



## To Study the Accuracy of Foetal Weight Estimation by Ultrasonography

Authors

**Dr Chandan Sen<sup>1</sup>, Dr Sadhna Sharma<sup>2</sup>, Dr GL Sharma<sup>3</sup>**

<sup>1</sup>Post Graduate Student, MS (Obstetrics and Gynaecology), Adesh Institute of Medical Sciences & Research Bathinda, Adesh University, Bathinda. Punjab 151009

<sup>2</sup>Professor and Head, Department of Obstetrics and Gynaecology, Adesh Institute of Medical Sciences & Research Bathinda, Adesh University, Bathinda. Punjab 151009

<sup>3</sup>Professor and Head, Department of Radiodiagnosis, Adesh Institute of Medical Sciences & Research Bathinda, Punjab 151009

Corresponding Author

**Dr Chandan Sen**

Mobile: 7044013181/7837396641, Email: [chandansen0@gmail.com](mailto:chandansen0@gmail.com)

### Abstract

**Introduction:** Accurate estimation of fetal weight is of paramount importance in the management of labour and delivery. Sonography when carefully performed and accurately interpreted can supply vital information about the status of fetus. Ultrasound can predict the fetal weight accurately with a small margin of error if done by expert. So that when there is doubt regarding the gestational age or suspicion of IUGR or big baby it has become the best guide to the obstetrician.

**Aim and Objective:** To identify the most accurate method for foetal weight estimation

**Objective:** To calculate estimated fetal weight by Hadlock's formula (USG).

**Material and Method:** It is a hospital based study. Members of the study group have been selected consecutively as and when they present to hospital applying inclusion and exclusion criteria. Patients were selected from the maternity ward which is the Obstetrics & Gynaecology ward of AIMS, BATHINDA.

**Results and Conclusion:** Ultrasound (Hadlock's method) is found to be most reliable in foetal weight estimation. Least difference between the mean actual birth weight and mean estimated foetal weight. Predictive accuracy of estimated foetal weight by USG is 52% within 100 gm and 95% within 300 gm.

### Introduction

Accurate estimation of fetal weight is of paramount importance in the management of labour and delivery. During the last decade, estimated foetal weight has been incorporated into the standard routine ante partum evaluation of high risk pregnancies and deliveries. For instance, management of diabetic pregnancies, vaginal birth after a previous caesarean section and intra partum management of foetuses presenting by the breech

will be greatly influenced by estimated foetal weight.<sup>1-2</sup>

Also when dealing with anticipated preterm delivery, perinatal counselling on likelihood of survival, the intervention undertaken to postpone preterm delivery, optimal route of delivery or the hospital where delivery should occur may be based wholly or in part on the estimation of expected birth weight. Categorization of fetal weight into either small or large for gestational

age may lead to timed obstetric interventions that collectively represent significant departure from routine antenatal care.<sup>2-5</sup> High rate of perinatal mortality is still a major cause for concern in developing countries like India, a large portion of this problem is related to birth weight which remains the single most important parameter that determines neonatal survival.<sup>6-10</sup>

Sonography when carefully performed and accurately interpreted can supply vital information about the status of fetus. There is no known risk from ultrasonography. Ultrasound can predict the fetal weight accurately with a small margin of error if done by expert. So that when there is doubt regarding the gestational age or suspicion of IUGR or big baby it has become the best guide to the obstetrician.<sup>11-12</sup>

The advent of ultrasonography gave a breakthrough in estimating fetal weight as it was non-invasive, non-hazardous and reliable, fetal biometry gradually developed.

Although some Obstetrician considers sonographic estimates to be superior to clinical estimates, others believe in comparing both the techniques concurrently.<sup>13</sup>

#### **Aim**

- To identify the accuracy of ultrasound for foetal weight estimation.

#### **Objective**

- To calculate estimated fetal weight by **Hadlock's** formula (USG).

#### **Material and Method**

My study had been carried out in the Department of Obstetrics and Gynaecology and Dept of Radiodiagnosis.

Study is hospital based. Members of the study group have been selected consecutively as and when they present to hospital applying inclusion and exclusion criteria.

- Maternal height, weight measured and recorded as per proforma.
- Foetal weight assessment done by ultrasound.

- Actual birth weight measured just after birth.
- Comparison between the weight sonologically assessed and actual birth weight done.

