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A Comparative study of Fetal Weight estimation at term by clinical method and ultrasound method and after delivery

KEYWORDS: Birth weight, Had lock, Johnson method, SFH(Symphysio Fundal Height)

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ABSTRACT *Introduction: The aim of modern obstetrics is to achieve the best quality of life for both mother and her unborn child. Accurate estimation of fetal weight is of paramount importance in the management of labour and delivery1. Birth weight is an important predictive parameter of neonatal outcome and its prenatal estimation plays a significant role in comprehensive evaluation and management of high risk pregnancies. Accurate fetal weight estimation remains an elusive goal for obstetricians*

Aim: The aim of the study is to compare the accuracy of clinical (Johnson's formula) and Ultrasonographic (Hadlock's Method) estimations of fetal weight at term with actual birth weight within 15 minutes after delivery.

Materials and Methods: A prospective observational study of 100 anti-natal women between 37-40 weeks of gestational age with a single term pregnancy with no fetal anomalies. Estimated fetal weight was estimated by clinical method using Johnson's formula and by ultrasound using Hadlock's formula and compared with the actual birthweight.

Result: By ultrasound Hadlock's Method over estimation of birthweight was seen in 36% of cases and under estimation in 64% of cases. The correct weight was estimated with an error of 100gms in 16% of cases by Johnson's formula and in 60 % of cases by ultrasound Hadlock's method. Maximum error with Johnson's formula was 600gms whereas with that of Hadlock's method was 542gms.The difference between the ultrasound estimated weight and actual weight was not statistically significant (p=.41).

Conclusion : Ultrasonographic fetal weight estimation was relatively superior than the clinical method in the prediction of birthweight. Jonhnson's formula is also still valuable if it is assessed by the experienced obstetricians, in remote places where the facility of ultrasonography is not available.

Introduction :

The aim of modern obstetrics is to achieve the best quality of life for both mother and new born. Accurate estimation of fetal weight is of paramount importance in the management of labour and delivery. Fetal weight in conjunction with gestational age is an important indicator of pregnancy outcome.

Estimated fetal weight has been incorporated into the standard routine antepartum evaluation of high risk pregnancies and deliveries, for instance [2]

- Management of diabetic pregnancies
- Vaginal Birth after Caesarean section
- Intrapartum management of foetuses presenting by breech
- when dealing with anticipated preterm delivery
- the interventions to undertake to postpone the preterm delivery
- optimal route of the delivery
- the level of hospital where delivery should occur may be based wholely or in part of the estimation of fetal weight.

For excessively large foetuses the complications associated with the delivery include shoulder dystocia, brachial plexus injury,bony injuries and intrapartum asphyxia.

In terms of maternal risks include birth canal and pelvic floor injuries and post post-partum haemorrhageThe CPD with big babies, contributes both increased rate of operative vaginal delivery and caesarean deliveries compared with foetuses of normal weight.

It has been suggested that accurate estimation of fetal weight would help in successful management of labour, care of the newborn in the neonatal period help avoidance of complications associated with the macrosomia and in low birth weight babies thereby decreasing the perinatal morbidity and mortality.

A quick, easy accurate and reliable method for the estimation of fetal weight in utero would be obvious benefit to the obstectician. the time honoured practice of palpating and measuring Symphysio Fundal Height(SFH) has produced variable results. It has its own fallacies and advantages.

In developing countries like India estimation of foetal weight by clinical method is important in smaller countries[3]especially in high risk pregnancies and intrapartum evaluation and management of foetuses[4,5] .Ultrasonography revolutionized the situation and gained the popularity for evaluating the foetus in Utero

In view of this the present study is conducted to estimate the fetal weight at term pregnancies by clinical method using Johnson's formula and ultrasound method by Hadlock's formula and then verify which method almost correlates with the actual birth weight of the neonate at term.

Materials and Methods :

The study was conducted in the department of obstetrics and gynaecology, Government General Hospital, Kurnool Medical college, Kurnool, from 2008-2009.

