developing country like ours, where ultrasound is not available at many health caredelivery systems.
Keywords: Insler's formula, birth weight estimation, Johnson's formula, Hadlock's formula.

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INTRODUCTION
The aim of a good obstetrician is to give a healthy baby to a healthy mother. The perinatal and maternal outcome grossly depends upon fetal weight at term gestation. Foetal weight in conjunction with gestational age is an important indicator of pregnancy outcome.[1]
As far as independent extra uterine existence and optimum survival of fetus is concerned, undoubtedly, birth weight is considered one of the most significant criteria of

perinatal mortality and morbidity. It is very important for the prevention of prematurity, evaluation of pelvic disproportion, before induction of labour and detection of intrauterine growth restriction.[2]

Studies were conducted using measuring tapes and pelvimeter to measure the uterine height and volume and thereby arrive at quantitative value of foetal weight.[3] A quick, easy clinical method for estimation of foetal weight in utero, would be of obvious benefit not only to the obstetrician but also for the birth attendants and paramedical staff working in rural areas to decide regarding referral to higher centre.[4]

With the advent of ultrasonography, it has proved to be a simple, important and non-invasive diagnostic tool in the hands of obstetrician to measure foetal weight.[5] In spite of its many advantages, the equipment is costly, availability of trained personnel well versed in its applications to obstetrics, aware of expectations and needs of obstetrician is limited. The present study was undertaken to made a comparative evaluation of fetal weight estimation in term pregnancy using Abdominal girth x Symphysis fundal height (Insler's Formula), Johnson's formula, and Hadlock's formula using ultrasonography.

MATERIAL AND METHODS

Present study was single-center, prospective, comparative study, conducted in department of Obstetrics & Gynaecology, at XXX medical college & hospital, XXX, India. Study duration was of 2 years (December 2018 to December 2020).Study was approved by institutional ethical committee.

Inclusion criteria

- Patients attending antenatal clinics and maternity wards, with term, Singleton pregnancy, Cephalic presentation, had their last USG done within one week prior to delivery, delivered at our hospital, consented for participation.

Exclusion criteria

- Patients with multiple gestation
- Malpresentation
- Poly or oligo hydramnios
- Fibroids or adnexal masses
- Known fetal malformations
- Obesity
- Not willing to participate

Study was explained to pregnant women & a written informed consent was taken. Detailed obstetric and menstrual history was taken for the correct duration of gestational age, which was calculated by Naegele's rule or by first trimester USG report. Significant antenatal history such as history of antepartum haemorrhage, hypertensive disorders, diabetes mellitus, cardiac disease, anaemia and tuberculosis were noted. Clinical examination was done & findings were noted in CRF. Fetal weight estimation in term pregnancy were carried.

1. Fetal weight estimation by AG x SFH (Insler Formula)

EFW (Weight in grams) = AG (cms) x SFH (cms)

After emptying the bladder, patient should lie supine with legs flat on the bed i.e, extended both at hip and knee. Abdominal girth is measured at the level of umbilicus and expressed in cms.

After correction of dextrorotation, Mc Donald's measurement of height of the fundus from upper edge of symphysis pubis following the curvature of abdomen were taken in centimeter tape. The upper hand was placed firmly against the top of the fundus, with the measuring tape pressing between the index and middle fingers readings were taken from perpendicular

intersection of the tape with the fingers.

2.. Fetal weight estimation by simplified Johnson's formula

As mentioned in previous method Mc Donald's measurement of symphysis fundal height is done, which is distance from height of fundus to the upper edge of pubic symphysis

Station of presenting part was assessed by abdominal examination and by vaginal examination.

Fetal weight was estimated as follows:

Fetal weights (gms) = (Mc Donald's measurement – 13) x 155 When the presenting part was at 'minus' station. = (Mc Donald's measurement – 12) x 155, when presenting part was at 'zero' station = (Mc Donald's measurement – 11) x 155 when pp was at plus station.