#### **Materials of Study**

- I. Patients were selected from the maternity ward which is the Obstetrics & Gynaecology ward of AIMSR, BATHINDA.
- II. Weighing machine for mother
- III. Electronic weighing machine – for recording foetal weight very accurately.
- IV. USG machine (Voluson E8)
- V. The patients who fulfil the selection criteria are taken for study.

#### **Inclusion Criteria**

Patients with term pregnancies defined as 37 completed weeks and upto 40 weeks.

- 2) Singleton pregnancies.
- 3) Cephalic presentation.
- 4) Patient in early labour, booked for labour induction or elective cesarean.
- 5) USG estimated fetal weight (EFW) within a week prior to delivery

#### **Exclusion Criteria**

- 1) Multiple gestation
- 2) Malpresentation
- 3) Foetal anomalies
- 4) Intrauterine foetal demise
- 5) Polyhydroamnios or oligohydroamnios
- 6) Premature rupture of membrane (PROM)
- 7) Eclampsia
- 8) Ante partum haemorrhage
- 9) Maternal obesity
- 10) Fibroid or adnexal mass

#### **Ultrasonography**

After clinical assessment of the foetal weight, the patients were taken for ultrasound for estimating foetal weight, for this as such no preparation is required, patient is scanned in supine position with plenty of jelly on the abdomen after proper exposure of the whole abdomen.

Before scanning started

- i) Obstetric mode is selected
- ii) Patient's name, age, registration no. bed no. and date last menstrual period were entered to the machine.

Now transducer is gently placed over the abdomen after applying jelly and appropriate adjustment of brightness & contrast done. Foetal parts identified, cardiac pulsation noted. The lie & presentation of foetus determined. If any congenital anomaly is incidentally found out noted. The lie & presentation of foetus determined. The position of placenta and its maturity was noted. The amount of liquor is also noted.

### USG measurement of foetal parameters

For measuring foetal weight by USG these are four measurements to be done accurately they are

- i. Biparietal diameter (**BPD**)
- ii. Head circumference (**HC**)
- iii. Abdominal circumference (**AC**)
- iv. Femoral length (**FL**)

### Actual birth weight

All the baby delivered either by vaginal route or by Abdominal route were weighed within 4 hours of delivery by electronic baby weighing machine in labour room, and the weight is noted. This actual weight at birth is compared with the weight estimated by USG and accuracy were noted.

### Results

In this study 200 patients examined and their age, height, weight, weight gain recorded (Table 1). 200 patients belonging from 18 to 38 years of age with mean age of about 28 years. The range of height for 200 patients is from 142 cm to 170 cm with mean being 156 cm. The range for weight distribution is 38 kg to 74 kg with mean weight being 56 kg. Total weight gain during pregnancy in these 200 women varies from 5kgs to 11.5 kg with the mean weight gain being 8.5 kg.

The study group of 200 babies comprises of 113 female babies along with 87 male babies (Table 2). The mean actual birth weight of female babies is 2824.23 g with range from 750g to 4300 g. The

mean actual birth weight of male babies is 2911.28 g with range from 1500g to 4300 g. The range of actual birth weight of 200 babies varies from 1500 g to 4300 g with mean being 2894.31 g.

Out of 200 subjects 11 at 5.5% were from age group below 20, 121 at 60.5% were from age group in between 20 to 29 and 68 at 34% were from age group 30 and above (Table 3).

Among the 200 subjects in the study group the average actual birth weight of the three groups are as follows: <20 years of age = 2862.88 g; In between 20-29 years of age = 2844.29 g; 30 and above years of age = 2886.61 g (Table 4)

The actual average birth weight for both group A & B are 2799.62 g and 2800.72 g respectively (Table 5).

It is observed that for group A comprising of 36 subjects the average actual birth weight is 2555 g. For group B comprising of 164 subjects the average actual birth weight is 2909 g (Table 6).

### Actual Birth Weight

Total No. of pregnant women studied	= 200
Total No. of live birth	= 200
Mean actual birth weight	= 2886 gm
Maximum birth weight	= 4300gm.
Minimum birth weight	= 1500 gm.
Range	= 2800 gm.
Standard Deviation	= 502.34

Table 7 explains that in 68.3% of the baby the birth weight lie within Mean  $\pm$  502 gm and in 95.4% cases within Mean  $\pm$  1004 gm lastly 99.7% cases within Mean  $\pm$  1506.

