AN ULTRASONIC STUDY OF ESTIMATION OF FOETAL WEIGHT BY BIPARIETAL DIAMETER AND ABDOMINAL CIRCUMFERENCE

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SUMMARY

The need for a quick and easy method for estimating fetal weight in utero has been clearly established. A total of 100 patients with 37 to 41 weeks pregnancy were ultrasonically scanned within 72 hours of delivery and biparietal diameter (BPD) and abdominal circumference (AC) were measured. From BPD and AC using two equations E_1 and E_2 foetal weight was estimated. It was found out that with equation E_2 in 94 per cent cases, weight could be estimated within 150 gm of actual birth weight in comparison to only 72 per cent with E_1 equation.

Introduction

Foetal weight estimates are very vital in obstetrics and play an important role in comprehensive evaluation and management of high risk pregnancy. Conventional methods of estimation of birth weight using clinical parameters are neither accurate nor reproducible. Johnson's formula (1957) and Dawn's formula (1981), though very easy are less accurate. Since the advent of ultrasound, direct measurement of foetal anatomy has been possible and one would logically be able to predict foetal weight more accurately. Biparietal diameter (Willocks *et al*, 1967), abdominal circumference (Campbell and Wilkin, 1975), thoracic diameters and total intrauterine volume (Gohari *et al*, 1977) have all been used individually to predict foetal weight but with less accurate results.

More recently attempts have been made to calculate foetal weight by two or more parameters. Warsof *et al* (1977) found a combination of BPD and AC to be most accurate. They derived equation E_1 on the basis of 85 ultrasonic profiles and showed prospectively 78 per cent accuracy within 10 per cent of actual birth weight in 32 cases by E_1.

Shepard et al (1982) used equation E_2 in 72 patients and compared their results obtained by E_2 to those obtained by E_1. They found that with E_1 there was a significant underestimation of birth weight especially in the range of less than 2.5 kg. With E_2, the estimates were much closer to the actual birth weight (Error of 40.85 gm/kg). Key *et al* (1983) found equation E_1 to be more accurate (92% cases falling within 10% error) as compared to E_2. Thus different accuracy by different authors prompted us to carry out the present study.

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Material and Methods

The present study was carried out in 100 patients with normal term (37 to 41 weeks) pregnancy admitted in the department of Obstetrics and Gynaecology, Rohtak (Haryana) between August, 1985 to February 1987, who were expected to deliver within 72 hours.

After doing clinical examination, all patients were subjected to sonographic examination and following measurements were taken:

(1) Biparietal diameter (BPD) was measured at the level at which a clear midline echo of falx cerebri was discernible.

(2) Foetal abdominal diameters (FADS) were measured at a plane where umbilical vein was seen entering the porta-hepatis.

(i) Foetal abdominal diameter antero-posterior (FAD-AP). This was taken from mid point of spine posteriorly in a direction perpendicular to it.

(ii) FAD-transverse: This was taken at right angles to FAD-AP along the widest transverse diameter.

Abdominal circumference (AC) was then calculated from the above two using following formula by Campbell and Wilkin, 1975.

$$AC = \sqrt{\frac{(FAD\text{-}AP)^2 + (FAD\text{-}Trans)^2}{2}}$$

Foetal weight was then calculated using the following two equations:

Equation E_1 (Warsof *et al*, 1977)

$$E_1 \log 10\ BW = -1.59940 + 0.144(BPD) + 0.032(AC) - \frac{0.11(BPD)^2\ AC}{1000}$$

Equation E_2 (Shepard *et al*, 1982)

$$E_2 \log 10BW = -1.7492 + 0.166\ (BPD) + 0.046(AC) - \frac{2.646(BPD)(AC)}{1000}$$

Two readings of estimated foetal weight by equation E_1 and E_2 were obtained and compared with the actual birth weight taken after birth.

Results

Actual birth weight ranged from 2.00 to 3.70 kg with mean being 3.0 kg in the present study of 100 cases. Estimated birth weight by equation E_2 ranged from 2.10 to 3.72 kg with mean being 3.446 kg. There was mean overestimation of 44.62 gm with E_2 (Standard error of 50.69). It was observed that actual birth weight and antenatal ultrasonic estimated weight were similar in 4 cases by equation E_2. In 46 women the estimated weight was within 50 gm. Birth weight could be estimated accurately in 80% cases within 100 gm. In rest of 20 cases, it was within 100-150 gm in 14 cases and 150-200 gm in 2 cases. Only in 4 cases estimation was within 200-300 gm (Table I). On further analysis of equation E_2 in 70 cases there was overestimation of foetal weight by 50, 100, 150 and 200 gm in 28, 24, 12 and 2 cases respectively. In 4 cases overestimation was more than 200 gm. In 26 cases there was underestimation of foetal weight by 50, 100 and 150 gm in 14, 10 and 2 cases respectively.

