



**Sudan University for Sciences and Technology**  
**College of Graduate Studies**



**Prediction Of Gestational Age Using Humeral Length  
In Third Trimester Using Ultrasonography**

التنبؤ لعمر الجنين بقياس طول عظم العضد في الفتره الثالثه من الحمل باستخدام  
الموجات فوق الصوتيه

*A thesis Submitted for partial fulfillment for the requirement of  
M.Sc. degree in Medical Diagnostic Ultrasound*

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## الآية

قَالَ تَعَالَى :

{يَرْفَعُ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا  
الْعِلْمَ دَرَجَاتٍ}

صَدِيقُ اللَّهِ الْعَظِيمِ  
سُورَةُ الْمَجَادِلَةِ-آيَةُ(11)

# **DEDICATION**

**TO**

**MY TEACHERS**

**MY PARENTS**

**MY BROTHERS AND SISTERS**

**MY FRIENDS**

**MY COLLEAGUES**

**With my faithfulness and love Magdi**

## **ACKNOWLEDGEMENTS**

Firstly, thanks to Al MIGHTY ALLAH who gave me health and power to conduct this study.

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## **ABSTRACT**

This is analytic study was carried out in Alturki teaching hospital in ultrasound department in period between of September 2018 to December 2018.the study population 70 singleton pregnancy ,healthy pregnant women, whom sure of their LMP.also fetus must be free of congenital anomalies. The study sample was selected randomly from pregnant women whom came to antenatal care ,GA by LMP and by FL were calculated. the proplem was delivered from inability to asses GA by head biometry in fetus whom engaged and had congenital head disease. The aim of this study was to predict GA by using HL. The measurement was done by ultrasound machine SONACE X6.The data was collected by data sheet ,which contained maternal age ,gravidity, LMP,FL,HL GA by LMP and GA by FL. then the analysed by SSPS, The result revealed that there was significant correlation noticed between GA by LMP and length of both FL(.811) and HL(.902). also there was significant correlation between GA by FL and HL(.884). The study recommended that the humeral length must be used as measurement in calculation of GA in third trimester, also numbers of sample should be increased in further study.

## الخلاصة

هذه دارسه تحليلية اجريت في مستشفى التركي التعليمي قسم الموجات الصوتيه , في الفتره بين سبتمبر - ديسمبر 2018 م .

استهدفت الدراسه النساء الحوامل اللواتي اعمارهن بين 18- 40 سنه في الفتر الثالثه من مراحل الحمل على ان تكون الحامل معافاة , وعلي علم بتاريخ اخر دوره شهريه. و الجنين مفرد و خالي من التشوهات . عينه البحث عباره عن 70 حامل حضرت للمتابعه الروتينيه و من ثم تم اخذ تاريخ اخر دوره شهريه و قياس طول عظمتي العضد و الفخذ و عمر الجنين بطول عظم الفخذ و عمر الجنين بتاريخ اخردوره شهريه .نبعت مشكلة البحث من صعوبة تقدير عمر الجنين بحسابات عظمة الراس نتيجة للعيوب الخلقية بالرأس او نتيجة لانغراز الرأس بين عظام حوض الام. الهدف من الدراسه التنبؤ لعمر الجنين باستخدام عظم العضد.جمعت البيانات بواسطة استبيان احتوي علي عمر الام,عدد مرات الولادة,طول عظمتي العضد والفخذ,عمر الجنين بطول عظم الفخذ وعمر الجنين بتاريخ اخر دورة شهريه. تمت القياسات بواسطة جهاز الموجات SONACE X6. تم تحليل البيانات ببرنامج التحليل الإحصائي وتوصلت الدر اسه الي وجود علاقة قوية بين عمر الجنين بتاريخ اخر دوره شهريه مقارنة مع طول عظم العضد(811. )والفخذ (902.)وتوصلت الدراسة ايضا إلى وجود علاقة قوية بين عمر الجنين بقياس طول عظم الفخذ مع طول عظم العضد(884.).اوصت الدراسه بزيادة عدد العينات في الدراسات المقبله و تعميم الدراسه علي الفتره الثانيه للحمل واستخدام قياس طول العضد في تقدير عمر الجنين.

## TABLE OF CONTENTS

الآية .....	I
DEDICATION .....	II
ACKNOWLEDGEMENTS .....	III
ABSTRACT.....	IV
Arabic Abstract .....	V
TABLE OF CONTENTS .....	VI
LIST OF TABLES .....	IX
LIST OF FIGURES .....	X
LIST OF ABBREVIATIONS .....	XI

### Chapter One

#### Introduction

1.Introduction.....	1
1.2.Problem of the study:.....	2
1.3. Objectives: .....	2
1.3.1. General objective .....	2
1.3.2. Specific objectives:.....	2
1.4 Thesis lay out:-.....	3

### Chapter Two

#### Literature Review

2.Literature Review .....	4
2.1: Anatomy: .....	4
2.1.1: Anatomy of the Femur:.....	4
2.1.2: anatomy of Humerus: .....	5
2.2 Embryology: .....	5
2.2.1 limb growth and development: .....	5
2.3 Physiology: .....	7
2.3.1 Deposition and Absorption of Bone-Remodeling of Bone: .....	7
2.3.2 Absorption of Bone-Function of the Osteoclasts: .....	7

2.3.3 Bone deposition and absorption are normally in equilibrium: .....	8
2.4 Pathology .....	9
2.4.1: Congenital anomalies of the fetal bones: .....	9
2.4.1.1 lethal skeletal dysplasia: .....	9
2.4.1.1.1 Thanatophoric Dysplasia: .....	10
2.4.1.1.2 Platyspondyly: .....	10
2.4.1.1.3 Achondrogenesis: .....	10
2.4.1.1.4 Osteogenesis Imperfecta (OI):.....	11
2.4.1.1.5 Hypophosphatasia:.....	11
2.4.1.1.6 Campomelic Dysplasia: .....	11
2.4.1.1.7 Short-Rib Polydactyly Syndromes: .....	12
2.4.1.1.8-: Fibrochondrogenesis: .....	12
2.4.1.2 Nonlethal skeletal dysplasia: .....	12
2.4.1.2.1 Heterozygous Achondroplasia:.....	12
2.4.1.2.2 Diastrophic Dysplasia:.....	12
2.4.1.2.3 Asphyxiating Thoracic Dysplasia:.....	13
2.4.1.2.5 ChondrodysplasiaPunctata: .....	13
2.4.1.2.6 Dyssegmental Dysplasia:.....	14
2.4.1.2.7 Osteogenesis Imperfecta (OI) Types I, III, IV-Nonlethal Types: ..	14
2.4.1.2.7.1Osteogenesis imperfecta type I:.....	14
2.4.1.2.7.2 Osteogenesis imperfecta Type III:.....	14
2.4.1.2.7.3 Osteogenesis imperfecta Type IV: .....	14
2.4.1.2.8 Down syndrome:.....	15
2.5 .Estimation of gestational age (Fetal biometry) .....	15
2.5.1. Gestational Sac (Weeks 4 to 5): .....	15
2.5.2. Crown Rump Length (CRL):.....	17
2.5.3. Yolk sac diameter (YS): .....	18
2.5.4. Bi-parietal Diameter(BPD):.....	18
2.5.5. Femur Length (FL): .....	19



2.5.6. Abdominal circumference (AC): .....	21
2.5.7. Head Circumference: .....	21
2.5.8. Occipito frontal Diameter: .....	22
2.5.9. Lateral Ventricle Measurement: .....	22
2.6. Previous studies: .....	23

### **Chapter Three**

#### **Materials and Methods**

3.1 MATERIALS: .....	26
3.1.1 population of study: .....	26
3.1.1.1 Inclusion criteria .....	26
3.1.1.2 Exclusions criteria .....	26
3.1.2 Machine: .....	26
3.1.3 Data Collection : .....	26
3.2 METHODS: .....	26
3.2.1 Scanning technique: .....	27
3.2.2 Data analysis : .....	28
3. 2.3 Ethical consideration: .....	28

### **Chapter Four**

#### **Data analysis and result**

4.1 Result .....	29
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### **Chapter Five**

#### **Discussion, Conclusion and Recommendations**

5.1 Discussion .....	37
5.2 Conclusion: .....	39
5.3 Recommendations: .....	40
References: .....	41
Appendixes .....	36

LIST OF TABLES

Table	Table names	Page.
(4-1)	the mean and the stander deviation of maternal age, gravidity, gestational age by LMP, gestational age measured using the FL and the HL.	29
(4-2)	Relation between number of gravidity and humeral length	30
(4-3)	Relation between dependat HL and constant FL	32
(4-4)	coefficient of FL and HL(mm)	32
(5-5)	The correlation between the gestational age using the LMP versus FL, LMP versus HL, and FL versus HL	33
(4-6)	Chart for prediction of GA(weeks) using HL(mm)	36

## LIST OF FIGURES

Fig	Figure names	Page No.
(2- 1)	Gestional sac	17
(2-2)	Crown rump length	17
(2- 3 )	Yalk sac diameter	18
(2- 4)	Biparital diameter and occipito-frontal diameter	19
(2- 5)	Femur length measuremen	20
(2-6)	Head circumference measurement	21
(4-1)	Relation between gravidity and HL in mm	31
(4-2)	Scatter plot, relationship between FL (mm) andHL(mm)	31
(4-3)	Direct linear relationship between the GA/LMP (weeks) and HL(mm)	35
(4-4)	Direct linear relationship between the FL (mm) and HL(mm)	35
(4-5)	Direct linear relationship between the GA/FL (weeks) and HL(mm)	36

