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Review Article

"ULTRASONOGRAPHIC FETAL GESTATIONAL AGE DETERMINATION IN HEALTHY WOMEN WITH UNCOMPLICATED PREGNANCY-A-Review"

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ABSTRACT

Appropriate assessment of gestational age is paramount in obstetric care. Making appropriate management decisions requires accurate appraisal of gestational age. Accurate pregnancy dating may assist obstetricians in appropriately counseling women who are at risk of a preterm delivery about likely neonatal outcomes and is also essential in the evaluation of fetal growth and the detection of intrauterine growth restriction. The aim of the present study is to compare various parameters which can be used for gestational age estimation and to find out reliable parameter. These parameters have been analyzed in detailed as a part of Ph.D. work of the third author under the first author.

KEYWORDS : Gestational age, Fetal foot length, Ultrasonographically age estimation

INTRODUCTION : Appropriate assessment of gestational age is quintessential in obstetric care. Making appropriate management decisions requires accurate appraisal of gestational age. Accurate pregnancy dating may assist obstetricians in appropriately counselling women who are at risk of a preterm delivery about likely neonatal outcomes and is also essential in the evaluation of fetal growth and the detection of intrauterine growth restriction. Accurate gestational age is also important in the interpretation of biochemical serum screening test or for counselling patients regarding the option of pregnancy termination early in the pregnancy. Since clinical data such as the menstrual cycle or uterine size often are not reliable, the most precise parameter for pregnancy dating should be determined by the obstetrician by ultrasound. Ultrasound is an accurate and useful modality for the assessment of gestational age in the first and second trimester of pregnancy and, as a routine part of prenatal care, can greatly impact obstetric management and improve antepartum care[1].

Methods for assessment of gestational age are:

1. Assessing gestational age using LMP : The first day of the last menstrual period (LMP) traditionally has been used as a reference point, with a predicted delivery date 280 days later. However, assessing gestational age using the menstrual cycle

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can often be inaccurate. One obstacle in using the LMP is the varying length of the follicular phase and the fact that many women do not have regular menstrual cycles[1].

2. Clinical methods for determining gestational age : Aside from ultrasound, other methods used to assess gestational age have included uterine size assessment, time at quickening and fundal height measurements. However, these clinical methods are often suboptimal[1].

3. Ultrasound assessment of gestational age : Ultrasound assessment of gestational age has become an integral part of obstetric practice in recent times. Correspondingly, assessment of gestational age is a central element of obstetric ultrasonography. Fetal biometry has been used to predict gestational age since the time of A-mode ultrasound. Currently, the sonographic estimation is derived from calculations based on fetal measurements and serves as an indirect indicator of gestational age. Over the past three decades, numerous equations regarding the relationship between fetal biometric parameters and gestational age have been described and have proven early antenatal ultrasound to be an objective and accurate means of establishing gestational age[1].

Ultrasonographic assessment of gestational age can be done by different methods during the course of pregnancy:

(a) First trimester ultrasound : Gestational age assessment can be predicted with ultrasound most accurately in the first trimester of pregnancy. During this time, biological variation in regards to fetal size is minimal. The gestational sac is the earliest sonographic sign of pregnancy. 1973, Robinson reported using the crown rump length (CRL) for determining gestational age. Since that time, ultrasound equipment, techniques and prediction formulas have substantially improved and allow for more precise measurement of the crown rump length and determination of gestational age. For the best results, the fetus should be imaged in a longitudinal plane. The greatest embryonic length should be measured by placing the calipers at the head and rump of the fetus. Three adequate CRL measurements should be taken and the average used for gestational age determination. The accuracy of the CRL measurement has been well documented in the medical literature. In particular, sonographic measurement of the CRL during the first trimester is the best parameter for estimating gestational age and is accurate within five days of the actual conception date[1].

(b) Second trimester ultrasound : In addition to screening for fetal anomalies, sonographic gestational age assessment is of clinical value in that it has been shown to decrease the incidence of post-term as well as preterm diagnoses. In addition, uncertain gestational age has been associated with higher perinatal mortality rates and an increase of low birth weight and spontaneous preterm delivery[1].

(c) Third trimester ultrasound : While ultrasound has proven to be useful in the assessment of gestational age in the first and second trimesters, accuracy in the third trimester is not as reliable. Biologic variation can be a major factor that affects accuracy in gestational age prediction, and this variability greatly increases with advancing pregnancy[1].

Review of literature : When choosing the optimal parameter for estimating gestational age, it is essential that the structure has little biologic variation, and can be measured with a high degree of reproducibility. In the past, the biparietal diameter (BPD) had been described as a reliable method of determining gestational age. While the BPD was the first fetal parameter to be clinically utilized in the determination of fetal age in the second trimester, more recent studies have evaluated the use several other biometric parameters including head circumference (HC), abdominal circumference (AC), femur length (FL), foot length (FTL), Tibial length (TL), ear size, orbital diameters, cerebellum diameter and others[1].

