Sudan University Of Sciences and Technology

College Of Graduate Studies

Assessment of Fetal Age by Measuring Bi-Parietal Diameter and Femur Length in the Third Trimester Using Ultrasonography

تقيم عمر الجنين بقياس عظم الراس وطول عظم الفخذ في الثلث الثالث من الحمل باستخدام الموجات فوق الصوتية

A Thesis Submitted in Partial Fulfillment For Degree of (M.Sc)In Medical Diagnostic Ultrasound

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الآيـة

بسم الله الرحمن الرحيم

قال تعالى:

{ أَمَّنْ هُوَ قَانِتٌ آنَاءَ اللَّيْلِ سَاجِدًا وَقَائِمًا يَحْذَرُ الْآخِرَةَ وَيَرْجُو رَحْمَةَ رَبِّهِ ۗ قُلْ هَلْ يَسْتَوِي الَّذِينَ يَعْلَمُونَ وَالَّذِينَ لَا يَعْلَمُونَ ۗ إِنَّمَا يَتَذَكَّرُ أُولُو الْأَلْبَابِ}

صدق الله العظيم

سورة الزمرالآية (9)

Dedication

To my families

My Brothers

Sister and Friends

Acknowledgement

I would like to express my deepest appreciation to all those who provided me the possibility to complete this work, thanks to all who supported me emotionally, academically or financially.

A special gratitude I give to my supervisor Dr/Asma ibrahime ahamed.

Abstract

The main objective of this study was to assess the fetal age by measuring bi parietal diameter and femur length using ultrasonography . Imaging was conducted through allowing the subjects to lie supine , and the transducer was put above the symphysis pubic many sections (longitudinal and transverse) of two fetal barometric bi parietal diameter and femur length were taken. The machine used was Aloka (SSD-500) and Zoncare with 3.5 MHz convex probe.

The findings included that there was strong correlation between the fetal age by bi parietal diameter and femur length R^2 = (0.849), and another strong correlation between fetal age by bi parietal diameter in (weeks) and bi parietal diameter in (millimeter) R^2=0.882.

It was also found that there was strong correlation between fetal age in weeks and femur length in (millimeter) R^2= 0.980. There was strong correlation of fetal age by bi parietal diameter in (weeks) and expected date of delivery in (weeks) R^2=0.853.

The study also found that there was strong correlation between fetal age by femur length in (millimeter) and expected date of delivery in (weeks).

The study concluded that there was no significance difference between bi parietal diameter and femur length , although there was little relation between them , However the femur length was more accurate for fetal age measurement in third trimester of pregnancy.

مستخلص الدراسة

اجريت هذه الدراسه لتقيم عمر الجنين بقياس عظم جانبي الراس وطول عظم الفخذ باستخدام الموجات فوق الصوتيه.

هذه الدراسة تمت بوضع المريض مستلقيا علي ظهره بوضع محول الطاقه فوق عظمه العانه ,عدة مقاطع تم اخذها وهي عظم جانبي الراس وطول عظم الفخذ, وتم المسح باستخدام جهاز الوكا (اس اس دي -500) وذونكير بتردد 3,5 ميجاهيرتز بمحول متعدد

أوضحت النتائج ان هناك علاقه قوية بين عمر الجنين من خلال قياس عظم جانبي الراس وطول عظم الفخذ R^2=0.849. وعلاقة قوية بين عمر الجنين و عظم جانبي الراس باستخدام الاسابيع كمدة وعظم جانبي الراس (بالمليمتر) R^2=0.882 .

وجدت الدراسة علاقة قوية بين عمر الجنين بقياس طول عظم الفخذ بالاسابيع كمدة وطول عظم الفخذ (بالمليمتر) R^2= 0.980 .

ايضا هناك علاقه قوية بين عمر الجنين بين طرفي عظم الراس باستخدام الاسابيع كمدة والتاريخ المتوقع للولاده (بالاسابيع) R^2= 0.853.

بالاضافة الى ذلك أوضحت الدراسة وجود علاقة تربط بين عمر الجنين بطول عظم الفخذ (بالمليمتر) والتاريخ المتوقع للولادة الاسابيع كمدة.

خلصت الدراسة الي انه لا يوجد فرق مهم بين طرفي الراس وطول عظم الفخذ وتقدير عمر الجنين عن طريق قياسي جانبي الراس وطول عظم الفخذ ولكن اتضح ان طول الفخذ هو أكثر دقة لقياس عمر الجنين في الثلث الاخير من فترة الحمل .