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Study design : Prospective observational study 100 antenatal women between 37 and 40 weeks of gestation.

The pregnant women were selected in whom delivery was anticipated within 72 hours for this study.

Inclusion Criteria
1. All antenatal women between 37 and 40 weeks gestation
2. Vertex presentation
3. Singleton pregnancy
4. Patient with reliable date
5. Ability to give informed consent
6. Irrespective of parity and socio economic status.

Exclusion Criteria
1. Multiple gestation
2. Obese women
3. Presentations other than vertex
4. Preterm or post term
5. Pregnancy with oligohydramnios or polyhydramnios
6. Pregnancy with uterine or abdominal mass
7. Fetal demise
8. Fetal anomalies.

The patients who were selected from antenatal clinics and maternity wards had their last fetal weight estimation done within 1 week of delivery.Prior to allocation, participants were counseled regarding the study, and explained that ultrasound which is a routine for obstetrics cases is a non-invasive and safe procedure and consent obtained in a designated form and they were formally included in the study. Patients in whom delivery was anticipated within 1 week and women who were in labor were also included in this study. Patients who did not deliver within 1 week of fetal weight estimation were excluded from this study. These women were from all socioeconomic classes. Detailed obstetric and menstrual history was taken. The duration of gestation was calculated according to Naegele's rule. Patients with associated diseases such as anemia, heart disease was also included. Significant antenatal history such as history of antepartum hemorrhage, hypertensive disorders, diabetes mellitus, cardiac disease, anemia and tuberculosis were noted. Routine hematological and biochemical investigations were carried out.

Foetal Weight Estimation by Simplified Johnson's Formula (1957)
After emptying the bladder, patient placed in the supine position. After correction of dextrorotation, McDonald's measurement of height of the fundus from the upper edge of the symphysis pubis following the curvature of the abdomen was taken with centimeter tape. The upper hand was placed firmly against the top of the fundus, with the measuring tape pressing between the index and middle finger (Figure 1).

Station of presenting part was assessed by abdominal examination and by vaginal examination when they were in labor. Condition of the membranes was also noted (intact or ruptured).

Fetal weight was estimated as follows: Fetal weight (g) = (McDonald's measurement - 13) × 155 When the presenting part was at "minus" station

= (McDonald's measurement - 12) × 155 when presenting

parts at "zero" station = (McDonald's measurement - 11) × 155 when presenting

part at plus station If woman weighed more than 91 kg, 1 cm was subtracted from fundal height[6-8]

Fetal Weights Estimation by Hadlock's Formula using Ultrasonography (USG)
Sonographic examination was done in all patients using 3.5 MHz convex array and linear array transducer (Transverse Siemen's Sonoline SL grey scale model with M and B mode for simultaneous imaging and calculating fetal heart rate). Biparietal diameter (BPD) abdominal circumference (AC) and femur length (FL) were measured incentimeters, the sonography machine calculated fetal weight[9,10]

BPD Measurement
The BPD was measured at right angles to the longitudinal axis of the elliptical skull at a level at which a clear midline Echo and easily discernable lateral ventricle could be Visualized. At this level, the transverse scan also should Show cavum septum pellucidum and the thalamus. BPD Was measured from the outer table of anterior skull to the Inner table of the posterior skull (Figure 1)[11,12].

AC Measurement
The measurement of the fetal AC was made from a transverse axial image of the fetal abdomen at the level of the liver (Figure 2). The major landmark in this section is the umbilical portion of the left portal vein deep in the liver, with the fetal stomach representing a secondary landmark[13.]

