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ROLE OF FETAL THIGH CIRCUMFERENCE IN PREDICTI0N OF FETAL WEIGHT AND COMPARING IT WITH OTHER CLINICAL AND ULTRASOUND METHODS

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ABSTRACT

The aim of the study is to evaluate the accuracy of predicting birth weight by various clinical and ultrasound methods and comparing it with actual neonatal weight. Accuracy of fetal weight estimation is analysed with addition of one more parameter – mid thigh circumference and compared with usual Hadlock formula, clinical formula and actual neonatal weight.

100 women with singleton term pregnancies in whom fetal anomalies were ruled out were selected for study. 60% patients were in the age group of 20 to 25 years with average age of 24 years.48% were primi gravida and 52% were multi. 58% delivered vaginally and 42% delivered by LSCS. General and obstetric examination were done for these patients. Symphysiofundal height and abdominal circumference at the umbilical level was measured. Fetal weight was calculated by Johnson and Insler formula. Ultrasound was done for these patients, Fetal parameter – Biparietal diameter, Head circumference, abdominal circumference and mid-thighcircumference were taken. Estimated fetal weight by Hadlock formulae which is already computed in the USG machine is taken. Fetal weight using mid-thigh circumference using Vintzileos formula was calculated. Fetal weight using these methods were taken within 2 days of delivery. Actual neonatal weight was calculated within 1 hour of delivery in an electronic fetal weighing scale.

Fetal weight in grams were categorized into 4 categories – less than 2500 (9%), 2501 - 2000 (51%), 3001 – 3500 (32%) and more than 3500 (8%).Fetal weight estimation by clinical and ultrasound formulae were compared and analysed by % error prediction, standard deviation, chi square test and p value. Mean average fetal weight was 3042 grams.

Standard deviation for Johnson formula was 232, Insler formula was 253, Hadlock was 198 and Vintzileos was 61.2.

Vintzileos error prediction was 2% in 2nd and 3rd categories, 8% in less than 2500gm category and 2 % in 3500 gm categories which is least against 12 to 14% in clinical methods.

Mean difference of weight from actual weight in grams is very less in Vintzileos for all categories.51 for less than 2500- 3000 group, 75 for more than 3500gm group. P% of error is 1 – 2 % by Vintzileos.

Vintzileos formula incorporating fetal mid-thigh circumference was very accurate in all weight categories with very significant P value of <0.0001. Particularly in above 3500gm group prediction error is 1 -2%.In less than 2500gm group Vintzileos was comparable with Hadlock group.

Regarding clinical formulae Insler formula was accurate than Johnson formula with P value of .002.

Both clinical ad USG methods predict the birth weights within 7 % of the actual birth weights. But when any growth abnormalities are present fetal weight by ultrasound is accurate than clinical methods in all weight groups.

KEYWORDS

INTRODUCTION:

Fetal and extra uterine life forms a continuum during which human growth and development are affected by genetic, socioeconomic and environmental factors. One of the most important factor is BIRTH WEIGHT an important determinant for neonatal survival. There are documenting evidences showing relationship between low birth weight and increased infant mortality and morbidity. Perinatal and infant mortality rates are 2 times higher in low birth weight infants.

World Health Organisation (WHO) on basis on worldwide date has recommended than new-borns weighing less than 2500gms are considered to fall in low birth weight categories carrying greater risk of perinatal and neonatal morbidity and mortality with substandard growth and development in later life. they are prone for malnutrition, recurrent infection and neurodevelopmental handicaps. They are prone for diabetes, hypertension, coronary heart disease in later life with adverse outcome.

In another spectrum of the study are macrosomic babies weighing more than 4000 grams with high mortality and morbidity. They have high association with maternal diabetes, prolonged labour, higher LSCS rates, susceptibility to birth injuries like clavicle fracture, brachial plexus injuries, hypoglycaemia, electrolyte imbalance and neonatal jaundice. Estimation of birth weight has great significance in detecting growth restriction, prematurity and situation when clinical decision involving induction of labour or deciding the mode of delivery is to be taken.

