A Comparative Study of Fetal Weight Estimation in Term Pregnancy by Clinical and Ultrasonographic Method at Umaid Hospital Jodhpur

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Abstract: *Objective: To make a comparative evaluation of estimated fetal weight using Johnson's formula and Hadlock's formula. Methods: This was a prospective comparative conducted at Umaid Hospital, Dr. SN medical college Jodhpur to compare accuracy of fetal weight estimation by clinical method and USG method at term pregnancy and compared with actual birth weight in 100 patients. In clinical method Johnson's formula was used. Results: Both clinical methods and sonographic method show good correlation with actual birth weight in all birth weight ranges (r= 0.829 and r= 0.904, p- value for both <0.05) except in extreme of birth weight. Both methods correlated well at birth weight range 2.5 kg to 3.5 kg. In extreme of weight USG is better than clinical method. Conclusion: Our study shows that Johnson's formula effectively estimates birth weight and so in low resources settings where USG facility is not easily available, clinical estimation of fetal weight can gives an idea of fetal weight and so helps in deciding optimal mode of delivery.*

Keywords: Fetal weight, Symphysiofundal height, Term pregnancy

1. Introduction

Fetal weight is surrogate determinant of fetal health. During last decades, estimated fetal weight has been incorporated into routine ante partum evaluation of high risk pregnancies and deliveries.[1]

Categorization of fetal weight into either small or large for gestational age may lead to timed obstetric intervention that collectively represent significant departure from routine antenatal care.[2,3] Both low and high birth weight is harmful for fetal development. Complications of low birth weight include preterm deliveries and IUGR. Excessive weight gain cause complications include difficult delivery, shoulder dystocia, brachial plexus injury, intrapartum asphyxia, birth canal injury, traumatic PPH. These complication can be avoided when there is fetal weight estimation in utero.

Accurate estimation of fetal weight is important for decision making regarding mode of delivery specially in high risk patients like breech presentation and previous caesarean section so as to achieve overall healthy outcome of pregnancy in forms of healthy mother and healthy baby.

Two methods used for fetal weight estimation:-
(a) Clinical methods :- it based on abdominal palpation of fetal fetal parts and calculation of fetal weight based on fundal height
(b) Ultrasound estimation of fetal weight by using fetal biometry

Clinical estimation of fetal weight has been criticized as less accurate because of inter observer variations. But some studies Raman S et al [4], Baum JD et al[5], Anupama kumari et al[6] found that there was no significant difference in birth weight estimation by clinical or ultrasonographic methods.

The ultrasound method have an advantages of being accurate, simple, and non invasive and has gained much popularity.[13]

Hadlock's et al [14] derived a formula by using abdominal circumference and femur length and this gives more accurate fetal weight estimation in extreme variation in shape of fetal head.

Formula- hadlock 3(1985)
$Log 10 BW = 1.5662 - 0.108(HC) + 0.0468(AC)0.1719(FL) + 0.00034(HC)2 - 0.003685(ACXFL)$.

In clinical method various formula are used – Johnson's formula, Dare's formula, Dawn's formula. These are based on symphysiofundal height.

Present study is conducted to estimate fetal weight at term pregnancies by clinical and sonographic methods and compare it with actual birth weight. In clinical method Johnson's formula was used and in USG Hadlock's formula used.

Aims and Objectives

To estimate fetal weight by clinical and ultrasound method and compare with actual birth weight.
- Estimate fetal weight by clinical method using Johnson's formula
- Estimate fetal weight by ultrasound by Hadlock's formula
- Actual birth weight after delivery
- Comparison of both method with actual birth weight

2. Material and Methods

This is a prospective observational study and in this comparison of fetal weight estimation by clinical and ultrasound method and compare with actual birth weight, conducted in Ummaid hospital Jodhpur.
This study was approved by institutional ethical committee.

Patient population:
100 cases randomly selected who fulfill inclusion criteria were included.

Inclusion Criteria:-
All primigravida with term singleton pregnancy, cephalic presentation and have an intact membrane were included. Primigravida with live pregnancy who had their gestational age confirmed by dated scan or have an ultrasound before 22 weeks of pregnancy.
Clinical measurement was taken within 24 hour of delivery.
An ultrasound also preformed within 24 hour of delivery.