FL Measurement
The shaft of the femur is the easiest fetal long bone to visualise and measure. FL measurement was obtained from

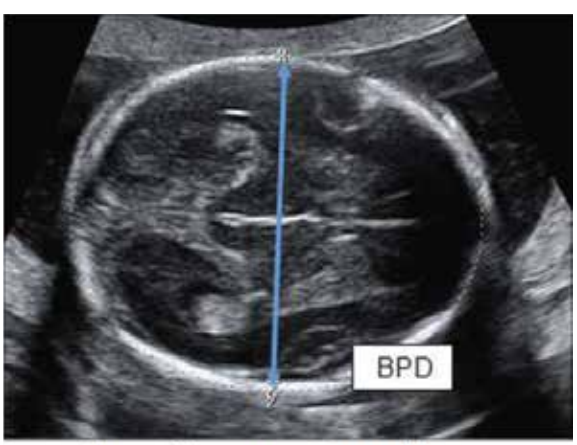

Figure 1: Measurement of biparietal diameter

the greater trochanter to the lateral condyle[14]. The head of the femur and the distal femoral epiphysis, when present, was not included in the measurement. The measured ends of the bone were blunt and not pointed (Figure 3).

The fetal weight was calculated using the formula: Log10 (EFW) 1.4787 - 0.003343 AC × FL + 0.001837 BPD2 + 0.0458 AC + 0.158 FL

Predicted estimated fetal weight by each method was Compared with respective neonatal actual birth weight using weighing scale. Statistical analysis of the difference between calculated EFW and actual birth weight was done in both methods. Birth weight estimation accuracy was compared with parity,

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Age of the mother, weight and height of the mother. The Relative observations were recorded and subjected to statistical analysis.

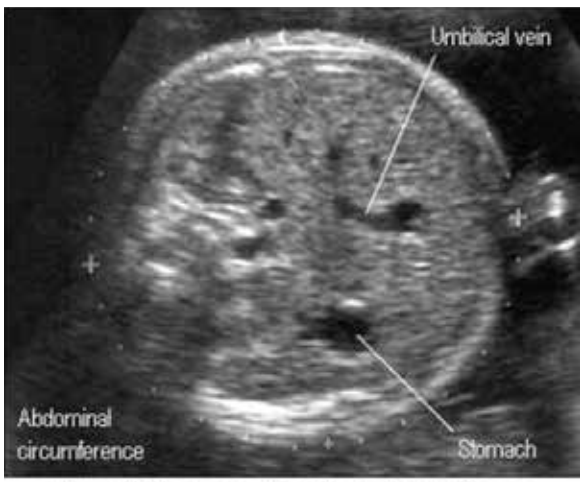


Figure 2: Measurement of abdominal circumference

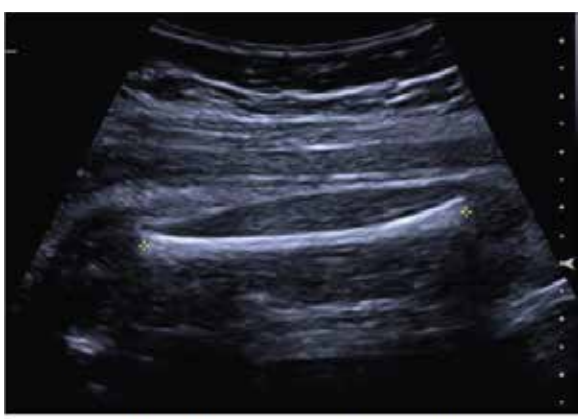


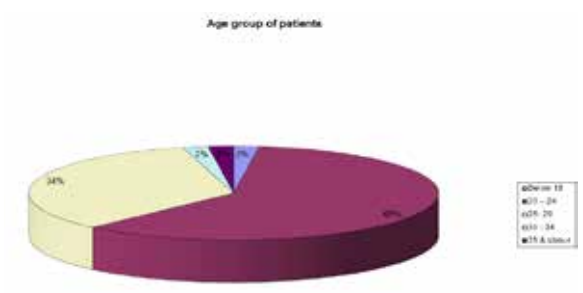
Figure 3: Measurement of femur length

Results :

Table No.1

Age Group distribution of patients

Age Group Years)	No. Of Patients	Percentage
Below 19	2	2.0
20-24	60	60.0
25-29	34	34.0
30-34	2	2.0
35 & above	2	2.0
Total	100	100



The majority of patients belong to 20-24 years of age (60%) , followed by 25-29 years (34%)

There are only 2 patients (2%) among below 19 years, 30-34 years and 35 and above year age group

TableNo.2

Mode of Delivery	No. of patients	Percentage
Normal	86	86.0
Caesarean	14	14.0
Total	100	100

Majority of the patients had normal delivery (86%) and only 16% cases required a C-Section.