The measurement of the long bones of the extremities is being increasingly incorporated into the ultrasonic evaluation for fetal development and diagnosis of fetal anomalies[2].

Sonographic measurement of ossified shafts of fetal long bones is possible after 12 weeks of gestation. Several studies have established standard growth curves for femur, but only a few authors have described normal values for the humerus, tibia,

fibula, radius and ulna, the few ultrasound studies reporting fetal limb bone length data are not really comparable, in that they are based on study population with different genetic and socioeconomic characteristics. Furthermore the techniques employed in these studies were not comparable[3].

Measurement of fetal limbs can be used to date pregnancies assessment of fetal anatomy. The femur length is the most as well as forming an important part of the commonly used limb measurement and is usually included as a routine part of any fetal anomaly scan. However, when signs indicating the possibility of a skeletal dysplasia are found more extensive evaluation of all long bones is needed to aid diagnosis[4].

Radiological measurements e.g. lengths of foetal long bones, have been earlier considered to determine gestational age (Felts)[5] & (Mehta and Singh)[6]. Martin and Higginbottom[7] reported on parallax radiological measurement of the femoral shaft in approximately 100 foetuses from 16 to 38 weeks. The method was mathematically complicated and the number of cases after 30 weeks was small but it showed that growth in length of the femur occurred at a regular rate for each week of gestation.

Available evidence on the ontogeny of human limb bones reveal distinct patterns of pre and post-natal growths. Early foetal development (2-4 months) is characterized by accelerated growth of the upper limbs (Bagnall et al)[8] while postnatal growth is characterized by accelerated growth of lower limbs (Watson and Lowery[9]; and Meredith[10]. Noback[11] studied the ossification centres of the long bones in foetal specimens from 2 months to birth. He noted that ossification centres of the upper extremity form earlier than those of the lower extremity, and form in the sequence humerus-radius-ulna in the upper extremity and femur-tibia-fibula in the lower extremity. Interestingly embryological studies by Queenan et al.[12], O'Brien et al.[13] & Hadlock Elejalde[14] have demonstrated strong correlations between the size of organs and gestational age as well as limb bones lengths and gestational age.

Direct measurement of the lengths of ossifying bones in human foetal limb bones has been the subject of several radiographic and USG studies [Hodges[15], Brandfass and Howland[16]; Owen et al.,[17] Russell et al., [18] & Pandey et al.[19,20]]