Abbreviations

BPD	Bipraietal diameter.
CRL	Crown rump length.
FL	Femur length.
GA	Gestational age
HC	Head circumference.
LMP	Last menstrual period.
SD	Stander deviation.
YS	Yolk sac.

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Chapter One

Introduction

Chapter one

1.1. Introduction:

full term pregnancy is considered 40 weeks counted from the first of last menstrual period, this is broken down into weeks and divided into three equal part called trimesters, the third trimester is the last stage of pregnancy which starts from week 27 and last up to week 40.(John.1983).

Fetal biometry is a methodology to measurement of the several parts of fetal biometry and their growth. Fetal growth is defined as the time dependent changes in body dimensions that occur throughout the pregnancy. The growth rate of various parameters is rapid especially in the 1^{st} and 2^{nd} trimesters; they change significantly with the advancement of pregnancy and must be evaluated against normal value at the age (Burwin.1995).

Fetal biometry can be carried out by two different kinds of biometrics example femur length (FL) and bi-parital diameter (BPD), fetal age is established in early pregnancy, abnormal growth curves are easily diagnosed, and the statistics provide more relevant and stronger information, these studies necessitate that same fetuses be scanned during the whole gestation, which considerably increases the time to collect the date and calls for a high motivation on the part of both the mother and investigator. (Burwin. 1995).

Professor lan Donald in glasgow first used ultrasound examine for obstetrical purpose in late 1950, fetal cephalometery was employed for fetal biometry. (Burwin.1985).

The last decades have seen a progress in application of ultrasound as a diagnostic modality; this is particularly due to its-non- invasive and non-acceptability.

Ultrasound is safe for the patient, the fetus and the sonographer. It does not require the injections such as radio-opaque days sometimes needed in radiology.

The single or repeated intrautreine exposure to ultrasound, early or late in pregnancy does not carry the risk, of development. (Burwin.1995).

1.2. Problems of the study:

Most problems arising with measuring the bi-parietal diameter BPD are due to a combination of fetal movement and slow use of the freezebutton.

Fetal presentation also can effect in measuring of bi-parietal diameter bi-parital when fetus presented transversely or breech.

1.3. objectives:

1.3.1. General objective:

To assess the fetal age by measuring Bi-parietal diameter and femur length in the third trimester using ultrasonography.

1.3.2. Specific objective:

- To measure the fetal age in the third trimester by using Bi-parietal diameter and femur length
- To correlate the gestational age with femur length and bi-parietal diameter.
- To evaluate and use expected date of delivery in the third trimester for bi- partial diameter and femur length.

1.4 Over view of the study:

This study consist of five chapters, in (chapter one) introduction, chapter two) literature review, (chapter three) material and method, (chapter four) results, (chapter five) discussion ,conclusion and recommendation , reference and appendix.

Chapter Tow

Fetal anatomy and Embryology

Chapter Tow

2.1. Fetal anatomy and Embryology:

Recognizing normal fetal anatomy is critical to the performance of obstetric ultrasound studies. Once normal anatomic structures are identified, the investigator is prepared to detect malformations in fetal development. The task of identifying standard anatomic planes and organs poses a considerable challenge for the sonographer, must continuously update his or her knowledge of ultra sonographic techniques and fetal anatomy.The sonographer should initially determine the position of the fetus in relationship to the position of the mother(john.1983).