Sex Of the Babies:

Majority of the patients had delivered male babies - 54% compared to that of female babies at 46%

Table No. 3 Socio Economic status of patients

Socio Economic status	No. of patients	Percentage
Low	88	88.0
High	12	12.0
Total	100	100

Majority of the patients belong to low socio economic status group 88% and higher are at 12%.

Table No.4 Distribution of patients by Birth weight range (Gms)

Birth weight Range(Gms)	No. of patients	Percentage
<2500	15	15.0
2501-3000	46	46.0
3001-3500	35	35.0
>3500	4	4.0
Total	100	100

In majority of cases the birth weight ranged from 2501-3000 gms (46%) and there were 15% low Birth weight babies (>2500 gms)

Table No. 5 Birth weight in relation to maternalweight

Maternal Wight (Kgs)	Birth Weight (gms)				Total (%)
	<2500	2501-3000	3001-3500	>3500	
40-55	10(25.0)	15(37.5)	14(35.0)	1(2.5)	40(100.0)
56-70	5(8.3)	31(51.7)	21(35.0)	3(5.0)	60(100.0)
Total	15(15.0)	46(46.0)	35(35.0)	4(4.0)	100(100.0)

X2 = 6.53; P=0.042;S

The proportion of Low Birth weight (>2500) was found to be higher with maternal weight ranging from 40-55 Kg

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(25%) compared to women with weight range of 56-70 Kgs (8.3%) . It can be observed that the birth weight increased along with the maternal weight increase.The differences in the proportion of birth weight in relation to maternal weight were also found to be statistically significant (P= 0.042;S)

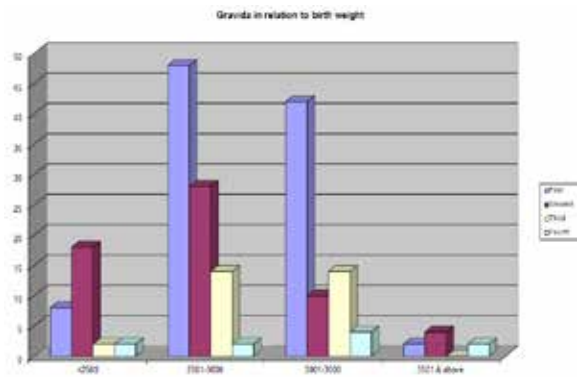

Table No: 6 Birth Weight in relation to gravida

Gravida	Birth Weight (gm)				Total (%)
	<2500	2501-300	3001-3500	>3500	
1	4(8.0)	24(48.0)	21(42.0)	1(2.0)	50(100.0)
2	9(30.0)	14(46.7)	5(16.7)	2(6.7)	30(100.0)
3	1(6.7)	7(46.7)	7(46.7	0(0.0)	15(100.0)
4	1(20.0)	1(20.0)	2(40.0)	1(20.0)	5(100.0)
Total	15(15.0)	46(46.0)	35(35.0)	4(4.0)	100(100.0)

x^2= 11.27;P=0.023;S

The proportion of low birth weight (<2500 gms) was found to be higher with second gravida (30%) followed by 4th gravida (20%) it can be observed that the birth weight increased with the increase in the gravida.The differences in the propoprtions of birth weight in relation to gravida were also found to be statistically significant (P=0.023;S)

Table No.7
Actual Birth weights in relation to estimation of birth weights by clinical and ultrasound methods