For birth weight less than 2500 gm comprising of 36 women standard deviation is 287.19 and standard error is 57.4 For birth weight from range 2500gm to 3500gm comprising of 143 women standard deviation is 256.51 and standard error is 23.27. For birth weight more than 3500 gm comprising of 21 women standard deviation is 258.46 and standard error is 86

From Table 8 it is clear that most of the baby have birth weight in range of 2500 –3500 gm. It is also observed that standard error is also minimum in this range.

Table 9 shows the difference between mean actual birth weight and mean estimated foetal weight by USG is = 13.40 gm. The mean error of estimation of foetal weight = 130.94 gm. i.e. = 46gm/kg of birth weight, with S. D – Standard deviation = 481.11 and S.E- Standard error of the mean = 39.29. In this study coefficient of correlation  $Y = 0.9475$  suggesting a positive correlation between the foetal weight estimation by USG and actual birth weight.

Estimated foetal weight studied in detail – according to no. of cases underestimated; no. of cases over estimated and no. of cases having equal value to actual birth weight.

Table 10 depicts that:

1. Total no. of case over estimated = 72.
2. Total no. of case having exactly equal foetal weight estimation with birth weight = 11.
3. Total no. of cases underestimated = 117.

Table showing percentage of cases predicted with accuracy in the above said range.

Such as

20.66% is within 50 gm.

66% is within 150 gm.

96.66% is within 30 gm.

100% is within  $\pm 500$  gm.

Table 11 shows the comparison of foetal weight estimation done by ultrasound in term of percentage estimated within the range.

Table 12 shows that the average weight for actual birth weight in this study group is 2886 gm, for ultrasound is 2872.60 gm. The difference of mean actual birth weight and mean estimated foetal weight for ultrasound is 13.4 gm. The standard deviation of actual birth weight is 502.34, for USG is 481.11. The mean error of estimation for USG is 130.94 gm. The mean error per kg for USG is 46 gm/kg. The Co-efficient of correlation for USG is 0.9475.

**Table 1:** Patient Characteristics

N=200	Mean	Range
Age	28 years	18-38 year
Height	156 cm	142-170 cm
Weight(pre pregnancy)	56 kg	38-74 kg
Weight gain during pregnancy	8.5 kg	5-11.5 kg

**Table 2:** Sex of the Baby

SEX OF BABY	MEAN (weight in gram)	RANGE (weight in gram)
FEMALE(n=113)	2824.23	1750-4300
MALE(n=87)	2911.28	1500-4100
TOTAL(N=200)	2894.31	1500-4300

**Table 3:** Age Distribution

AGE RANGE	No OF PATIENTS	PERCENTAGE
<20	11	5.5
20-29	121	60.5
30 and above	68	34

**Table 4:** Comparison of Actual Birth Weight with Maternal Age

AGE GROUP	ACTUAL BIRTH WEIGHT
<20 (n=11)	2862.88 g
20-29 (n=121)	2844.29 g
30 and above (n=68)	2886.61 g

**Table 5:** Comparison of Maternal Height with actual Birth Weight

GROUP	HEIGHT	ACTUAL BIRTH WEIGHT
A	>150 cm (n=34)	2799.62 g
B	150 cm and above (n=166)	2800.72 g

**Table 6:** Comparison of Maternal Weight with actual Foetal Weight

GROUP	MATERNAL WEIGHT	ACTUAL BIRTH WEIGHT
A	≤ 45 kg (n=36)	2555 g
B	> 45 kg (n=164)	2909 g

**Table 7:** Percentage of the cases with the Range of Birth Weight

Sl. No.	Percentage of cases	Range (birth weight) in grams
1	68.3%	Mean ± 502
2	95.4%	Mean ± 1004
3	99.7%	Mean ± 1506

**Table 8:** Range of Birth Weights with Number, Standard Deviation and Stand Error

Sl. No.	Average Birth Weight	No. of women	S. D.	S.E.
1	< 2500 gm	36	287.19	57.4
2	2500 – 3500 gm	143	256.51	23.27
3	> 3500 gm	21	258.46	86