Birth weight estimated by equation E_1 ranged from 1.88 to 3.62 kg with mean being 2.904 kg and mean underestimation of 94.76 gm (standard error 48.67). In 18 cases birth weight could be estimated within 50 gm while in 52% estimations could be done within 100 gms. Another 20 cases were between 101-150

TABLE I

Showing Equation E_2 to Show Overestimation and Underestimation

Variation in weight	No. of cases showing overestimation	No. of cases showing underestimation	Total No. of cases
Zero	—	—	4
50 gms	28	14	42
51-100 gms	24	10	34
101-150 gms	12	2	14
151-200 gms	2	—	2
>200 gms	4	—	4

gm making 72% women within 150 gms. Only in 28 cases underestimation was done beyond 150 gm with 20 cases lying between 151-200 gm and only 8 cases were beyond 200 gm (Table II). On further analysis of equation E_1 there was underestimation in 90 cases with 12, 32, 18 and 20 cases underestimating by 50 gms, 100 gms, 150 gms and 200 gms respectively. Only 8 cases showed underestimation beyond 200 gm. In 10 cases there was overestimation of birth weight by 50, 100 and 150 gms in 6, 2 and 2 cases respectively (Table II).

On comparing the two equations, E_2 gave better results with 46%, 80%, 94%, 96%, 100% cases lying within 50 gm, 100 gm, 150 gm, 200 gm and 350 gm respectively in comparison in 18%, 52%, 72%, 92% and 100% of equation E_1 (Table III).

The results of E_1 in the present study were compared with those of Shepard *et al* (1982) and mean standard deviation and standard error were almost same in two studies (Table IV).

The results of equation E_2 were also compared with those of Shepard *et al*

TABLE II

Showing Equation E_1 to Show Underestimation and Overestimation

Variation in weight	No. of cases showing overestimation	No. of cases showing	Total No. of cases
50 gms	6	12	18
51-100 gms	2	32	34
101-150 gms	2	18	20
151-200 gms	—	20	20
>200 gms	—	8	8

TABLE III

Showing Comparison of Percentage of Accuracy between Equation E_1 and E_2

Variation in weight	Percentage of accuracy by equation E_1	Percentage of accuracy by equation E_2
± 50 gm	18%	46%
± 100 gm	52%	80%
± 150 gm	72%	94%
± 200 gm	92%	96%
± 250 gm	100%	100%

TABLE IV
Percentage of Accuracy By E_1

Actual weight in entire group	Standard deviation		Standard error	
	Shepard *et al* (1982)	Present study (1987)	Shepard *et al* (1982)	Present study (1987)
<2500 gm	212.4	168.13	33.65	84.63
2500-3500 gm	395.42	230.43	84.30	35.14
>3500 gm	566.06	90.42	170.67	52.40
Mean	343.30	344.15	40.19	48.67

TABLE V
Showing Percentage of Accuracy by E_2

Actual weight in entire group	Standard deviation		Standard error	
	Shepard *et al* (1982)	Present study (1987)	Shepard *et al* (1982)	Present study (1987)
<2500 gm	218.82	163.13	34.60	82.57
2500-3500 gm	405.20	342.82	86.39	77.03
>3500 gm	566.54	563.75	170.82	166.80
Mean	348.98	358.28	40.85	50.69

(1982) and were found to be consistent with each other (Table V).

Comments

The findings of the present study indicated that there was an underestimation of foetal weight with equation E_1. While when equation E_2 was used the overall average difference between actual and predicted foetal weight were found to be more closer to zero than when estimates were taken from E_1 (+ 44.62 versus —12.85 gm versus —130.21 gm). Though in earlier study Warsof *et al* (1977) had reported good results with E_1 with 78% estimates falling within 10% of actual birth weight.

Key *et al* (1983) found 92% cases falling within 10% of actual birth weight with E_1.

But in present study equation E_2 gave better estimate. Although the differences in estimates of foetal weight between E_1 and E_2 are not dramatic, E_2 does provide a better estimate for majority of cases with 94% cases falling within 150 gm of actual birth weight in comparison to 72% with E_1.

In conclusion equation E_2 should be used for predicting foetal weight.

References

1. Campbell, S. and Wilkin, D.: Brit. J. Obstet. Gynec., 82: 689, 1975.
2. Dawn, C. S.: Cal. M. J., 78: 60, 1981.
3. Gohari, P., Berkowitz, R. L. and Hobbins, J. C.: Am. J. Obstet. Gynec. 127: 255, 1977.
4. Johnson, R. W.: Am. J. Obstet. Gynec. 74: 929, 1957.
5. Key, T., Bonnie, C., Dattel, J. and Resnik, R.: Am. J. Obstet. Gynec. 154: 574, 1983.
6. Shepard, M. J., Richards, V. A., Berkowitz, R. L., Warsof, S. L. and Hobbins, J. C.: Am. J. Obstet. Gynec., 142: 47, 1982.
7. Warsof, S. L., Gohari, P., Berkowitz, R. L. and Hobbins, J. C.: Am. J. Obstet. Gynec., 128: 881, 1977.
8. Willocks, J., Donald, I. and Duggan, T. C.: J. Obstet. Gynec. Brit. C'Wealth, 71: 11, 1964.