S No.	Method of estimation	Birth weight (Mean ± SD)	Statistical Significance
1	Clinical	3135.40 ± 341.79	1vs 2; t=2.40; P=0.016;S
2	Actual	3014.28±368.61	
3	Ultrasound	2971.37±372.36	1Vs 3 ; T= 3.42; P=0.001;S 2Vs3=0.81; P=0.41NS
Statistical significance	F Ratio = 6.09; P=0.0025;S		

The average Birth weight based on clinical method was found to be 3135.40gms which was over estimated comparted to the actual average birth weight of 3014.28gms while the ultrasound slightly underestimated the brth weight as 2971.37 gms. The difference in the mean birth weights are estimated by clinical ultra sound methods and the actual birth weights were found to be statistically significant. The differences betyween the ultra sound estimated weight and the actual weight was however not statistically significant (P=0.41;NS). Thus one can inper that the ultrasound method of estimation is better than the clinical method of estimating the birth weight.The differences among mean birth weights estimated by clinical and ultrasound methods compared to actual mean birth weights were found to be statistically significant .

Table No.8 Error of the birth weights estimated by clinical and ultrasound methods compared to actual weights

S No	Type of method	Mean error in Gm
1	Clinical method	121.12
2	Ultrasound Method	42.91

It can be observed that the ultrasound method of estimation has less error compared to that of clinical method of estimation of birth weight.

Table No.9 Details of error between the two methods of birthweight

S. No	Parameter	Clinical Method	Ultrasound Method
1.	Minimum error (Gms)	10	2
2.	Maximum Error (Gms)	600	542
3.	Median Error (gms)	280	99.5
4.	Mean Percentage error	9.31	4.50

The ultrasound method has a minimum error of (2gms) compared to (10gms) by clinical method, while the maximum error was lesser in ultrasound method (542gms) compared to clinical methods (280gms). The mean percentage error was also found to be lower with the ultrasound method of estimation (4.5%) compared to clinical method (9.31%)

Table 10 Ranges of percentage error between the two methods of estimation of birth weight

S.No	Range of percentage error	Clinical method	Ultrasound Method
1	Less than 5	22	65
2	Upto 10	54	88
3	Upto 15	87	97
4	Upto 20	98	99
5	Upto 25	100	100

X^2 = 42.697;P<0.001;S

The range of percentage error was found to be less than 5% in 65% of cases in ultrasound method compared to 22% with clinical methods.The error was less than 10% in 88% of cases compared to 54% in the case of clinical estimation. Almost all cases were less than 15% error (97%) in the case of ultrasound while it was 87 % only in the case of clinical method.So the ultrasound method has less error compared to clinical method.

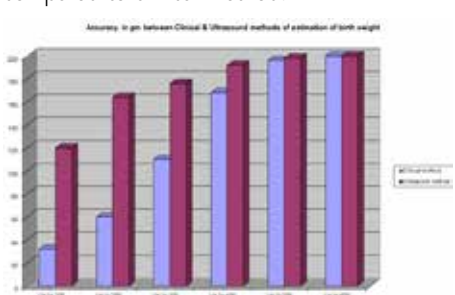

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Table No.11 Accuracy of Birth weight estimated between the clinical and ultrasound methods in terms of grams

S.NO	Accuracy in Gms	Clinical Method	Ultra Sound Method
1	Upto 100	16	60
2	UPto 200	30	82
3	Upto 300	55	88
4	Upto 400	84	96
5	Upto 500	98	99
6	Upto 600	100	100

^{X2}24.5;P<0.001;S

In 60 % of the cases, The accuracy by ultrasonic method of estimation of birth weight was up to 100gms comprared to only 16% in the case of clinical method.Similarly the accuracy was upto 200 gms in 82% cases by ultrasound cases compared to 30% only with clinical method of estimation. The accuracy was upto 300 gms in 885 of cases with ultrasound method compared to only a 555 with that of clinical methods of estimation. The differences in the estimations of birth weights between the two methods are also statistically significant. Thus one can conclude that the ultrasound estimations of birth weight is accurate compared to clinical method of birth weight estimation.