Accurate estimation of fetal weight is important in dealing with high risk foetuses with IUGR and macrosomia. The error in estimation of fetal weight is more at two ends of the weight scale. Hence a more suitable formula for accurate measurement of fetal weight in all weight categories is needed.

Hence one more parameter –fetal midthigh circumference is added to improve the accuracy of available formula.

Materials and Methods

This is a prospective study of 100 antenatal women presented to labour ward Department of obstetrics &Gynaecology Government Rajaji Hospital Madurai in a time between May 2010 to November 2010 for delivery during our senior residency and submitted as dissertation. 60% patients were in the age group of 20 to 25 with an average age of 24years. 48% were primi gravida and 52% were multi gravida. 58% delivered vaginally and 42% delivered by LSCS. Consent was obtained. General, obstetric examination done for these patients. Clinical fetal weight estimation was done by Johnsons and Insler formula. Fetal biometry was taken by MAINDRAY ultrasound machine available in the OG department. USG fetal weight estimation was done by Hadlock formula which was already computed in the ultrasound machine and by Vintzileos formula using Midthigh circumference using the below given formula. Actual neonatal weight was taken in an electronic weighing scale within 1 hour of delivery.

Estimation of Fetal weight – Methods and Measurement.

A. Clinical methods include Johnson formula and Insler formula

Per Johnsons formula fetal weight in grams is (Symphysiofundal height in cms - N) x 155.

Per Insler formula fetal weight in grams is Symphysiofundal height x abdominal girth in cms.

Symphysiofundal height is length between symphysis pubis and fundus taken after empty bladder and correction of dextrorotation. N is taken as 11 when the presenting part is below the spines and N is 10 when the presenting part is above the spine. Abdominal girth is taken at the level of the umbilicus.

Limitations of clinical methods of estimating fetal weight are obese abdominal wall, malpresentations, poly/oligo hydramnios, Multiple pregnancies, uterine/ adnexal tumours, IUGR and macrosomia etc. Advantage of these methods are that it is very simple to use without any sophistic machine and can be done even by para medical workers at primary health care levels levels.

B. Ultrasound method include Hadlock formula and Vintzileos formula.
With advanced technology Ultrasound has become an essential tool in assessing fetal, placental and liquor indices. It is also superior to clinical methods in determining fetal growth, gestational age and fetal weight. Basic fetal measurements used to estimate various fetal parameters constitute fetal biometry. They are biparietal diameter, head circumference, abdominal circumference, femur length and midthigh circumference.

Biparietal diameterBPD is two-dimensional measurement taken between outer edge of near calvarial wall to inner edge of far calvarial wall. Any plane of section through a 360-degree arc passing through the thalami and third ventricle is acceptable.

Femur lengthFL is a single dimension measurement where only the ossified portion of the diaphysis and metaphysis ismeasured. Transducer should be aligned such that femoral head, greater trochanter and the femoral condyle are simultaneously viewed.

Abdominal circumference AC is a three-dimensional measurement. It is a position where the right and left portal veins are continuous with one another. The shortest segment of umbilical segment of left portal vein should be depicted. AC has the largest reported variability. It is more acutely affected by growth disturbances than other parameters.

Mid-thigh circumferenceTL is a three-dimension measurement. Whole femur from greater trochanter to the distal metaphysis is imaged. Then the transducer is rotated by 90degrees to obtain cross sectional profile of the middle of the thigh at a position where bone profile is as round as possible. Boundary of the thigh profile should be well defined. Thigh circumference is determined with elliptical approximation 3 times and average is taken as final measurement.