Exclusion Criteria:
- Multiple gestation
- Polyhydramnios /oligohydramnios
- Ante partum hemorrhage
- Eclampsia
- Congenital anomalous fetus diagnosed by USG
- PROM
- Malpresentation

After proper counseling patients were enroll for the study. The study consisted of estimation of fetal weight using following methods-

Johnson's formula:-
After emptying the bladder patient placed in supine position. After correction of dextro rotation, Mac Donald's measurement of height of fundus from the upper edge of symphysis pubis following the curvature of the abdomen will be taken with flexible non-elastic measuring tape calibrated in centimeters. Using this tape , fundal height will be measured from the highest point on the uterine fundus to the midpoint of the upper border of symphysis pubis, using the thumb to sustain the tape, while attempting to reach the upper border of symphysis pubis.

Station of presenting part will be assessed by abdominal examination and by vaginal examination when they are in labour, condition of membrane also noted.

Johnson's formula:-
Fetal weight in grams= (fundal height in centimeters-K)x 155
K=13 when presenting part not engaged
K=12 when presenting part is at '0' station
K=11 when presenting part is at +1 station

Hadlock's formula:-
Log10   EFW=1.4787-0.003343
ACXFL+0.001837BPD2+0.0458AC+0.158FL

Measurement of abdominal circumference:-
Transverse section through the upper abdomen, which should demonstrate the following landmarks:-
- Fetal stomach
- Umbilical vein
- Portal sinus

AC measurement should not be taken on a foreshortened abdomen and the calipers should be on the skin surface. The kidney and cord insertion should not be visible. The umbilical vein should not be seen up to the skin line.

Measurement of biparietal diameter (BPD):
The BPD should be measured on an axial plane that traverse the thalami, and cavum septum pellucidum. The transducer must be perpendicular to the central axis of the head, and thus the hemisphere and calvaria should appear symmetric.

The calipers should be placed at the:-
- Outer edge of the near calvarial wall
- Inner edge of the far calvarial wall.

The cerebellar hemisphere should not be in the plane of image.

Measurement of femur length:
Femur length is generally preferred over other long bones. The femur length measurement is made with the transducer aligned along the long bone axis of the bone ideally with the beam exactly perpendicular to the shaft. Measurement is from the greater trochanter to the lateral condyle. Head of femur should not be included in the measurement.

3. Results

100 term singleton pregnant female who fulfill inclusion criteria were enrolled.
Majority of women were in the average reproductive age group of 21-25 year.
Majority of babies born had mean birth weight of 2882.1 grams.
Majority of patients were booked (62%).
Majority of patients had SFH between 30-35 cms.
Most of patient in our study were of gestational age between 38-40 week (62%).
The mean simple error and and mean absolute error was least with USG than with Johnson's formula.

The correlation coefficient showed that USG method for fetal weight estimation correctly correlated with actual birth weight. P- values for both the methods were <0.05% that signify both the methods were statistically significant.

Antenatal assessment of fetal weight was better by both clinical or USG but USG seems to be more effective at extremes of weight that is low and high birth weight.

Table 1: Distribution of age group in study population

Age (yrs)	No. of patients	Percentage
≤20	16	16
21-25	58	58
26-30	20	20
≥31	6	6
Total	100	100

Table show majority of patients were in age group between 21-25 years (58%).

Table 2: Distribution of patients according to their gestational age

Gestational age (weeks)	No. of patients	Percentage
37-38	24	24
38-40	62	62
40-42	14	14
Total	100	100

Table 2 shows that majority of patients were of gestational age of 38-40 weeks (62%) , 24 % were of gestational of 37-38 weeks and 14% were of 40-42 weeks.
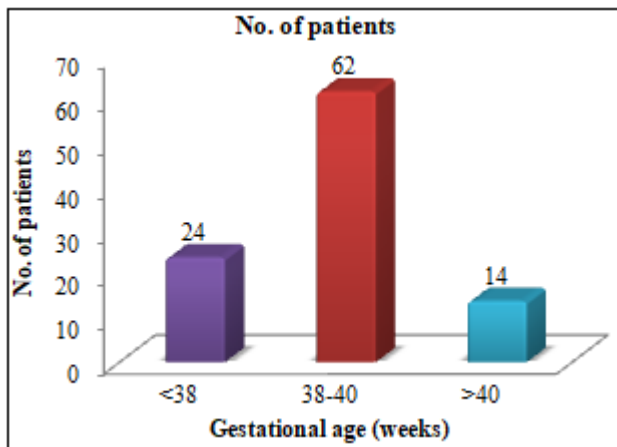

Figure 2

Table 3: Distribution of babies according to their actual birth weight

Actual birth weight (gm)	No. of patients	Percentage
≤2000	4	4
2001-2500	13	13
2501-3000	45	45
3001-3500	31	31
>3500	7	7
Total	100	100

Table 3 shows that 45% babies weighed between 2501-3000 grams , 31% weighed between 3001-3500 grams, 13 %weighed 2001-2500 grams, 7% weighed more than 3500 grams, and only 4% weighed <2000 grams.