## LIST OF ABBREVIATIONS

AC	abdominal circumference
AER	apical ectodermal ridge
BPD	biparital diameter
CHD	congenital heart diseases
CRL	crown-rump length
CSP	cavum septum pallucidum
DS	down syndrome
EDD	expected date for delivery
FL	femur length
GA	gestational age
GS	gestational sac
HCG	human chorionic gonadotrophin
Hz	hertz
IQ	intelligence quotien
KHz	kilo hertz
LMP	last menstrual period
MHz	mega hertz
MSD	mean sac diameter
OFD	occipito frontal diameter
OI	Osteogenesis imperfecta
PTH	parathyroid hormons
SOX9	sex-determining protein homeobox 9 mapped to 17q24
SPSS	Statistical Package for the Social Sciences
TAUS	trans abdominal ultrasound
US	ultra sound
YS	yalk sac

# **Chapter One**

## **Introduction**

## Chapter One

### 1.Introduction

Clinical dating of a pregnancy is usually based on the patient's recollection of the first day of her LMP and on physical examination of uterine size. Unfortunately, both these methods are subject to imprecision, leading to inaccuracies in gestational age assignment. Dating by LMP (menstrual age) may be inaccurate because of variability in length of menstrual cycles (early or late ovulation occurs in 20% of population), faulty memory, recent exposure to oral contraceptives, or bleeding during early pregnancy. Determining gestational age from the palpated dimension of the uterus may be affected by uterine fibroids, multiple pregnancy, and maternal body habitus. Clinical dating is accurate only if one of two conditions apply: the patient is a good historian with regular menstrual cycles, and the uterine size correlates closely with LMP; and information is available specifying the time of conception, such as a basal body temperature chart or in vitro fertilization. When the pregnancy cannot be dated accurately by clinical evaluation, sonography is accepted as the most useful and accurate tool for estimating gestational age (Carol, 2011).

Estimation of fetal gestational age is very essential in any obstetric practice. Ultrasonography plays a very important role in the estimation of fetal gestational age. It is a very safe, convenient, economical, noninvasive, accurate and easily available technique for assessing fetal gestational age. Many ultrasound parameters currently are in use for the estimation of fetal gestational age. (Nagesh et al., 2016).

A normal pregnancy last for 9 month, 40 weeks, or 280 days. However, it may last up to 42 weeks. As a result, typically the first trimester is defined as weeks 1 through 12, the second trimester is defined as weeks 13 through 26, and the third trimester is defined as weeks 27 through 42. Fetal biometry measurements. In the first trimester include yolk sac -crown rump length and

nuchal translucency and in the second and third trimester include abdominal circumference - head circumference - femur length and bi parietal diameter. Femur length Measured at the long axis of the femoral shaft when the ultrasound beam is perpendicular to the shaft. Bi-parietal diameter Measured from the outer edge of the proximal skull to the inner edge of the distal skull at the level of the third ventricle, thalamus cavum septum pellucidum, and falx cerebri(Steven. 2011)

Femur length measurement is as accurate as the BPD in the prediction of gestational age. It is useful in confirming the gestational age estimated from BPD or HC measurements and can often be obtained when fetal position prevents measurement of the BPD or HC. As examination of intracranial anatomy is an important part of all ultrasound examinations, measurement of femur length should not replace that of the BPD or HC as the sole predictor of gestational age. The femur can be measured from 12 weeks to term (Chudleigh and Thilaganathan. 2004).

### **1.2.Problem of the study:**

the problem delivered from inability to measure or inaccurate measurement of BPD and HC in third trimester due to congenital anomalies or due to engagement of presenting part in cephalic presentation in pelvic cavity of the mother, for this reasons estimation of gestational age in third trimester by femur length and humeral length is better than other head biometry.To see if the gestational age can be predicted by humeral length?

### **1.3. Objectives:**

#### **1.3.1. General objective**

To Predict gestational age using humeral length in third trimester .

#### **1.3.2. Specific objectives:**

- To measure FL and HL in third trimester.
- To compare between humeral length and FL .
- To correlate LMP, FL ,and HL.

-To estimate humeral length using equation

#### **1.4 Thesis lay out:-**

This study consist of five chapters. Chapter one gives information about problem and its objectives, chapter tow presents literature review (anatomy, embryology , physiology, pathology and previous study),chapter three deals with materials and methods ,while chapter four deals with result and finally chapter five includes discussion, conclusion and recommendations.



# **Chapter Two**

## **Literature Review**

## Chapter Two

### 2.Literature Review

#### 2.1: Anatomy:

##### 2.1.1: Anatomy of the Femur:

The femur articulates above with the acetabulum to form the hip joint and below with the tibia and the patella to form the knee joint. The upper end of the femur has a head, a neck, and greater and lesser trochanters. The head forms about two thirds of a sphere and articulates with the acetabulum of the hip bone to form the hip joint. In the center of the head is a small depression, called the fovea capitis, for the attachment of the ligament of the head. Part of the blood supply to the head of the femur from the obturator artery is conveyed along this ligament and enters the bone at the fovea. The neck, which connects the head to the shaft, passes downward, backward, and laterally and makes an angle of about  $125^{\circ}$  (slightly less in the female) with the long axis of the shaft. The size of this angle can be altered by disease. The greater and lesser trochanters are large eminences situated at the junction of the neck and the shaft. Connecting the two trochanters are the inter trochanteric line anteriorly, where the iliofemoral ligament is attached, and a prominent intertrochanteric crest posteriorly, on which is the quadrate tubercle .The shaft of the femur is smooth and rounded on its anterior surface but posteriorly has a ridge, the linea aspera, to which are attached muscles and intramuscular septa. The margins of the linea aspera diverge above and below. The medial margin continues below as the medial supracondylar ridge to the adductor tubercle on the medial condyle. The lateral margin becomes continuous below with the lateral supracondylar ridge. On the posterior surface of the shaft below the greater trochanter is the gluteal tuberosity for the attachment of the gluteus maximus muscle. The shaft becomes broader toward its distal end and forms a flat, triangular area on its posterior surface called the popliteal surface. The lower end of the femur has

lateral and medial condyles, separated posteriorly by the intercondylar notch. The anterior surfaces of the condyles are joined by an articular surface for the patella. The two condyles take part in the formation of the knee joint. Above the condyles are the medial and lateral epicondyles. The adductor tubercle is continuous with the medial epicondyle (Richard et al, 2012).

### **2.1.2: anatomy of Humerus:**

The humerus articulates with the scapula at the shoulder joint and with the radius and ulna at the elbow joint. The upper end of the humerus has a head, which forms about one third of a sphere and articulates with the glenoid cavity of the scapula. Immediately below the head is the anatomic neck. Below the neck are the greater and lesser tuberosities, separated from each other by the bicipital groove. Where the upper end of the humerus joins the shaft is a narrow surgical neck. About halfway down the lateral aspect of the shaft is a roughened elevation called the deltoid tuberosity. Behind and below the tuberosity is a spiral groove, which accommodates the radial nerve. The lower end of the humerus possesses the medial and lateral epicondyles for the attachment of muscles and ligaments, the rounded capitulum for articulation with the head of the radius, and the pulley-shaped trochlea for articulation with the trochlear notch of the ulna. Above the capitulum is the radial fossa, which receives the head of the radius when the elbow is flexed. Above the trochlea anteriorly is the coronoid fossa, which during the same movement receives the coronoid process of the ulna. Above the trochlea posteriorly is the olecranon fossa, which receives the olecranon process of the ulna when the elbow joint is extended (Richard *et al*, 2012).

## **2.2 Embryology:**

### **2.2.1 limb growth and development:**

The limbs, including the shoulder and pelvic girdles, comprise the appendicular skeleton. At the end of the fourth week of development, limb buds become visible as outpocketings from the ventrolateral body wall. The

fore-limb appears first followed by the hind limb 1 to 2 days later. Initially, the limb buds consist of a mesenchymal core derived from the parietal (somatic) layer of lateral plate mesoderm that will form the bones and connective tissues of the limb, covered by a layer of cuboidal ectoderm. Ectoderm at the distal border of the limb thickens and forms the apical ectodermal ridge (AER). This ridge exerts an inductive influence on adjacent mesenchyme, causing it to remain as a population of undifferentiated, rapidly proliferating cells, and the progress zone. As the limb grows, cells farther from the influence of the AER begin to differentiate into cartilage and muscle. In this manner, development of the limb proceeds proximodistally. By the sixth week of development, the first hyaline cartilage models, foreshadowing the bones of the extremities, are formed by these chondrocytes. Joints are formed in the cartilaginous condensations when chondrogenesis is arrested, and a joint interzone is induced. Cells in this region increase in number and density, and then a joint cavity is formed by cell death. Surrounding cells differentiate into a joint capsule. Factors regulating the positioning of joints are not clear, but the secreted molecule WNT14 appears to be the inductive signal. Ossification of the bones of the extremities, endochondral ossification, begins by the end of the embryonic period. Primary ossification centers are present in all long bones of the limbs by the 12th week of development. From the primary center in the shaft or diaphysis of the bone, endochondral ossification gradually progresses toward the ends of the cartilaginous model. At birth, the diaphysis of the bone is usually completely ossified, but the two ends, the epiphyses, are still cartilaginous. Shortly thereafter, however, ossification centers arise in the epiphyses. Temporarily, a cartilage plate remains between the diaphyseal and epiphyseal ossification centers. This plate, the epiphyseal plate, plays an important role in growth in the length of the bones. Endochondral ossification proceeds on both sides of the plate. When the bone has acquired

its full length, the epiphyseal plates disappear, and the epiphyses unite with the shaft of the bone. In long bones, an epiphyseal plate is found on each extremity; in smaller bones, such as the phalanges, it is found only at one extremity; and in irregular bones, such as the vertebrae, one or more primary centers of ossification and usually several secondary centers are present. Synovial joints between bones begin to form at the same time that mesenchymal condensations initiate the process of forming cartilage. Thus, in the region between two chondrifying bone primordia, called the interzone (for example between the tibia and femur at the knee joint), the condensed mesenchyme differentiates into dense fibrous tissue. This fibrous tissue then forms articular cartilage, covering the ends of the two adjacent bones; the synovial membranes; and the menisci and ligaments within the joint capsule (e.g., the anterior and posterior cruciate ligaments in the knee). The joint capsule itself is derived from mesenchyme cells surrounding the interzone region. Fibrous joints (e.g., the sutures in the skull) also form from interzone regions, but in this case the interzone remains as a dense fibrous structure (Sadler. 2012).