Discussion:

Birthweight is an important parameter to predict the neonatal outcome and its prenatal estimation plays a significant role in the management of high risk pregnancies.

The minimum age of the mothers in this study was 18 years and the maximum age was 35 years. The maximum number of cases were in the age group of 20-24 years (60%) which is similar to Rajya Shri Sharma et al[15].,(2002) study.

In this study Maternal weight range was from 40-70 Kgs and it was seen that the maternal weight increased there was an increase in the birth weight of the baby. which was similar to O'Sullivan et[16].(1965) Study.

In the present study 50% were primi gravidas which is similar to Bhandary Amritha et [17], (2004). Four was the highest gravidity. The birth weight was influenced by the gravidity. which were found to be statistically significant, which is similar to Karn and Pernose (1965) study. Though Rajya Shri Sharma et al (2002) study didn't find any significant change in birth weight with gravidity.

In the present study 46% were in birth weight range from 2501- 3000g. Similar results have been reported by Daya Sirohival et [18]on (2004) study and Bhandary Amritha et al., (2004). Study Johnson's Formula had a tendency to overestimate 68% of cases and underestimate 32% . Similar results have been reported by Niswander et al., (1970), Tewari and sood [19](1989),Rajya Shri Sharma et al (2002) and Daya Sirohiwal et al., (2004). Sonographic estimation in the present study by Hadlock's Method had a tendency to underestimate 64% of cases and overestimate the remaining 36%. Tiwari and Sood et al (1989) reported almost equal incidence of under and over esxtimation using warsof et al., formula by ultrasonography. In Daya Sirohiwal et al., (2004) study, Ultrasonographic estimation by shepherd's method had a tendency to underestimate in 58% of the cases and overestimate in 34% of the cases. In the present study correct weight could be estimated by Johnson's Formula with an error of 100gms in 18% of the cases, it was 32% in Daya Sirohiwal et al., (2004) study. By Hadlock's Method it was 54 % of the cases in the present study. In the study of Daya Sirohiwal 's study it was 74 % .

The accuracy was 54% within 300gms by clinical method when compared to Johnson R.W (1957) and Daya Sirohiwal et al., (2004). It was 93% by Hadlock's Ultrasound method when compared to Daya Sirohiwal et al' study at (95% of cases within ±300 gms)

In this study average maximum error was least by hadlock's Ultrasound method when compared to johnson's clinical method .and Similar results were found in Bhandary Amritha et al., (2004) study.

In this study, in 97% of babies percentage of errors was restricted to 15% by Hadlock's method compared to 87% of cases by Johnson's Formula. Tiwari and Sood found 92% Cases within 15% of error by ultrasound method and 78% of cases by Johnson's method. Dawn et al using estimation by dawn's formula showed that 100% of cases were within 10% of actual birth weight as compared to only 54% cases in the present study.This can be practically explained by the fact that they considere only those women with vertex just sitting at the brinm,whereas in the present study all the women irrespective of the station of the head were included . Bhandaryer al (2004) study obtained 41% shepered et al ; obtained 50.7% of estimated within 10% error by using modified warsof's formula and Ott (19810 obtained 71.3% of results within 10% and 87.4% of results within 15% or error by using the same formula.

Conclusion:

To conclude this study, the ultrasonographic method is superior to the clinical method in the prediction of Birth weight. In developing countries like ours,. It is important to remember that ultrasound fetal weight estimation requires expensive equipment and it is a time consuming work for the hospital staff to perform the examination that are often working at sub optimal conditions and overcrowded maternity facilities.Whereas the clinical method is simple easy and cost effective.

Both fetal macrosomia and intra euterine growth restriction increases the risk of perinatal morbidity and mortality and of long term neurologic and developmental disorders.

Despite the superiority of ultrasonography the simple clinical method of estimated fetal weight is of great value especially in a developing country.

As a result of the recent improvement in the accuracy of fetal weight prediction, practicing obstetricians can now undertake prospective interventions more confidently than before, with the aim of minimizing intrapartum and peripartum risks for both foetuses and mothers.

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