3. Fetal weight estimation by Hadlock's formula using ultrasonography

Sonographic examination was done in all patients using 3.5 MHz convex assay and linear assay transverse (Transverse sumen's sonoline SL grey scale model with M & B mode for simultaneous imaging and calculating fetal heart rate).

After biparietal diameter (BPD) abdominal circumference (AC) and femur length (FL) were measured in centimeters, the sonography machine calculated fetal weight by formula.

$Log_{10}(EFW) = 1.4787 - 0.003343\ AC \times FL + 0.001837\ BPD^2 + 0.0458\ AC + 0.158\ FL$

BPD diameter is measured using real time scanner. Linear array Dynamic imaging equipment yields the most accurate results of BPD measurement.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables.

Unpaired t test, Pearson's correlation and one way ANOVA tests were applied Pearson's correlation coefficient to know there is a significant relationship between estimated and actual birth weight for all the methods. P value less than 0.5 was considered as statistically significant.

RESULTS

Among 150 cases, maternal age distribution was in the range of 19-36 years. Mean age was 24.11 ± 3.83 years. The maximum number of cases studied were in the age group 21-30 years. 97 respondents (64.67 %) had full term vaginal delivery, while 53 respondents (35.33 %) underwent lower segment cesarean section.

Table 1: Distribution by age groups & outcome

	No of respondents	% of respondents
Age groups (years)		
≤ 20	32	21.33
21-30	111	74.00
>30	7	4.67
Out come		
FTND	97	64.67
LSCS	53	35.33

The mean birth weight by symphysiofundal height* abdominal girth ± SD was 2948.90± 325.90 whereas mean birth weight by actual birth weight method ± SD was 2924.88 ± 360.52, difference was statistically not significant. Difference between mean birth weight by Johnson's formula (3277.23±399.60) was statistically significant as compared to mean actual birth weight (2924.88±360.52). Difference between mean birth weight by Hadlock's formula

(3013.65±390.77) was statistically significant as compared to mean actual birth weight (2924.88±360.52).

Table 2: Comparison of fetal weight estimation methods with actual birth weight

Procedure	Mean	Std.Dv.	Mean Diff.	SD Diff.	Paired t	p-value
Symphysio-fundal height * AG	**2948.90**	**325.99**	**24.02**	**368.24**	**0.7989**	**0.4256**
Actual birth weight	2924.88	360.52				
Johnsons formula	3277.23	399.60	352.35	412.70	10.4565	0.00001*
Actual birth weight	2924.88	360.52				
Hadlock's formula	3013.65	390.77	88.77	230.59	4.7147	0.00001*
Actual birth weight	2924.88	360.52				

Birth weight calculated by SFH*AG in 45.3% of cases, by Johnson's formula in 80.6% of cases and by Hadlock's formula in 60% of cases was overestimated. Birth weight calculated by SFH*AG in 54.7% of cases, by Johnson's formula in 19.4% of cases and by Hadlock's formula in 40 % of cases was under estimated.

Table 3: Number of cases with over and under estimate of birth weight

Method	Over estimation no. of cases	Under estimation no. of cases
SFH*AG	68[45.3%]	82[54.7%]
Johnson's	121[80.6%]	29[19.4%]
Hadlock	90[60%]	60[40%]

The correlation between actual birth weight with symphysio fundal height * AG method is showing positive co relation with r value 0.4282, t value 5.7642 and p value was 0.0001 which is statistically significant.

The correlation between actual birth weight with Johnson's method is showing positive correlation with r value 0.4142, t value 5.5355 and p value was 0.0001 which is statistically significant.

The correlation between actual birth weight with Hadlock's method is showing positive correlation with r value 0.8145, t value 17.0812 and p value was 0.0001 which is statistically significant.