Per Hadlock formula fetal weight in grams is calculated by
$Log_{10}EFW = 1.335 - 0.0034(AC)(FL)+0.0316(BPD+0.0457(AC)+0.1623(FL)$.
All machines have computation package utilizing Hadlock formula for estimating fetal weight.
Per Vintzileos formula fetal weight in grams' is
$Log_{10}(BW)= 1.897 + (0.015 \times AC) + (0.057 \times BPD) + (0.054 \times FL) + (0.011 \times TC)$

ANALYSIS
Birth weight in different groups - Actual neonatal birth weight is categorized into 4 groups- group 1 weighing less than 2500 grams, group 2 weighing 2501 to 3000 grams. group 3 weighing 3001 to 3500grams and group 4 weighing more than 4000 grams. Percentage of neonates in each weight categories are 9%51% 32% and 8% respectively. Group 2 formed the major category. Overall mean birth weight was 3042 grams. Standard deviation for Johnson's and Insler formula was 232 and 253. 198 and 612 was for Hadlock and Vintzileos formula. Vintzileos method proved better than all methods in different weight groups and more accurate in group 3 and 4. In category 1 it was comparable with Hadlock formula.

Mean of difference from actual birth weight in different categories –Vintzileos has least difference from the actual weight in all categories. It predicts the birth weight within 2% in all categories except in Category 1 which was 8 %. Hadlock predicts 6-7% in category 1 which was better than Vintzileos. All the methods predicted within 8% in category 2 which forms the major sample size. In category 1 Vintzileos is comparable to Hadlock. Among clinaical methods Insler is better than Johnson.

% of error of different methods in all categories- It is the difference in calculated weight divided by actual weight multiplied by 100. Vintzileos is accurate in all categories particularly in group 2. Among the clinical methods Insler is more accurate than Johnson.

Chi square analysis and P value of different formulae in different categories – All formulae were compared against actual birth weight and against Vintzileos. In birth weight above 3500grams p value is extremely significant in the order of less than 0.0001 for Vintzileos. In less than 2500gram category Vintzileos is comparable with Hadlock. In other categories, also Vintzileos proved better than other formula. Among clinical method Insler is better than Johnson with p value of 0.002.

Discussion–This is a prospective study involving 100 antenatal women attending labour ward. fetal weight estimation was done by clinical and ultrasound method.a new parameter midthigh circumference was taken to predict birth weight using vintzileo formula. all the 4 values were compared with the actual neonatal weight.

- **Prediction of birth weight does not rely on the Age of the patient and parity.**
- **Prediction of Macrosomic foetuses is more accurate with Vintzileos**
- **Prediction of birth weight in lower group categories by Vintzileos is comparable with Hadlock.**
- **In extreme weight categories error of prediction is less for USG formulae than clinical methods.**
- **Among the clinical methods Insler is more accurate than Johnson.**

Comparative Analysis Of Birth Weights In Different Groups

Methods	Less than 2500gms	2501 to 3000gms	3001 to 3500gms	More than 3500gms	Overall Weight
No of cases	N=9(9%)	N=51(51%)	N=32(32%)	N=8(8%)	N=100
Actual Birth Weight(mean)	2456	2855	3235	3625	3042
Johnson	2721	3027	2964	3157	2945
Insler	2700	2989	3022	3129	2906
Hadlock	2585	2751	3116	3235	2897
Vintzileos	**2625**	**2906**	**3300**	**3550**	**3162**

Mean Of Difference From Actual Birth Weight In

Different Weight Categories

Methods	Less than 2500gms N=9	2501to 3000gms N=51	3001 to 3500gms N=32	More than 3500gms N=8
Johnson	265	172	271	468
Insler	244	134	213	496
Hadlock	129	104	219	390
Vintzileos	179	51	65	75

Percentage Of Error Of Different Formulas In Different Weight Categories

Method	Less than 2500gms	2501 – 3000gms	3001 – 3500gms	More than 3500gms
Johnson	10.79%	6.02%	8.38%	12.9%
Insler	9.93%	4.69%	6.58%	13.68%
Hadlock	5.25%	3.64%	6.76%	10.76%
Vintzileo	6.73%	1.79%	2.01%	2.07%

6.Mean difference of weight from actual weight in grams:

	Vintzileo	Hadlock	Insler	Johnson	Dawn
Our study	92.5	210	272	294	--
Hebbar	141	263	377	414	--
Bhandary	--	299	224	292	464

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