## **2.3 Physiology:**

### **2.3.1 Deposition and Absorption of Bone-Remodeling of Bone:**

Deposition of Bone by the Osteoblasts. Bone is continually being deposited by osteoblasts, and it is continually being absorbed where osteoclasts are active. Osteoblasts are found on the outer surfaces of the bones and in the bone cavities. A small amount of osteoblastic activity occurs continually in all living bones (on about 4 per cent of all surfaces at any given time in an adult), so that at least some new bone is being formed constantly (Arthur et al, 2006).

### **2.3.2 Absorption of Bone-Function of the Osteoclasts:**

Bone is also being continually absorbed in the presence of osteoclasts, which are large phagocytic, multinucleated cells (as many as 50 nuclei), derivatives

of monocytes or monocyte-like cells formed in the bone marrow. The osteoclasts are normally active on less than 1 per cent of the bone surfaces of an adult. Later in the chapter we see that PTH controls the bone absorptive activity of osteoclasts. Histologically, bone absorption occurs immediately adjacent to the osteoclasts. The mechanism of this absorption is believed to be the following: The osteoclasts send out villus like projections toward the bone, forming a so called ruffled border adjacent to the bone. The villi secrete two types of substances: proteolytic enzymes, released from the lysosomes of the osteoclasts, and several acids, including citric acid and lactic acid, released from the mitochondria and secretory vesicles. The enzymes digest or dissolve the organic matrix of the bone, and the acids cause solution of the bone salts. The osteoclastic cells also imbibe by phagocytosis minute particles of bone matrix and crystals, eventually also dissolving these and releasing the products into the blood (Arthur et al, 2006).

### **2.3.3 Bone deposition and absorption are normally in equilibrium:**

Normally, except in growing bones, the rates of bone deposition and absorption are equal to each other, so that the total mass of bone remains constant. Osteoclasts usually exist in small but concentrated masses, and once a mass of osteoclasts begins to develop, it usually eats away at the bone for about 3 weeks, creating a tunnel that ranges in diameter from 0.2 to 1 millimeter and is several millimeters long. At the end of this time, the osteoclasts disappear and the tunnel is invaded by osteoblasts instead; then new bone begins to develop. Bone deposition then continues for several months, the new bone being laid down in successive layers of concentric circles (lamellae) on the inner surfaces of the cavity until the tunnel is filled. Deposition of new bone ceases when the bone begins to encroach on the blood vessels supplying the area. The canal through which these vessels run, called the Haversian canal, is all that remains of the original cavity. Each new area of bone deposited in this way is called an osteon (Arthur et.al, 2006).

## **2.4 Pathology**

### **2.4.1: Congenital anomalies of the fetal bones:**

Congenital bone disorders are a heterogeneous group of disorders primarily affecting the growth and development of the musculoskeletal system. There are three major categories. The skeletal dysplasias are developmental disorders of chondro-osseous tissue caused by single gene disorders with prenatal and postnatal manifestations. The dysostoses are single-gene disorders resulting in malformations of individual bones caused by transient abnormalities of signaling factors. Disruptions are morphologic defects of an organ or larger region resulting from extrinsic breakdown or interference with an originally normal developmental process. The prevalence of skeletal dysplasias, also called osteochondro-dysplasias, diagnosed prenatally or during the neonatal period, excluding limb amputations, is 2.4 to 4.5 per 10,000 births.

Nonetheless, the majority of lethal skeletal dysplasias, including thanatophoric dysplasia, achondrogenesis, and osteogenesis imperfect (OI), type II, can be diagnosed solely on the basis of prenatal ultrasound. Lethal skeletal dysplasias were identified correctly by prenatal ultrasound; however, only 13 of 27 (48%) received an accurate specific antenatal diagnosis (Carol, 2011).

#### **2.4.1.1 lethal skeletal dysplasia:**

The lethal skeletal dysplasias are characterized by severe micromelia and small thoracic circumference with pulmonary hypoplasia. The most important determinant of lethality is the presence and degree of pulmonary hypoplasia. The three most common lethal skeletal dysplasias are thanatophoric dysplasia; achondrogenesis, and osteogenesis imperfecta type II, overall accounting for 40% to 60% of all lethal skeletal dysplasias (Carol, 2011).

#### **2.4.1.1.1 Thanatophoric Dysplasia:**

Thanatophoric dysplasia is the most common lethal skeletal dysplasia, with a prevalence of 0.24 to 0.69 per 10,000 births. The key features are severe micromelia with rhizomelic predominance and macrocrania (disproportionately large head) in association with decreased thoracic circumference but a normal trunk length. Mineralization is normal, with no fractures present. Typically, the extremities are so foreshortened that they protrude at right angles to the body. The skin folds are thickened and redundant secondary to a relatively greater rate of growth of the skin and subcutaneous layers than the bones. Clinical presentation is usually caused by large-for-date measurements secondary to polyhydramnios (Carol, 2011). Thanatophoric dysplasia has many phenotypic similarities to homozygous achondroplasia. Both conditions may appear identical from ultrasound and radiographic perspectives. They can be distinguished by the positive family history, in which both parents are affected with the heterozygous form of achondroplasia (Carol, 2011).

#### **2.4.1.1.2 Platyspondyly:**

Platyspondyly, or flattened vertebral bodies, is one of the most characteristic features on AP radiographs of a thanatophoric dwarf. There is a U or H configuration of the vertebral bodies and a relatively increased height of the disc spaces. Platyspondyly appears on ultrasound as a wafer-thin vertebral body with a relatively larger, hypoechoic disc space on either side of the vertebral body (Carol, 2011).

#### **2.4.1.1.3 Achondrogenesis:**

Achondrogenesis is the second most common lethal skeletal dysplasia, with a prevalence of 0.09 to 0.23 per 10,000 births. It is a phenotypically and genetically diverse group of chondrodysplasias characterized by severe micromelia, macrocranium, decreased thoracic circumference and trunk length, and decreased mineralization (Carol, 2011).



#### **2.4.1.1.4 Osteogenesis Imperfecta (OI):**

Osteogenesis imperfecta is a clinically and genetically heterogeneous group of collagen disorders characterized by brittle bones resulting in fractures. The incidence is 1: 60,000 births. Until recently there were four types of OI, all with an autosomal dominant mode of inheritance and associated with mutations in the COL1A1 or COL1A2 genes. In the past several years a few more conditions that can be categorized phenotypically into one of the four categories, but of a different etiologies and some with autosomal recessive modes of inheritance, have been detected (Carol, 2011).

#### **2.4.1.1.5 Hypophosphatasia:**

Hypophosphatasia congenita, the lethal neonatal form of hypophosphatasia, is an autosomal recessive skeletal dysplasia caused by a deficiency of tissue-nonspecific alkaline phosphatase. Frequency of hypophosphatasia congenita is approximately 1 in 100,000 births. The key features are severe micromelia, decreased thoracic circumference with normal trunk length, and decreased mineralization with occasional fractures. Cranial vault size remains normal. The demineralized long bones may be bowed with occasional angulations caused by fractures. The bones appear thin and delicate and may appear entirely absent (Carol, 2011).

#### **2.4.1.1.6 Campomelic Dysplasia:**

Campomelic dysplasia, or bent-limb dysplasia, is a rare autosomal-dominant condition that usually results from a new dominant mutation in the SOX9 gene (sex-determining protein homeobox 9 mapped to 17q24.3).

The incidence is 0.5 to 1.0 per 100,000 births. Most cases are lethal because of respiratory insufficiency from laryngotracheomalacia in combination with a mildly narrowed thorax. The characteristic skeletal features of campomelic dysplasia are a short and ventrally bowed tibia and femur, a hypoplastic or absent fibula, talipes equinovarus (club-foot), and hypoplastic scapulae (Carol, 2011).

#### **2.4.1.1.7 Short-Rib Polydactyly Syndromes:**

Short-rib polydactylydysplasias are a heterogeneous group of rare and lethal skeletal dysplasias with an autosomal recessive mode of inheritance. All forms are characterized by severe micromelia and decreased thoracic circumference. The cranial vault measurements and bone mineralization are normal. Polydactyl, cardiac, and genitourinary abnormalities are found in most cases (Carol, 2011).

