

Study on Comparison of Ultrasonographic Fetal Birth Weight With The Actual Birth Weight in Tertiary Care Hospital

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Abstract

Introduction: Accurate estimation of fetal weight is important in the management of delivery. Ultrasonography is widely used for fetal weight estimation because of cost-effectiveness and well defined measurement procedure. Early methods to predict birth weight with an ultrasound will help the clinicians to make decisions on the route of delivery.

Method: This was a cross sectional study conducted at Lumbini Medical College and Teaching Hospital, Palpa in the Department of Radiodiagnosis for a duration of nine months from February 2024 to October 2024. The study was approved by the Institutional Review Committee of the institute (IRC-LMC-05/M-24). The study population included singleton pregnancy at term (at/after 37 weeks) meeting inclusion criteria. A total of 180 pregnant women participated in study.

Result: The mean actual birth weight (ABW) was 3070.57 gram \pm 301.13. The estimated mean fetal birth weight (EFW) by ultrasound was 3346.62 \pm 204.29 grams using Hadlock 1 and 3308.89 \pm 204.69 grams using Hadlock 2. There was no significant difference between the mean fetal weight estimated by ultrasound scan using Hadlock formula and mean actual birth weight (p -value = <0.05). There was a positive correlation between ultrasound estimated fetal weight and actual birth weight ($r=0.34, p<0.05$ for Hadlock 1 and $r=0.36, p<0.05$ for Hadlock 2).

Conclusion: Ultrasound is reliable method for estimating fetal birth weight through Hadlock formula and it has strong correlations with actual birth weight, making it the preferred method for estimating fetal weight and planning delivery.

Keywords: Actual, Birth weight, Comparison, fetal, Ultrasound

Introduction

Fetal birth weight estimation is important in the management of delivery and predicting fetal survival. Ultrasonography is widely used for fetal weight estimation because of cost-effectiveness and well defined measurement procedure.¹ Antepartum weight estimation is also helpful in monitoring and detection of macrosomia and intrauterine growth restriction thus, fetal weight is an independent risk factor for determining perinatal mortality.^{2,3} The accuracy for predicting fetal birth weight by different ultrasonic measurements, different formulas has been studied but no particular formula or biometric measurement has superior accuracy.⁴ However,

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the commonly used formulas are proposed by Hadlock and colleagues.^{5,6} There are numerous formulas which uses multiple parameters in different combinations, only few of them are in clinical use. In this study, we utilized the most commonly used formula which is referred to as Hadlock(H1) 1 and Hadlock(H2) 2. Hadlock 1 formula incorporates HC, AC and FL parameters whereas Hadlock 2(H2) excludes HC for EFW calculation.³

So, the aim of this study is to compare the accuracy of ultrasonographic fetal birth weight with the actual birth weight using Hadlock1 and Hadlock.²

Methods

This was a cross sectional study conducted at Lumbini Medical College and Teaching Hospital, Palpa in the Department of Radiodiagnosis for a duration of nine months from February 2024 to October 2024. The study was approved by the Institutional Review Committee of the institute (IRC-LMC-05/M-24). The study population included singleton pregnancy at term (at/after 37 weeks) meeting inclusion criteria. Verbal consent was taken from the patients. A total of 180 pregnant women participated in study.

Procedure for the ultrasound fetal weight estimation:

Bladder was emptied. Patient was asked to lie with knee joints slightly flexed. Ultrasound estimated fetal weight (EFW) was obtained for all women by the same radiologist with a 3.5 MHz transducer (MEDISON Ultrasonic machine) using standard Hadlock 1 and 2 formula that used biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL) for calculating fetal weight. BPD was obtained at midline with thalami, cavum septum pellucidum and third ventricle on a transverse image of skull. Calipers were placed outer to inner margin of the bone. Head circumference (HC) was taken at the same level of the outer perimeter of the skull. AC was obtained with transverse image of abdomen where fetal stomach, portal vein and umbilical vein were demonstrated. Calipers were placed on the skin. FL measurement was taken with femur as horizontal as possible and distance between outer borders of diaphysis of the femoral bone. Weight of fetus was measured using Hadlock 1 and Hadlock 2. The maternal age, date of delivery, gestational age at ultrasound were recorded. After delivery the weight of the fetus was measured using standard weighing machine. The accuracy of sonographic estimation of fetal weight was determined with the following: (1) mean (EFW – ABW/ABW), (2) mean of absolute error (absolute value of EFW – ABW/ABW) (3) mean percentage error ((EFW – ABW) × 100/ABW).