**Table 9:** Comparison of Mean Actual Birth Weight with Mean Estimated Birth Weight by USG

Sl. No.	No. of women		Mean weight
1	200	Mean actual birth weight	2886.00 gm
2	200	Mean estimated foetal weight by USG	2872.60 gm

**Table 10:** Table Showing the Comparison of Estimated Foetal Weight by USG with Actual Birth Weight

Sl. No.	Range	No. of cases over estimated	Equal	No. of cases underestimated	Total
1	± 50 gm	11	6	14	31
2	± 100 gm	23	6	51	80
3	± 150 gm	33	6	60	99
4	± 200 gm	45	6	76	127
5	± 250 gm	48	6	80	134
6	± 300 gm	51	6	88	145
7	± 500 gm	55	6	89	200

**Table 11:** Detailed Study of the Estimated Foetal Weight USG in Percentage

Sl. No.	Range	% of cases coming in the Range
1	± 50 gm	20.66%
2	± 100 gm	53.33%
3	± 150 gm	66%
4	± 200 gm	84.66%
5	± 250 gm	89.33%
6	± 300 gm	96.66%
7	± 500 gm	100%

**Table 12:** Comparison of USG with Actual Birth Weight

Sl. No.	Variables	Actual birth weight	USG
1	Average weight (in gm)	2886	2872.60
2	Difference of mean actual b.wt. and mean estimated foetal weight	-	13.4 gm
3	Standard deviation	502.34	481.11
4	Mean error of estimation		130.94g
5	Mean error per kg		46 gm
6	Co-efficient of correlation		0.9475

### Discussion

Various models have been used to estimated foetal weight and the are described by Hadlock (1985), utilising BPD, HC, AC and FL appears to be the most accurate.

The mean estimated foetal weight by USG is 2872.60 gm, mean actual birth weight is 2886 gm and the difference between these two mean is 13.40 gm. From this data it is seen that the difference is not significant so USG is a reliable method for foetal weight estimation. The standard deviation is 481.11, this means that mean+1standard deviation is 68 percent, mean +2 standard deviation is 95.4 percent, mean +3 standard deviation is 99.7 percent. Standard error of the mean is 39.29, here the standard error of the mean is the measurement of the sample error, this shows the accuracy of mean of our sample. Perfect accuracy of foetal weight prediction is understandably impossible from extrapolation of sizes of body parts and upto 15 percent difference between the actual and estimated weight are not uncommon.

Pearson product moment correlation coefficient ( $\gamma$ ) is used in order to find whether there is significant association or not between two variables.

Here in my study; I calculated coefficient of correlation between the actual birth weight and sonologically estimated foetal weight to be 0.9475 ( $\Gamma = 0.9475$ ). This shows strong positive correlation between the estimated foetal weight by ultrasound and actual birth weight in my study. The estimation of foetal weight is helpful to the obstetrician when considering preterm delivery or suspecting growth restriction or macrosomia in the third trimester but its limitations must be realised. The difference is more especially when totally foetal weight is <2500 gm, or >3500gm. When birth weight >3500 gm chances of under estimation is more by all (clinical and sonological) methods of foetal weight estimation. Where as when birth weight <2500 chances of over estimation is more

This is supported by the study of Niziurskip, Piase KG<sup>14</sup> – 2006 May. (Accuracy of weight prediction in full term new born by ultrasonography).

They found – The under estimation of foetal weight appeared with increasing new born weight >4.0 kg. The over estimation of foetal weight was found in the new born less than 2.5 kg.

This is also supported by the study of Colman A, Maharaj D, Hulton J, Thoh J (2006)<sup>15</sup>. They found – ultrasonic estimation of foetal weight tended to overestimate the weight of small in <2500 gm, and under estimate the weight of large infants  $\geq 4000$  gm.

### Conclusion

Ultrasound (Hadlock's method) – is found to be

- i) Most reliable in foetal weight estimation.
- ii) Least difference between the mean actual birth weight and mean estimated foetal weight.
- iii) Least mean error of estimation = 130.49 gm.
- iv) Least mean error /kg of birth weight = 46 gm/kg.
- v) Maximum coefficient of correlation = 0.9475.
- vi) Maximum predictive accuracy.

Predictive accuracy of estimated foetal weight by USG is 52% within 100 gm and 95% within 300 gm. Hence from the study it is seen that USG is most reliable in prediction of foetal weight accurately.

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