#### **2.4.1.1.8:- Fibrochondrogenesis:**

Fibrochondrogenesis is a rare, lethal, autosomal recessive rhizomelic chondrodysplasia. The typical features include narrow chest (short ribs with cupping), short long bones with irregular metaphyses with peripheral spurs, and extra-articular calcifications giving the appearance of stippling, platyspondyly with decreased ossification (particularly cervical vertebrae), and vertebral midline clefts. Other features include flat facies and cleft palate (Carol, 2011).

#### **2.4.1.2 Nonlethal skeletal dysplasia:**

##### **2.4.1.2.1 Heterozygous Achondroplasia:**

Heterozygous achondroplasia is the most common nonlethal skeletal dysplasia. About 80% of cases are the result of a spontaneous dominant mutation associated with advanced paternal age, and the remainder is inherited from parental heterozygous achondroplasia. The incidence is approximately 1 in 26,000 births. Previously considered a diagnosis of the third trimester, recent studies have shown that a second trimester diagnosis is possible (Carol, 2011).

##### **2.4.1.2.2 Diastrophic Dysplasia:**

Diastrophic dysplasia is an autosomal recessive disorder with variable expression and a predominantly rhizomelic form of micromelia. The term diastrophic implies “twisted,” which reflects the multiple postural deformities, dislocations, joint contractures, and kyphoscoliosis present. The

most characteristic feature is the “hitch-hiker thumb” caused by a lateral positioning of the thumb in association with a hypoplastic first metacarpal (Carol, 2011).

#### **2.4.1.2.3 Asphyxiating Thoracic Dysplasia:**

Asphyxiating Thoracic Dysplasia, or Jeune syndrome, is an autosomal recessive disorder with variable expressivity. The incidence is 1 in 70,000 to 130,000 births. The perinatal mortality is high as a result of pulmonary hypoplasia. Those who survive may develop renal and hepatic fibrosis. The key features are a mild to moderate form of micromelia (60%) with rhizomelic predominance, a long narrow thorax with short horizontal ribs, inverted “handlebar” appearance of the clavicles, renal dysplasia and cysts, and postaxial polydactyly in 14% (Carol, 2011).

#### **2.4.1.2.4 Ellis–van Creveld Syndrome:**

Ellis–van Creveld syndrome, or chondroectodermal dysplasia, is an autosomal recessive disorder with an incidence of 1 per 150,000 births. The condition has a high prevalence among inbred populations, such as the Amish and the Arabs of the Gaza strip. It is generally a nonlethal disorder, but death can result from pulmonary hypoplasia. Key features include mild to moderate form of micromelia with a mesomelic predominance, short horizontal ribs, postaxial or ulnar polydactyly that is almost 100% in the hands and 25% in the feet, and CHD (50%), most often atrial septal defect (Carol, 2011).

#### **2.4.1.2.5 Chondrodysplasia Punctata:**

Chondrodysplasia punctata, or stippled epiphyses, is a heterogeneous group of disorders with many small calcifications (ossification centers) in the cartilage, in the ends of bones, and around the spine. Known associated conditions include single -gene disorders such as rhizomelic chondrodysplasia punctata, Conradi-Hünermann syndrome, and Zellweger syndrome (cerebrohepatorenal syndrome); chromosomal abnormalities such

as trisomy 21 and 18; maternal autoimmune diseases; and teratogen exposure (e.g., warfarin, alcohol) (Carol, 2011).

#### **2.4.1.2.6 Dyssegmental Dysplasia:**

Dyssegmental dysplasia is a rare autosomal recessive skeletal dysplasia characterized by gross vertebral disorganization. The findings typically include micromelia, short narrow thorax, joint rigidity, anisospondyly (gross irregularity of the size and shape of the vertebral bodies) which may include malsegmentation, clefting or “over-size” bodies, kyphoscoliosis, and multiple ossification centers (Carol, 2011).

#### **2.4.1.2.7 Osteogenesis Imperfecta (OI) Types I, III, IV-Nonlethal Types:**

##### **2.4.1.2.7.1 Osteogenesis imperfecta type I:**

Is a mild, “tarda” variant inherited in an autosomal dominant manner as a result of mutation in the COL1A1 (on chromosome 17) or COL1A2 (on chromosome 7) and possibly in other collagen genes. OI type I is a generalized connective tissue disorder characterized by bone fragility and blue sclerae. The bones are of normal length, and only 5% present at birth with fractures. Most fractures occur from childhood to puberty. There is progressive hearing loss in approximately 50% of type I cases (Carol, 2011).

##### **2.4.1.2.7.2 Osteogenesis imperfecta Type III:**

Has a heterogeneous mode of inheritance. This is a nonlethal, progressively deforming variety of OI that often spares the humeri, vertebrae, and pelvis. Rib involvement is variable. The blue sclerae will normalize, and there is no associated hearing impairment (Carol, 2011).

##### **2.4.1.2.7.3 Osteogenesis imperfecta Type IV:**

Is an autosomal dominant form of OI. It is the mildest form, involving isolated fractures. The sclera is blue at birth but normalizes over time. There is no associated hearing impairment (Carol, 2011)

#### **2.4.1.2.8 Down syndrome:**

Down syndrome (DS), also known as trisomy 21, is a genetic disorder caused by the presence of all, or part of a third copy of chromosome 21. It is typically associated with physical growth delays, characteristic facial features, and mild to moderate intellectual disability. The average IQ of a young adult with Down syndrome is 50, equivalent to the mental age of an 8- or 9-year-old child, but this can vary widely (Carol, 2011).

#### **2.5 .Estimation of gestational age (Fetal biometry)**

Accurate knowledge of gestational age (age of unborn baby) is key for , care , planning , critical interpretation and successful management of all pregnancies. Failure can result in iatrogenic prematurity or post maturity , both of which are associated with increased perinatal mortality and morbidity. Initially the dating of pregnancy was based on the first day of last menstrual period) in a regular 28 day menstrual cycle. But this method for dating the pregnancy is unreliable in those women who do not exactly recall their menstrual history. Since the introduction of diagnostic ultrasound , more reliable methods to date the pregnancy have been developed. In early pregnancy , these are Gestational sac diameter and volume and Crown-Rump length (CRL) measurements. In second trimester most commonly used biometric parameters for estimating gestational age are Bi-parietal diameter and Femur length and other used parameters are transverse cerebellar diameter, Scapular measurement, Fetal kidney length, Fetal renal volume, Fetal kidney size , multiple fetal parameters (Carol, 2011) . Hence , the present study is undertaken to assess gestational age in third trimesters with the help of sonographic measurements of Femur length and humeral length.

##### **2.5.1. Gestational Sac (Weeks 4 to 5):**

The first definitive sonographic sign of an intra uterine pregnancy is identification of the gestational sac within the decidualized endometrium. The blastocyst is the developmental stage of the conceptus that

implants into the uterine cavity. The blasto cyst gives rise to the gestational sac , or chorionic sac. The early gestational sac appears as a small , anechoic sphere within the decidualized endometrium. It will grow at a rate of 1 mm per day in early pregnancy. The intradecidual sign denotes the appearance of the small gestational sac in the uterine cavity surrounded by the thickened , echogenic endometrium. The intra decidual sign can be mis diagnosed , as it may resemble the pseudo gestational sac of an ectopic pregnancy. To differentiate an intrauterine gestational sac from the pseudo gestational sac , sonographers can assess the endometrium for evidence of the double sac sign or double decidual sign. The double sac sign denotes the typical appearance of the two distinct layers of decidua , the decidua capsularis (inner layer) and decidua parietalis (outer layer) , separated by the anechoic fluid-filled uterine cavity (Steven , 2011).

The measurement of the gestational sac is the earliest sonographic measurement that can be obtained to date the pregnancy . A mean sac diameter (MSD) is achieved by adding the measurements of the length , width , and the height of the gestational sac and dividing by 3. The gestational sac measurement is a relatively accurate form of dating that can be used until a fetal pole is sonographically recognized. Although modern ultrasound equipment calculates the MSD for sonographers , there is also a simple formula that can be used. By adding 30 to the MSD (measurement in mm) , sonographers can obtain an estimate for the gestational age in days. When the gestational sac seems visually disproportional to the size of the embryo , that is , too small or too large compared to the size of the embryo , an MSD measurement can be exceedingly beneficial in determining if asymmetry truly exists. An irregularly shaped gestational sac can be a sign of impending pregnancy failure (Steven , 2011).

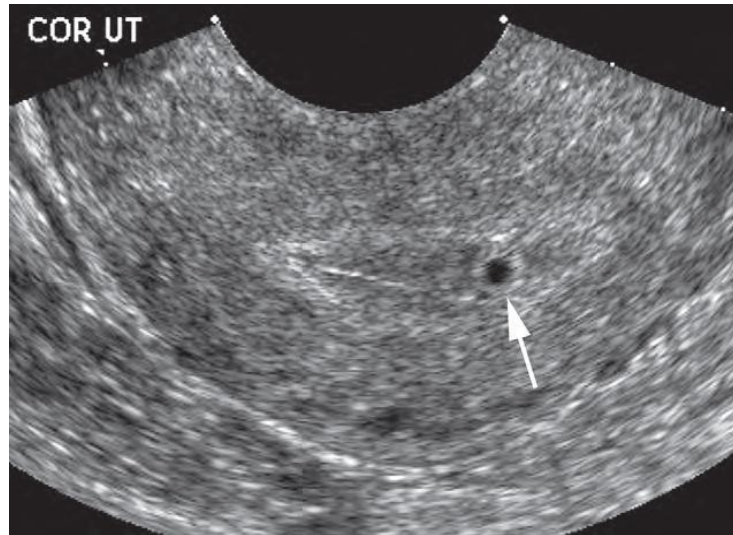


FIGURE 2-1 Gestational sac. At 5.0 weeks' gestation, gestational sac (arrow) appears as a small, intrauterine fluid collection with an echogenic rim. (Carol, 2011)

### 2.5.2. Crown Rump Length (CRL):

The most accurate sonographic measurement of pregnancy is the crown rump length. The crown rump length can be taken when a fetal pole is identified and should not include the yolk sac or fetal limb buds within the measurement. This measurement can be taken throughout the first trimester , and typically until second-trimester bio-metric measurements can be obtained secondary Yolk Sac (5.5 weeks) , (Steven , 2011).