Inclusion criteria

- Normal and singleton pregnancy after 37 weeks

Exclusion criteria

- Preterm labour
- Multiple pregnancies
- Congenital anomalies
- Intrauterine fetal death
- Polyhydramnios and oligohydramnios
- Mothers with obstetric complications like severe pre-eclampsia, eclampsia, HELLP syndrome
- Existing new medical illnesses

Statistical analysis

Date was analyzed using statistical package for social science (SPSS) version 21.0 software. The results were expressed as frequencies and percentages. Mean with standard deviation were calculated. Accuracy of Hadlock 1 and Hadlock 2 were calculated. Differences between EFW derived from the formulas and the actual birth were illustrated by the mean with 95% confidence interval and the results were tested by t-test. Mean error, mean absolute error, mean percentage error were calculated for each formula. The Pearson correlation between the estimated fetal weight and the actual weight was also determined and plotted as a scatter plot.

Results

The mean maternal age was 25.67 years with ± 4.90 . The minimum maternal age was 17 years and maximum were 39 years. The mean actual birth weight (ABW) was 3070.57 gram ± 301.13 . Minimum weight was 2415 grams and maximum were 4000 grams. Table 1

The estimated mean fetal birth weight (EFW) by ultrasound was 3346.62 ± 204.29 grams using Hadlock 1 and 3308.89 ± 204.69 grams using Hadlock 2. There was no significant difference between the mean fetal weight estimated by ultrasound scan using Hadlock formula and mean actual birth weight (p -value = <0.05). The mean of EFW for each method and the mean of ABW were compared using the paired t-test. Table 2

There was a positive correlation between ultrasound estimated fetal weight and actual birth weight ($r=0.34, p<0.05$ for Hadlock 1 and $r=0.36, p<0.05$ for Hadlock 2). Table 3

The mean in the estimation of birth weight was 22.38 gram and 22.13 gram for Hadlock 1 and Hadlock 2. The mean absolute error in the estimation of birth weight was 276.04 g and 238.32g. The absolute mean percentage error was 8.99% and 7.76 %. Table 4

Table 1: Maternal and fetal variable

Parameter	Mean (standard deviation)	Range	
		Minimum	Maximum
Maternal age(year)	25.67(4.90)	17	39
Actual birth weight(gram)	3070.57(301.13)	2415	4000
Hadlock 1 weight(gram)	3346.62(204.29)	2956	4210
Hadlock 2 weight(gram)	3308.89(204.69)	2923	4171

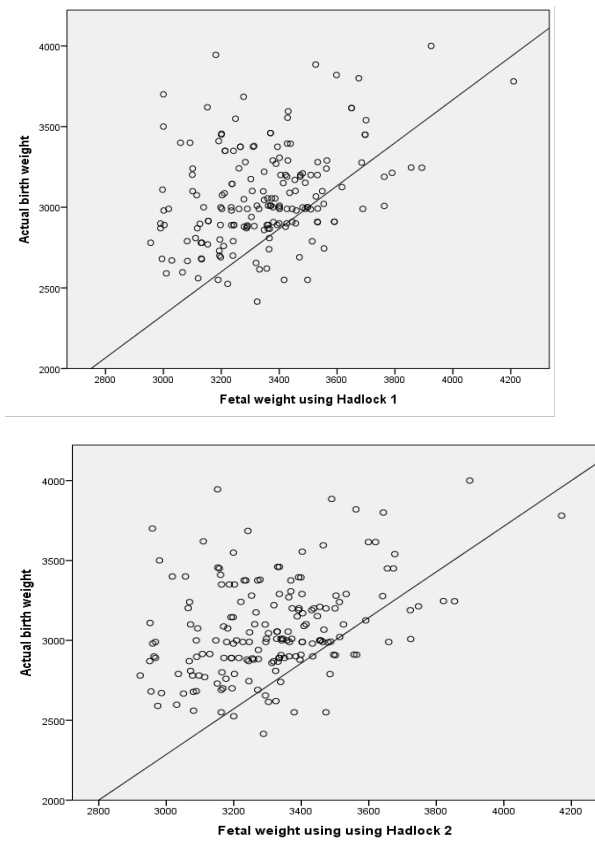
Table 2: Comparison of estimated actual birth weight with Ultrasound Hadlock 1 and Hadlock 2 methods