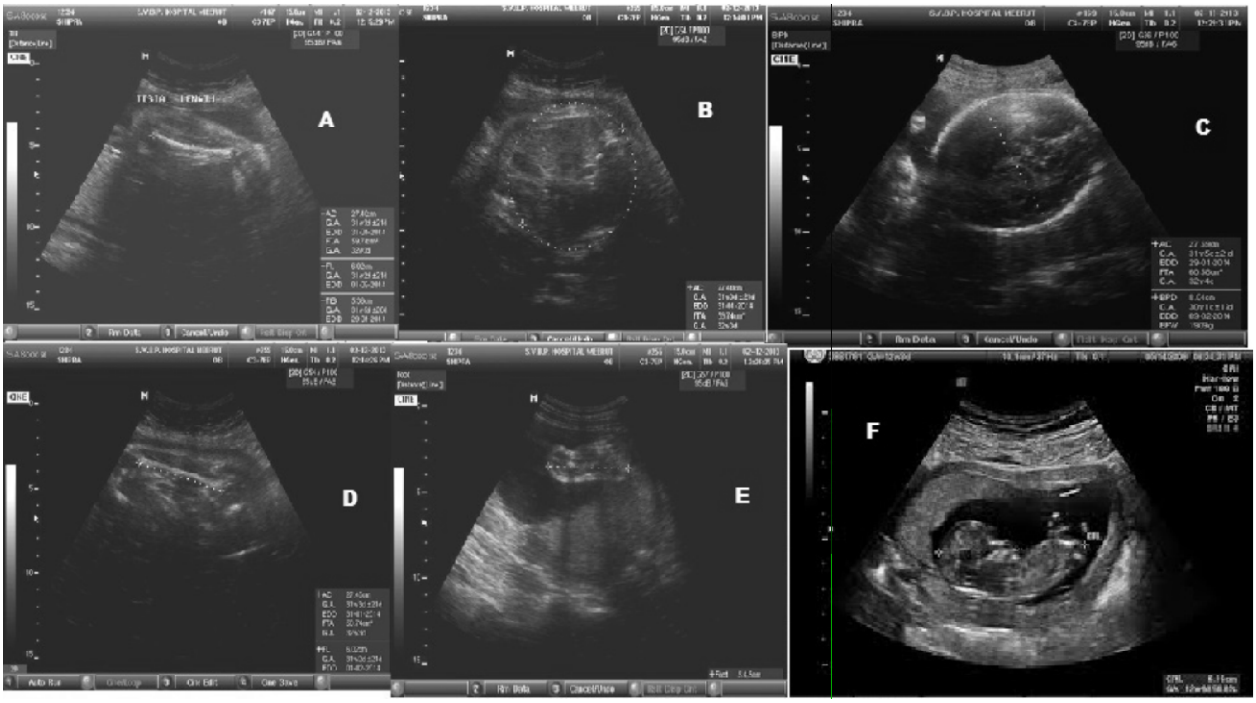

FIGURE-1: Ultra sonogram of 12-26 weeks of fetus showing A: Tibial length, B: Abdominal circumference, C: Biparietal Diameter, D: Femur length, E: Foot length and F: Crown Rump Length.

Weeks	Mean TL (mm±SD)	Mean BPD (mm±SD)	Mean AC (mm±SD)	Mean FL (mm±SD)	Mean FTL (mm± SD)
15	10.25±00	15.50±1.41	95.00±3.82	15.75±1.70	17.50 ± 1.29
16	15.25±0.50	32.75±1.89	104.0±2.82	20.50±0.57	19.75 ± 0.50
17	19.75±0.50	37.25±0.95	111.2±6.99	23.25±0.95	20.00 ± 0.81
18	24.40±0.55	40.60±0.89	116.4±4.09	27.80±0.44	22.60 ± 2.96
19	28.00±0.82	45.25±0.95	124.5±2.51	30.50±1.00	25.75 ± 0.50
20	31.00±0.90	47.66±0.81	144.0±4.19	33.33±1.21	26.66 ± 1.96
21	35.75±0.50	55.00±0.81	155.0±2.58	34.00±0.81	28.00 ± 0.81
22	37.40±0.90	56.80±0.83	173.2±2.77	37.20±1.30	30.20 ± 1.09
23	41.50±0.58	58.00±0.81	181.0±2.58	40.66±1.00	32.50 ± 1.00
24	42.40±0.55	61.00±1.41	196.2±3.63	42.60±0.89	34.80 ± 0.83
25	44.50±0.58	62.00±1.41	200.8±4.85	45.50±1.00	35.75 ± 0.50
26	46.40±0.55	65.20±1.64	216.4±5.77	49.20±1.30	35.80 ± 2.28
27	48.25±0.50	65.00±1.15	225.5±5.00	51.50±1.00	36.25 ± 2.06
28	50.60±0.82	71.66±3.07	231.2±11.5	54.00±2.52	37.33 ± 1.21
29	52.80±0.55	74.80±0.83	255.4±5.45	54.40±1.14	41.20 ± 1.09
30	55.40±0.55	75.00±1.00	272.8±3.34	57.40±0.89	43.40 ± 1.34
31	57.50±0.58	78.75±0.95	271.5±5.97	58.75±0.95	45.50 ± 2.38
32	60.50±0.52	79.20±0.83	288.2±9.70	62.40±2.07	47.00 ± 2.00
33	62.50±0.58	83.50±2.51	294.0±3.74	63.00±2.58	49.00 ± 3.46
34	65.50±0.58	85.00±0.81	304.0±4.32	66.20±50.5	51.25 ± 0.95
35	68.50±0.58	87.25±1.50	312.7±3.40	69.25±1.70	58.75 ± 4.78
36	70.80±0.84	89.80±1.48	325.6±6.22	72.60±1.34	64.40 ± 3.28

TABLE-1: Association between Gestational Age and Tibial Length, Bi-Parietal Diameter, Femur Length, Abdominal Circumference, Fetal Foot Length

CONCLUSION : Uncertain gestational age has been associated with adverse pregnancy outcomes including low birth weight, spontaneous preterm delivery and perinatal mortality, independent of maternal characteristics. Accurate gestational age assessment is also essential in the evaluation of fetal growth and the detection of intrauterine growth restriction. There are various methods and techniques to determine gestational age but USG is most widely used, safe and accurate mode. Various parameters like biparietal diameter (BPD) head circumference (HC), abdominal circumference (AC),

femur length (FL), foot length (FTL), Tibial length (TL) and others use for estimating the age of developing fetus. Fetal long bone length and foot length are good marker for gestational age and can be used in cases, who are not sure about their LMP. In the normally developing fetus the fetal foot length increases with advancing gestational age. Fetal foot length is a good marker for gestational age especially in cases of femur achondroplasia, dolichocephaly or brachycephaly and in cases who are not sure about their L.M.P. Fetal foot length was particularly useful when other parameters did not accurately predict gestational age, e.g., in cases of hydrocephalus, anencephaly , short-limb dwarfism, gastroschisis, and omphalocele.

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