FIGURE 2-2. Crown-rump length (CRL) measurement. Cursors delineate the length of the fetus from the top of its head to the bottom of its torso. The yolk sac (arrow) should not be included in the fetal CRL measurements. (Carol, 2011)

### **2.5.3. Yolk sac diameter (YS):**

The first structure seen with sonography within the gestational sac is the secondary yolk sac . It appears within the gestational sac as a round , anechoic structure surrounded by a thin , echogenic rim. It is located within the chorionic cavity , between the amnion and chorion. The yolk sac produces alpha-fetoprotein and plays an important role in angiogenesis and hemato poiesis during early embryologic development. It is connected to the embryo by the Vitelline duct , also referred to as the omphalo mesenteric duct , which contains one artery and one vein. It may be visualized during a first-trimester sonographic examination It is important to evaluate the appearance of the yolk sac , as a yolk sac that is echogenic , abnormally shaped , or calcified carries an increased risk for ensuing embryonic demise(Steven , 2011).



FIGURE 2-3 Yolk sac. Gestational sac contains yolk sac (arrow) on transvaginal sonogram at 5.5 weeks' gestation. (Carol, 2011)

### **2.5.4. Bi-parietal Diameter(BPD):**

The bi-parietal diameter (BPD) measurement of the fetal head can be taken after the first trimester has ended , typically starting between 13 and 14 weeks. The BPD is obtained in the axial plane at the level of the CSP , thalamus , and falx cerebri. This is the same level as the third ventricle , which may be seen between the two lobes of the thalamus (Steven , 2011)



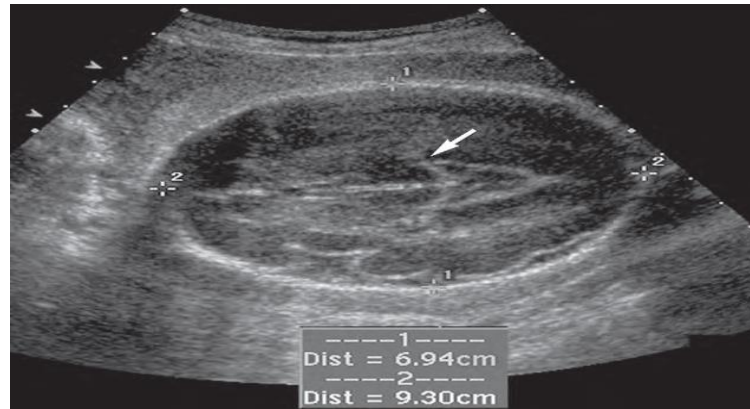


FIGURE 2-4 Biparietal diameter (BPD) and occipitofrontal diameter (OFD) measurements. Transaxial sonogram of the fetal head at the level of the paired thalami (arrow), with BPD (calipers 1) and OFD (calipers 2). Note how the calipers for the BPD are placed from the outer aspect of the skull to the inner aspect of the skull. (Carol, 2011)

#### **2.5.5. Femur Length (FL):**

This measurement is as accurate as the BPD in the prediction of gestational age. It is useful in confirming the gestational age estimated from BPD or HC measurements and can often be obtained when fetal position prevents measurement of the BPD or HC. As examination of intra cranial anatomy is an important part of all ultrasound examinations, measurement of femur length should not replace that of the BPD or HC as the sole predictor of gestational age. The femur can be measured from 12 weeks to term (Trish and Basky, 2004).

Measuring the femur is ideally undertaken after the AC has been measured. Slide the probe caudally from the AC section until the iliac bones are visualized. At this point, a cross-section of one or both femurs is usually seen. The upper femur should be selected for measurement. The lower femur is frequently difficult to image clearly because of acoustic shadowing from fetal structures anterior to it. Keeping the echo from the anterior femur in view, rotate the probe slowly until the full length of the femur is obtained. You might need to make a small sliding movement after each rotational

movement to bring the probe back onto the femur. To ensure that you have the full length of the femur and that your section is not oblique, soft tissue should be visible beyond both ends of the femur and the bone should not appear to merge with the skin of the thigh at any point. The end-points of the femur are often difficult to define when the femur is imaged lying horizontally but are much easier to define when the bone lies at a slight angle (5–15° to the horizontal). The angle of the bone relative to the horizontal can be manipulated by dipping one end of the probe gently into the maternal abdomen (Trish and Basky, 2004).

The measurement of the femur is made from the center of the 'U' shape at each end of the bone. This represents the length of the metaphysis. It is good practice to obtain measurements from three separate images of the same femur. These should be within 1 mm of each other (Trish and Basky, 2004). Femur length measured at the long axis of the femoral shaft when the ultrasound beam is perpendicular to the shaft (Steven, 2011).

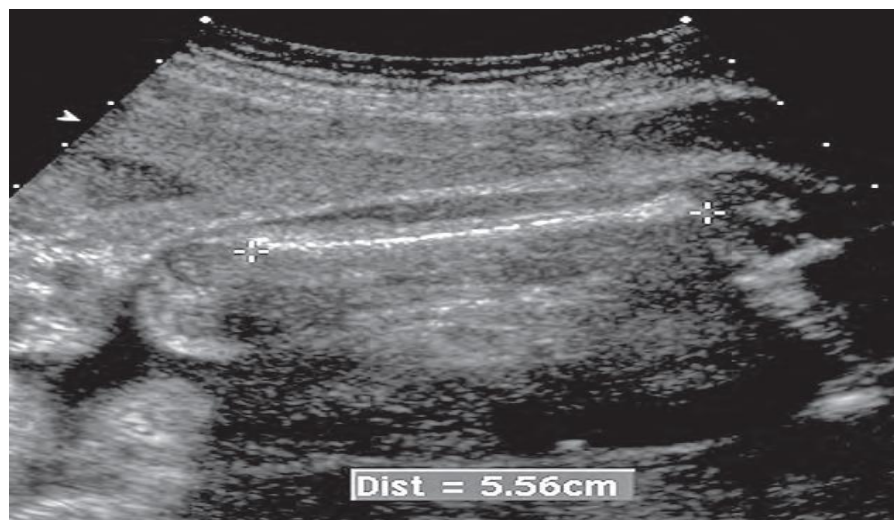


FIGURE 2- 5 Femur length (FL) measurement. Electronic calipers measure the ossified diaphysis of the femur. Note how the bone is imaged close to parallel to the transducer, and the femur closest to the maternal abdominal wall is measured (Carol, 2011)

### **2.5.6. Abdominal circumference (AC):**

Measured in an axial plane , and taken around the abdomen at the level of the umbilical vein and fetal stomach. Other structures that may be seen include the transverse thoracic spine , left adrenal gland , and fetal gallbladder (Steven , 2011).

### **2.5.7. Head Circumference:**

The head circumference (HC) measurement can be taken at the same time of gestation and at the same level of the cranium as the BPD. Thus , the HC is obtained in the axial plane at the level of the CSP , thalamus , falx cerebri , and a measurement around the entire cranium is obtained. This is the same level as the third ventricle , which may be seen between the two lobes of the thalamus. The cranial bones must be symmetric on both sides of the head. The HC can also be obtained by measuring the occipito frontal diameter (OFD) and taking an outer-to-outer diameter measurement at the level of the BPD. Some authors suggest that the HC measurement is typically more accurate than BPD because this measurement is independent of the fetal head shape , consequently providing a more consistent parameter for estimating gestational age (Steven , 2011).

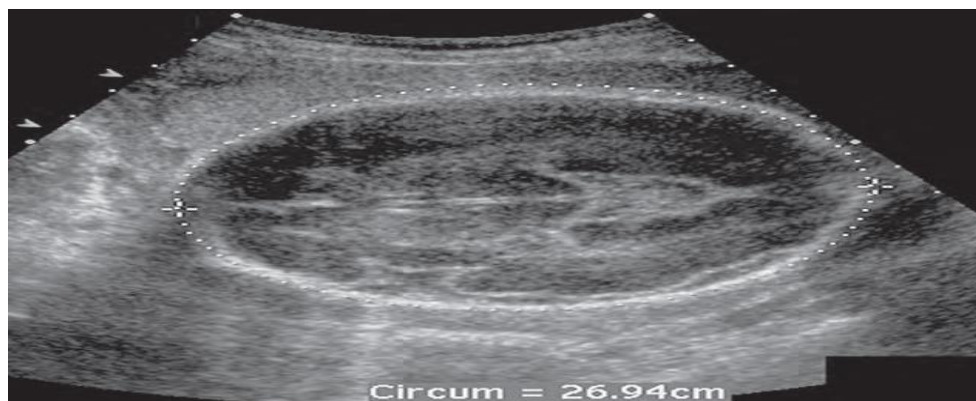


FIGURE2- 6 Head circumference (HC) measurement. HC measurement (calipers and tracing dots) on transaxialsonogram of the fetal head at the same level as for the biparietal diameter measurement. (Carol, 2011)

### **2.5.8. Occipito frontal Diameter:**

The OFD is obtained at the same level of the BPD and HC. The OFD is measured from the outside of the occipital bone to outside of the frontal bone , along the midline of the fetal cranium. The OFD may also be called the fronto occipital diameter. It can be added to the BPD and multiplied by 1.57 to obtain a HC as well(Steven , 2011).