Table 4: Comparison of actual birth weight vs weight predicted by johnson's formula across various ranges:

Actual birth weight (gm)	Johnson's Formula weight (gms)					Total
	≤2000	2001-2500	2501-3000	3001-3500	>3500	
≤2000	2	2	0	0	0	4
2001-2500	0	6	6	1	0	13
2501-3000	0	2	27	15	1	45
3001-3500	0	0	4	24	3	31
>3500	0	0	0	1	6	7
Total	2	10	37	41	10	100

Table 4 shows that exact correlation was seen in birth weight estimation by Johnson's formula was most accurate in weight group 3001-3500 grams and less accurate in weight group 2501-3000 grams

Table 5: Comparison of actual birth weight vs weight predicted by hadlock's formula across various ranges:

Actual birth weight (gm)	USG formula (gms)					Total
	≤2000	2001-2500	2501-3000	3001-3500	>3500	
≤2000	1	3	0	0	0	4
2001-2500	1	7	5	0	0	13
2501-3000	0	3	35	6	1	45
3001-3500	0	0	1	29	1	31
>3500	0	0	0	2	5	7
Total	2	13	41	37	7	100

Table 5 shows that birth weight estimation by USG was most accurate in weight group 3001-3500 grams and less accurate in weight range < 2000 grams.

Table 6: Comparison of mean, standard deviation and correlation coefficient between USG, Johnson's formula and actual birth weight

Variables	Mean	Standard deviation	t test		Correlation coefficient	
			t value	p value	r value	p value
Johnson's Formula	2995.5	413.97	1.941	0.053	0.829	<0.0001
ABW	2882.1	412.14				
USG	2928.4	412.96	0.793	0.428	0.904	<0.0001
ABW	2882.1	412.14				

Table 6 shows that weight calculated by Johnson's formula had correlation coefficient 0.829 and Hadlock's formula had correlation coefficient 0.904. Both methods were statistically significant.

4. Discussion

In our study majority of patients belongs to age group 21-25 years, which is a fertile period, similar observation was made by Aemiro Yiheyis[7]in which most common age group 21-25 years.

Table 2 shows that majority of patients were of gestational age between 38-40 weeks and this was comparable to Avirupa Guha Roy et al[8] , and Charles Njoku et al[9].

Table 3 shows average birth weight 2501-3000 grams. Similar observations were made by Bhandary et al[10] in which average birth weight was also 2501-3000 grams.

Table 4,5 shows that both methods correlated well with actual birth weight but Johnson's formula overestimated birth weight more than USG. In extreme of birth weight USG more reliable than Johnson's formula.

In our study 36 patients were misinterpreted by Johnson's formula out of which 7 (19.5%) were underestimated and 29 (80.5%) were overestimated. Similar observations were made by **S. Aruna et al**[11]and **Aemiro Yihesis et al** studies

In present study 24 patients were misinterpreted by Hadlock's formula out of which 7 (29.1%) were underestimated and 17 (70.9%) were overestimated. Similar observation was made by **S. Aruna et al** study

Table 6 shows p- values for both the methods were < 0.05 which is statistically significant. Similar observation was made by Sirusht B. Ali. et al[12] (p-value 0.002 for Hadlock's formula).

Correlation coefficient for Johnson's formula was 0.829 which signify that Johnson's formula correlated well with actual birth weight.

Correlation coefficient for Hadlock's formula was 0.904 which shows that Hadlock's formula correlated well with actual birth weight.

5. Conclusion

Clinical estimation of fetal weight is as effective as USG method and correlate correctly with actual birth weight. But at extreme of weight USG is better for weight estimation.

Our study shows that Johnson's formula effectively estimates birth weight and so in low resources settings where USG facility is not easily available, clinical estimation of fetal weight can gives an idea of fetal weight and so helps in deciding optimal mode of delivery.

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