Table 4: Correlation between Actual birth weights with others by Karl Pearson's correlation

Variable	Correlation between Actual birth weight with		
	r-value	t-value	p-value
Symphysio-fundal height * AG	0.4282	5.7642	0.00001*
Johnsons formula	0.4142	5.5355	0.00001*
Hadlock's formula	0.8145	17.0812	0.00001*

DISCUSSION

Accurate estimates of fetal weight can help the obstetrician in knowing the salvageability of the baby outside the uterus, as birth weight is principal variable, affecting the survival of the neonate. The perinatal complications associated with low birth weight are attributable to preterm delivery, small for gestation or intrauterine growth restriction.

Management of diabetic pregnancies, vaginal birth after previous caesarean section will be greatly influenced by estimated fetal weight.[6] The fetus had been virtually inaccessible to the observation until development of the diagnostic ultrasound. The main difficulty in

assessing fetal growth is inaccessibility of the fetus to the outside world.[7] Accurate prediction of fetal weight in relation to gestational age, if applied to all pregnancies, assist in identifying wrong dates, intrauterine growth restriction and hence reduce the number of preterm perinatal deaths.

Ultrasound is not merely sound of particular kind and its nature is best understood by considering it as a special form of sound which is painless, non-invasive, simple technique and has potential to screen all the patients. USG also provides much valuable information such as biophysical profile, gestational age, lie, position, presentation etc. However clinical methods are simple, and do not require sophisticated instruments for fetal weight estimation

The mean maternal age (in years) in present study was 24.11 yrs ± 3.83. The maximum number of cases studied were in the age group 21-30 years. Dare et al.,[8] found a percentage error between the actual and estimated weight to be 20.1% by AG x SFH method. In present study the percentage error was 12.6% for AG x SFH method. Bhandary Amritha et al.,[9] found the average error in various fetal weight groups by AG x SFH was 224.37 gms which was least when compared to Johnson's and Hadlock's method.

In present study the average error in gms was least by Hadlock's formula which was 230.5 gm and by AG x SFH method was 368.2 gm then followed by Johnson's formula, was 412.7 gm. The difference in average error between Hadlock's formula and AG x SFH is not statistically significant as p value is 0.367.(P<0.05 − statistically significant). Tiwari and Sood[10] in their study showed an average error of 364.96 gm, 327.28 grams and 198.6 gms by SFH * AG, Johnson's and Hadlock's ultrasound method respectively. In present study , average error in birth weight was least with Hadlock's (230.5gm), followed by SFH * AG method (368.2gm), followed by Johnson's formula (412.7gm).

Sherman et al.,[11] reported that rates of estimates within 10% of birth weight was not statistically significant in clinical and USG method (72% and 69% respectively). Bhandary Amritha et al.,[9] reported that rates of estimates within 10% of birth weights was not statistically significant in AG x SFH method and USG method (67% and 62% respectively).

In present study as well clinical estimation by AG x SFH (insler's formula) and USG method are equally good for estimation of birth weight within 10% and the difference is not statistically significant. In the present study, there was statistically significant difference in SFH * AG and Johnson's formula for estimation of fetal weight, SFH * AG being more accurate to actual birth weight. There was statistically significant difference in Johnson's and Hadlock's formula for estimation of fetal weight, making Hadlock's formula 2nd best method for estimation of fetal weight accurately after SFH * AG.

Diagnostic ultrasound is painless, non-invasive and has potential to screen all the patients. 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.[12] Early expectation that this method might provide an objective standard for identifying foetuses of abnormal size for gestational age was recently undermined by prospective studies that showed sonographic estimates of fetal weight to be no better than clinical estimation of fetal weight. Several technical limitations of the sonographic method are maternal obesity, anterior placentation etc. Low cost clinical methods for measuring foetal growth are worth considering for estimation of foetal weight in primary health centres or centres where ultrasonography machines are not available.

CONCLUSION

Of the three clinical formula's studied, AG x SFH (Insler's formula) has better predictable results in fetal weight estimation, compared to Johnson's and Hadlock's formula.

AG x SFH clinical formula can be of great value in a developing country like ours, where ultrasound is not available at many health care delivery systems. It is easy, cost effective and simple and can be used even by midwives.

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