### **2.5.9. Lateral Ventricle Measurement:**

The diameter of the lateral ventricle can be easily measured with sonography. The lateral ventricle is measured in the trans axial plane at the level of the atrium .The atrium of the lateral ventricle is the optimal site for measuring the lateral ventricle , because it is the first region where ventricular enlargement occurs. The calipers are placed at the level of the glomus of the choroid plexus.The normal lateral ventricle does not typically measure more than 10 mm at the level of the atrium (Steven , 2011).

## **2.6. Previous studies:**

Gameraddin et.al, in 2015 studied The Role of Fetal Humeral Length in Determination of Gestational Age Compared with Femoral Length Using Ultrasonography.

Assessment of fetal gestational age with ultrasound provides high accuracy and reliability, as ultrasound is safe, easy operating and cheap imaging modality. The Objective of this study to estimate the GA with HL and FL, to establish the role of HL which could be applied to determine the fetal GA, to compare between FL and HL.

The Results found that Statistical tests such as correlation and T-test had been used between humeral length and fetal length to analyze and get the correlation coefficients and significant values. There was a strong positive correlation between gestational age (last menstrual period) and humeral length ( $r=0.80$ ). Also strong correlation exists between gestational age and femoral length ( $r=0.89$ ). There was no significant difference between humeral length and femoral length ( $p\text{-value}=0.630$ ).

The Conclusion was revealed that The estimation of gestational age with fetal humeral length and femoral length still remain the most common measurements to assess the fetal growth. The fetal humeral length is an accurate biometry as well as femoral length. Evaluation of gestational age with humeral length and femoral length joined together is more accurate than using femoral length alone (Gameraddin, et al, 2015).

Patre, et.al in 2015 studied Ultrasonographic Evaluation of Fetal Humerus Length for Assessment of Gestational Age and Its Comparison with Other Conventional Parameters. Purpose of the study was To estimate the gestational age (GA) with humerus length (HL) and establish the accuracy of it as a reliable indicator for prediction of GA in comparison with other routine parameters. The Results of showed , Biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length

(FL) were compared with standard charts and scatter graphs were plotted. Coefficient of correlation were calculated which were 0.9620, 0.8632, 0.8208, 0.9853 for BPD, HC, AC, and FL, respectively, proving them reliable indicators except for AC. HL measured in the present study was compared with standard nomogram. A statistically significant curvilinear correlation was found between the HL and GA indicating it to be a reliable indicator of GA. Significant coefficient of correlation (0.9704) was observed between HL and GA indicating it to be a reliable parameter.

The Conclusion showed, The HL was most accurate parameter next to FL in assessing GA. The study also indicates that combination of BPD, HC, AC, FL, HL is more accurate in predicting GA than any single parameter, particularly in the third trimester of pregnancy. HL would contribute to maximum accuracy next to FL amongst all the parameters (Patre, et al, 2015).

Nagesh, et al, 2016 studied Ultrasonographic Estimation of Foetal Gestational Age by Humerus Length and Its Comparison with Femur Length. Aims and Objectives were To estimate foetal gestational age by measuring humerus length on ultrasonography in second and third trimesters of normal pregnancies and To compare it with conventional parameter femur length for verification of its accuracy and usefulness in foetal biometry.

Results were as flow Data obtained from 100 normal singleton gestations pertaining to gestational age, femur length and humerus length were statistically analysed and compared. Correlation coefficients and p-values were calculated. The association of GA with FL and HL showed positive correlation and are significant. [Gestational age and femur length:  $r=0.995$ ,  $p<0.001^{**}$ , Gestational age and humerus length:  $r=0.993$ ,  $p<0.001^{**}$ , Femur length and Humerus length:  $r=0.998$ ,  $p<0.001^{**}$ ] Scatter graphs for GA and FL, GA and HL, FL and HL also shown good correlation between the variables. Conclusions: Humerus length is a good parameter for estimation

of foetal gestational age. Compared with femur length, humerus length is similar and reliable in estimation of foetal gestational age and there is no much difference between the two parameters (Nagesh, et al, 2016).

# **Chapter Three**

## **Materials and Methods**



## Chapter Three

### MATERIALS AND METHODS

#### 3.1 MATERIALS:

##### 3.1.1 population of study:

Pregnant woman at third trimester was present to ultrasound department at Alturki teaching hospital and at the time of the study.

They are 70 cases from pregnant women in the third trimester for gestational age.

##### 3.1.1.1 Inclusion criteria

Were normal singleton pregnant woman , maternal age between 18 and 40 years, regular menstrual cycle and certain last menstrual period date.

##### 3.1.1.2 Exclusions criteria

Were multiple pregnancy, fetuses diagnosed to have congenital anomalies and maternal medical illness known to affect fetal size (renal disease- Hypertension).

##### 3.1.2 Machine:

ultrasound system was SAUMSUNG SONACE X6 diagnostic ultrasound system which has major machine three probes , with full US department facilities , and coupling jell. Personal computer was used. equipments for FL and HL measurement in the third trimester.

##### 3.1.3 Data Collection :

The data was collected by clinical data sheet. The collected data include the age of pregnant women , gravidity , gestational age using LMP, gestational age using FL, femur length and Humeral length in millimeter.

#### 3.2 METHODS:

This is cross sectional analytic, descriptive study , carried out in order to state the prediction of the GA in the third trimester by HL. at Al-turki Teaching Hospital Ultrasound Department ,it was conducted at duration from september- to december 2018.

### **3.2.1 Scanning technique:**

All the patients were examined in supine position using 3.5 MHz convex transducer ,jell was applied. Fetal head was identified to determine presentation of the fetus and then heart was located to confirm viability. A general survey of the fetus was done to rule out any anomalies. Liquor quantity was assessed. Placental location and maturity was noted. The measurement of femur and humerus were done as follows: To locate fetal femur, the transducer was moved transversely across the abdomen till iliac bones and bladder were seen. Then, turning the probe sagittaly, the long femur bone was identified manipulating the probe depending upon the position of thigh. Both the calcified ends of the femur were defined in long axis. Ultrasound cursers were placed at both ends of the diaphysis and the length was measured in mms

To locate humerus bone, the transducer was slided upwards transversely towards thorax of the fetus to locate beating heart of the fetus. Then, with a probe rotation of 90 degrees, probe was moved side wards to identify scapula and then the adjoining long bone, the humerus, with probe movements depending upon the position of fetal arm. The ends of the diaphysis of humerus in long axis were imaged. By placing the ultrasound cursers on both ends of the diaphysis, the length was measured in mms.

It is measured in a plane such that the bone was as close as possible to a right angle to the ultrasound beam. Care was taken to ensure that the full length of the bone was visualized and the view was not obscured by shadowing from adjacent bony parts. The foetal gestational age was calculated by using FL measurements in weeks. The humerus length measure in( mm). Typically , a 3- to5-MHz TA transducer will allow sufficient penetration in most pregnant patients , while providing sufficient resolution. Transducer should be cleaned after performing an obstetric sonogram to prevent the spread of disease.

### **3.2.2 Data analysis :**

Data was collected from (70) women at the third trimester sonographic fetal bio-metries measurements were performed for femur length and compared with humeral length and previous study. Statistical computer analysis Statistical Package for the Social Sciences (SPSS) was performed by completely randomized block design with each patient representing a block of related measurement.

### **3. 2.3 Ethical consideration:**

Permissions were taken from the patients before doing scans , and they were informed about the study , and accept it. Also the patients get sure that thier details will not be exposed. Before that permissions were taken from the head mangers of the hospitals.

# **Chapter Four**

**Data analysis and result**

## Chapter Four

### Data analysis and result

#### 4.1 Result

seventy pregnant women came for the routine ultrasound examination, in the ultrasound department of Alturki teaching hospital were selected to be the sample of the research, then the gestational age using the femur length and the humeral length is obtained.

Table4-1 Show the mean and the stander deviation of maternal age, gravidity, gestational age by LMP, gestational age measured using the FL and the HL.