	Mean	Std. deviation	Std Error mean	95% CI of the difference		t	df	sig
				lower	upper			
Hadlock 1 weight with ABW (gr)	276.04	300.27	22.38	231.88	320.20	12.33	179	.00
Hadlock 2 with ABW (gr)	238.32	296.99	22.13	194.64	282.00	10.76	179	.00

*Paired Samples Test

Table 3: Correlation between ultrasound estimated fetal birth weight with actual birth weight.

Figure 1:



Graph showing the relation between ultrasound estimated fetal weight (EFW) using Hadlock 1 and Hadlock 2 with actual birth weight (ABW) (in grams) and a linear association between variables.

Table 4: Accuracy of method

Parameter	Mean	Absolute mean error(gr)	Absolute mean percentage error (%)
Hadlock 1	22.38	276.04	8.99
Hadlock 2	22.13	238.32	7.76

Discussion

Accurate estimation of fetal weight is important in the management of delivery. A lot of work has been done to find out accurate methods of estimation of fetal weight in utero including clinical and ultrasound estimations. Before the availability of ultrasound, conventional methods such as measurement of the maternal abdominal circumference and uterine height were used to estimate fetal weights, though the traditional methods are easy to use, several maternal factors may affect assessment abilities.⁷

Early methods to predict birth weight with an ultrasound will help the clinicians to make decisions on the route of delivery. Estimation of fetal weight is done ultrasonographically using Hadlock and other formulae.⁵ Ultrasound estimation of fetal weight, while being accurate to a certain degree, is associated with error ranging from ± 6 to 11% depending on parameters measured and the equation used for estimation. Determination of weight within 10% of actual birth weight is considered acceptable accuracy.⁸

The mean actual birth weight in this study was 3070.57 grams \pm 301.13. This was similar to the mean actual birth weight of 3070 grams reported by Bajracharya et al.⁹ and slightly higher than the study done by Prasad VN et al (2822.5 grams).¹⁰ The reason may be due to socioeconomic factors and proper diet during pregnancy.

The mean of ultrasonic weight estimation was 3346.62 \pm 204.29 grams for Hadlock 1 and 3308.89 \pm 204.69 for Hadlock 2 and with mean difference between EFW and the actual birth weight was 276.05 grams and 238.32 grams respectively. When the result was compared with actual

birth weight, it was found that actual birth weight was not significantly different. Similar findings have been observed by other studies.^{11,12}

In our study, the mean is 22.38, absolute mean error 276.04, absolute mean percent error (APE) is 8.99% for Hadlock 1 and 22.13, 238.32 and 7.76 Hadlock 2 respectively.¹³ In a study done by Mattsson N et al, with Hadlock formula, mean absolute percent error was 6.2% and SD of error was 7.6% of mean birth weight.¹⁴ In various study, the mean absolute percent error has ranged between 6 and 15%¹⁵ and about three-quarters of estimations were within 10% of birth weight.^{16,17,18} So, ultrasound should be used to estimate the fetal weight for the purposes of planning delivery and monitoring of the fetus.

Conclusion

Ultrasound is reliable method for estimating fetal birth weight through Hadlock formula and it has strong correlations with actual birth weight, making it the preferred method for estimating fetal weight and planning delivery.

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