Descriptive Statistics					
	N	Minimu m	Maximu m	Mean	Std. Deviation
Maternal age	70	18.00	40.00	29.9429	6.08130
Gravidity	70	1.00	10.00	3.7000	2.28003
GA by LMP	70	26.00	40.00	33.0857	4.10988
FL in mm	70	47.00	75.00	63.7429	7.56362
GA by FL	70	26.00	39.00	32.9571	3.94320
HL in mm	70	35.00	64.00	54.9429	6.02142

Table 4-2: relation between number of gravidity and humeral length

Descriptives									
HL in mm									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	p-value
					Lower Bound	Upper Bound			
1.00	10	56.3000	2.66875	.84393	54.3909	58.2091	52.00	60.00	0.729
2.00	15	54.8000	7.61765	1.96687	50.5815	59.0185	35.00	63.00	
3.00	17	54.8235	6.49264	1.57470	51.4853	58.1617	36.00	62.00	
4.00	6	55.0000	4.89898	2.00000	49.8588	60.1412	49.00	62.00	
5.00	10	52.4000	5.10338	1.61383	48.7493	56.0507	44.00	61.00	
7.00	6	55.5000	6.22093	2.53969	48.9715	62.0285	46.00	61.00	
8.00	3	53.6667	9.50438	5.48736	30.0565	77.2769	44.00	63.00	
9.00	2	58.5000	4.94975	3.50000	14.0283	102.9717	55.00	62.00	
10.00	1	64.0000	.	.	.	.	64.00	64.00	
Total	70	54.9429	6.02142	.71970	53.5071	56.3786	35.00	64.00	

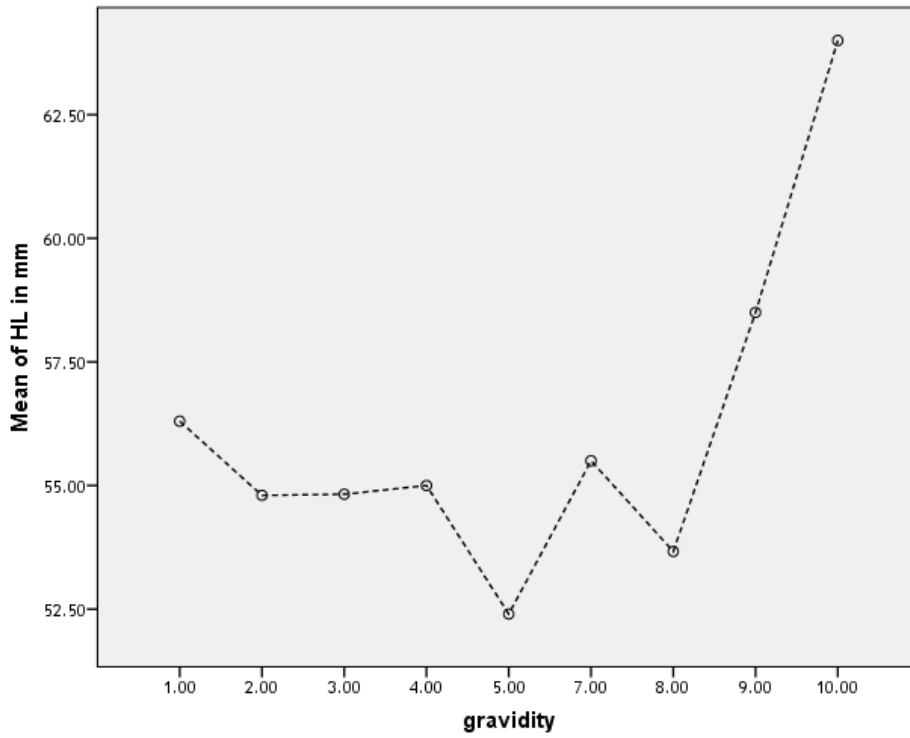


Figure 4-1: relationship between gravity and humeral length

**Normal P-P Plot of Regression Standardized Residual**

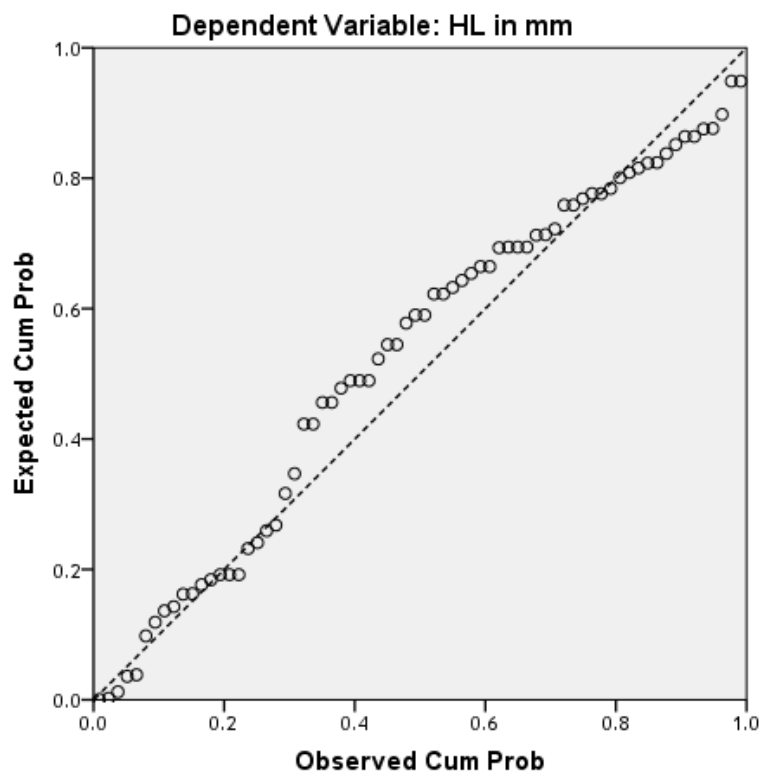


Figure4-2 p-plot regression between expected HL and constant FL in mm

Table 4-3 Relation between dependant(HL) with constant(FL)in mm

<b>Model Summary<sup>b</sup></b>				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.921 <sup>a</sup>	.847	.845	2.36878
a. Predictors: (Constant), FL in mm				
b. Dependent Variable: HL in mm				

Table 4-4 :coefficients of FL, HL(mm)

<b>Coefficients<sup>a</sup></b>						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.227	2.420		3.400	.001
	FL in mm	.733	.038	.921	19.439	.000
a. Dependent Variable: HL in mm						

$$HL \text{ in mm} = 8.227 + 0.733 * FL \text{ in mm}$$





Table 4-5: Show the correlation between the gestational age using the LMP versus FL, LMP versus HL, and FL versus HL.

Correlations							
		maternal age	gravidity	GA by LMP	FL in mm	GA by FL	HL in mm
Maternal age	Pearson Correlation	1	.759**	-.044	-.068	-.024	.033
	Sig. (2-tailed)		.000	.715	.577	.846	.788
	N	70	70	70	70	70	70
gravidity	Pearson Correlation	.759**	1	-.058	-.098	-.034	.026
	Sig. (2-tailed)	.000		.636	.420	.782	.830
	N	70	70	70	70	70	70
GA by LMP	Pearson Correlation	-.044	-.058	1	.902**	.959**	.811**
	Sig. (2-tailed)	.715	.636		.000	.000	.000
	N	70	70	70	70	70	70
FL in mm	Pearson Correlation	-.068	-.098	.902**	1	.948**	.921**
	Sig. (2-tailed)	.577	.420	.000		.000	.000
	N	70	70	70	70	70	70
GA by FL	Pearson Correlation	-.024	-.034	.959**	.948**	1	.884**
	Sig. (2-tailed)	.846	.782	.000	.000		.000

	N	70	70	70	70	70	70
HL in mm	Pearson Correlation	.033	.026	.811**	.921**	.884**	1
	Sig. (2-tailed)	.788	.830	.000	.000	.000	
	N	70	70	70	70	70	70
**. Correlation is significant at the 0.01 level (2-tailed).							

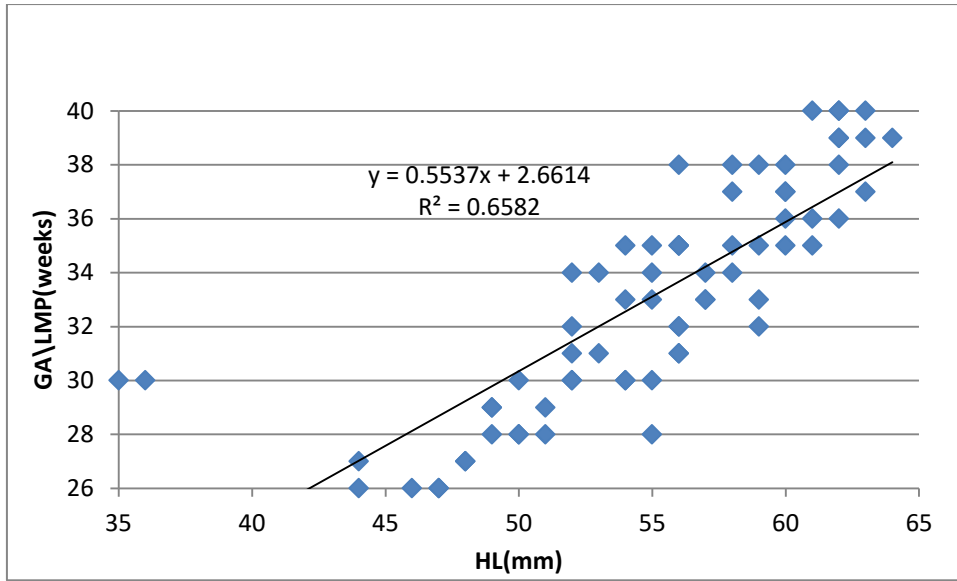


Figure 4-3: scatter plot, relationship between GA by LMP and humeral length(mm)

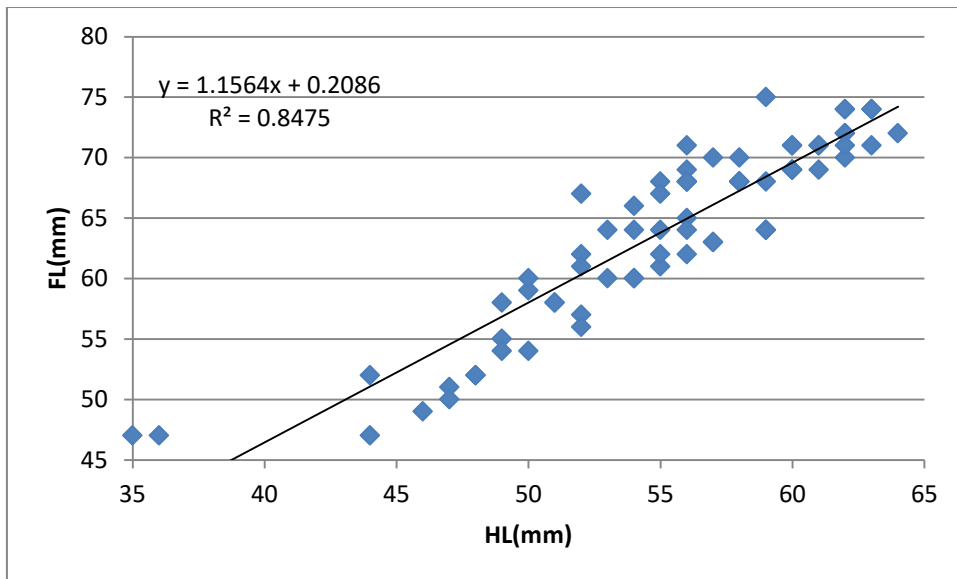


Figure 4-4 : scatter plot, relationship between FL (mm) andHL(mm)

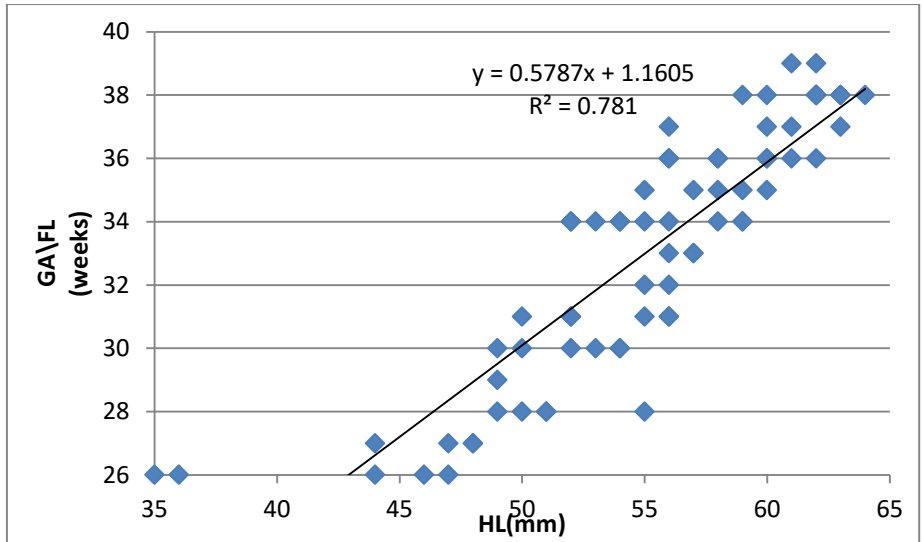


Figure 4-5: direct linear relationship between the GA/FL (weeks) and HL(mm)

**Table 4-6: Chart for prediction of GA(weeks) using HL(mm)**

GA(LMP)	Mean of HL(mm)
26	46
27	47
28	48
29	50
30	51
31	52
32	53
33	54
34	55
35	57
36	59
37	60
38	61
39	62
40	62

# **Chapter Five**

## **Discussion, Conclusion and Recommendations**

## Chapter Five

### Discussion, Conclusion and Recommendations

#### 5.1 Discussion

Seventy pregnant women in age between 18 and 40 years old who came for the routine ultrasound examination, in the ultrasound department of Alturki teaching hospital in third trimester .

FL is used as standard method to estimate gestational age to be compared with the other gestational age that obtained with HL and the LMP. The

The study revealed that the mean of maternal age, gravidity, GA by LMP, FL in mm, GA by FL and HL in mm were  $29.94 \pm 6.08$ ,  $3.70 \pm 2.28$ ,  $33.08 \pm 4.10$ ,  $63.74 \pm 7.56$ ,  $32.95 \pm 3.94$  and  $54.94 \pm 6.02$  respectively as was shown in table(4-1). There was strong relation between gravidity and HL, with no significant difference from point of maternal gravidity 8 deliveries (p-value 0.72) as shown in figure (4-2) and . strong correlation existed between HL and FL in mm ( $r^2 = .84$ ) as shown in table(4-3). Regression between expected HL and observed FL was positive linear relation as shown in figure(4-2). significant coefficient relation between HL and FL in mm was observed and explained by flowed equation ( $HL_{imm} = 8.227 + 0.733 * FL$  in mm). In this study a significant correlation were noticed between GA by FL and GA by LMP (.959), gestational age by LMP and HL in mm (.811) FL (mm) and HL(mm) (.921), GA by FL(weeks) and HL(mm) (.884), Further strong correlation was seen between maternal age and gravidity (.759) table (4-5). This study in line (Gameraddin et.al, 2015). The results revealed that there were direct linear relationships between the GA\LMP and humerus length, FL and HL and GA\FL and humerus length .figures (4-3) (4-4) and (4-5). The result agree with (Nagesh, et al, 2016). From this present study HL can be used to predict the gestational age and this agree with (Patre, et.al in 2015). GA(weeks) by using the length of HL(mm) can be predicted by chart table(4-5). The HL was most accurate parameter next to FL in

assessing GA. The limitations of this study were small size of sample, was done in one hospital and pathology that affected bone length.



## **5.2 Conclusion:**

From this result we can conclude that the humeral length measurement in the third trimester is accurate in calculation of the gestational age in the single fetus with no fetal anomalies, of the healthy pregnant women with normal uncomplicated pregnancy.

The gestational age calculated using the humeral length is another standard parameter used in the third trimester to precise measurement of the gestational age.

There is no significant difference between the gestational ages calculated using the femur length, last menstrual period, and the humeral length.

### **5.3 Recommendations:**

- From the above result we can see that in this research the gestational age that calculated by the measuring the humeral length is another accurate measurement for the fetal age in the third trimester and should be used as standard measure with FL when the other biometry are difficult to be obtained.
- further study should be carried out in this field by increasing number of sample.
- The humeral length must be used as routine measurement in calculation the gestational age in the third trimester, to confirm the accuracy of the femur length measurement, and the precise of the last menstrual period in the calculation of the third trimester gestational age.
- Further study should be carried out to estimate GA in second trimester using HL.
- Equipment company should be install HL as indicator for GA.

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# **Appendixes**

# Appendix I

## Data collection sheet

ID.....

Maternal age.....

Number of gravidity.....

LMP.....

FL(mm).....

.....

GA byFL.....

HL(mm).....

## Appendix II



Image1 This measurement was done in 31years old women,LMP was on5.3.2018, GA by date was 38 weeks, FL(74mm) and GAby FL was 38weeks.

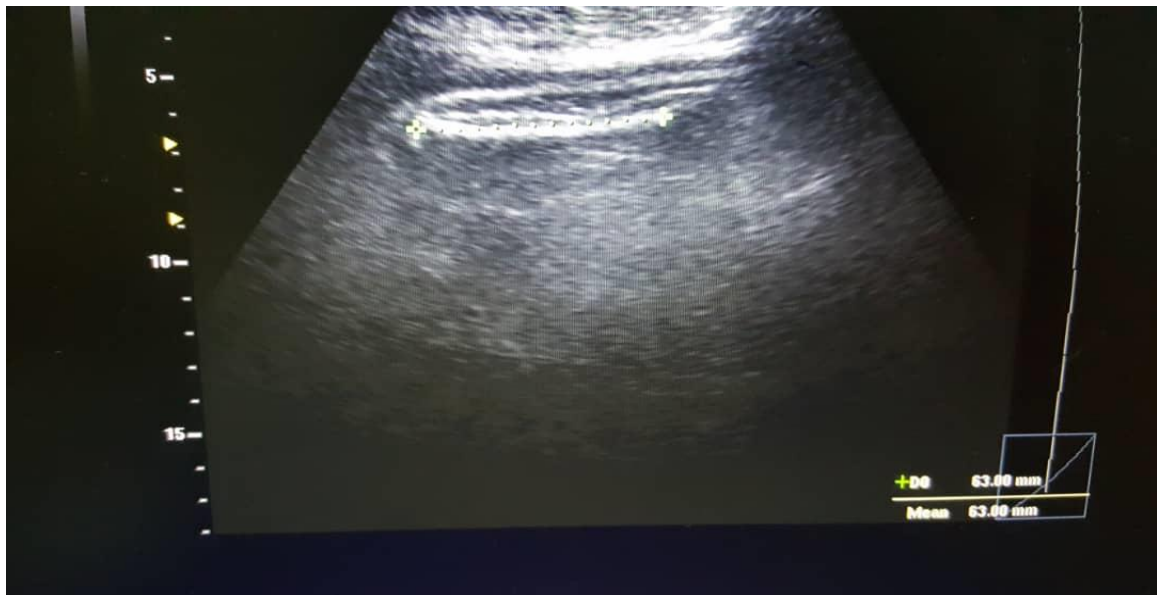


Image2 HL(63mm) of the same patient in figure1



Image 3 measurement of FL(68mm) in 27 years old lady, her LMP on 1.2.2018, GA at time of scan was 34 weeks, GA by FL was 35 weeks.



Image 4 HL(58mm) in the same patient of figure 14.