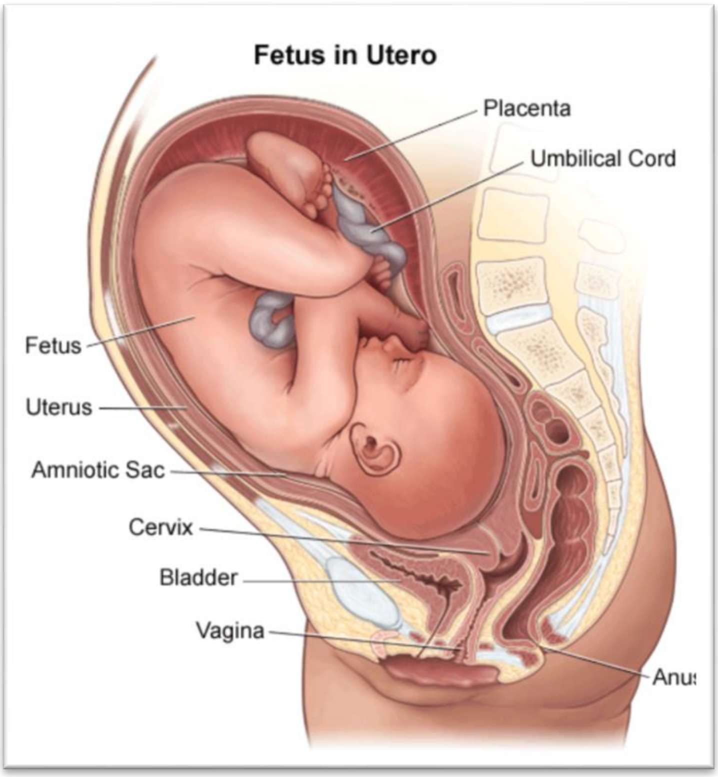

Figure 2.1 show the Anatomical structures of the fetus in uetro (www.fetal.com)

2.1.1. The Fetal heads:

Also the central nervous system (CNS) arises from ectodermal neural plate at around 18 gestational days. The cephalic neural plate develops into the forebrain and the caudal end form the spinal cord.

The midbrain and hindbrain then from and the neural plate begins to fold. The cranial and caudal neuropores represent un-fused regions of the neural tube that will close between 24 and 26 gestational days. The forebrain will continue to develop into the pros encephalon, the midbrain will become the mesencephalon, and the hindbrain will form the rhomb encephalon.(John.1983).

the end of the week the cephalie end of the neural tube will bend into the shape of a C (cephalic flexure), with area of mesencephalon having a very prominent bend. The brain then folds back on itself and by the beginning of5th week another prominent bend, the cervical flexure, appears the hindbrain and the spinal cord. The brain that originally was composed of three parts has now further divided into five parts, the porsencephalon divides into the telencephalon, which become the cerebral hemispheres, and diencephalon, which eventually develops into the epithalamiums, thalamus, hypothalamus and infundibulum. (John.1983).

The rhomb encephalon subdivides into the metencephalon, which ultimately becomes the cerebellum and Pons, and the myelencephalon. Which transforms into the medulla the fundamental organization of the brain, is represented in these five divisions that persist into adult life. The primitive spinal cord divides into two regions. The alar plate region matures into the sensory region of the cord, and the basal plate region develops into the motor region of the cord. These regions further subdivide into specialized functions. Initially, the spinal cord and vertebral column extend the length of the body. After the first trimester, the posterior portion of the body grows beyond the vertebral column and spinal cord, and the growth of the spinal cord lags behind that of the vertebral column. At birth the spinal cord terminates at the level of third lumbar vertebra, although by adulthood the cord will end at the the second lumbar vertebra (John.1983).

2.1.2. The facial and neck:

In its 4th week the embryo has characteristic external features of head and neck area in the form of a series of bronchial arches pouches, grooves and membranes, these structures are referred to as the bronchial appararus and bear resemblance to gills.

There are six bronchial arches, however, only the first four are visible externally. Each of the arches separated by the bronchial grooves and is composed of a core of mesenchymal cells. The mesenchymal form the cartilage, bones, muscles, and blood vessels. (.John.1983).

The bronchial arches consist of mesenchymal tissue derived interaembryonic mesoderm. Covered by ectoderm and transderm. Neural crest cells migrate into the bronchial arches and proliferate, resulting in swellings that demarcate each arch. The neural crest cells develop the skeletal of the face and the mesoderm of each arch develops the musculature of the face and neck. The maxillary prominences arise from the first bronchial arches and grow cranially just under the eyes, and the mandibular prominence which grows inferiorly. The primitive mouth is an indentation on the surface of the ectoderm (referred to as the stomodeum) by the 5th week of development, five prominences identified: the frontal nasal prominence forming the upper boundary of stomdeum, the paired maxillary prominences of the first bronchial arch, forming the lateral boundaries of the stomodeum, and the pared mandibular prominences forming the caudal boundary. The nasal pits are formed as the surface ectoderm thickens into the nasal placodes on each side of the frontal nasal prominence, as these placodes invginate, the nasal pits are formed until 24 to 26 days of gestation.(john.1983).

the stomodeum is separated from the pharynx by a membrane that ruptures by around 26 days, to place the primitive gut in communication with the amniotic cavity the maxillary prominences medially between the 5 and 8 weeks. grows compress the medial nasal prominences together toward the midline. Tow medial nasal prominences and the two maxillary prominences lateral to them fuse together to form the upper lip The medial nasal prominences from the medial aspect of the lip, which is the origin of the labial component of the lip. the upper incisor teeth, and the anterior of the primary palate. The lateral nasal prominences from the alae of the nose, the maxillary prominences and lateral nasal prominence are separated by the naso-lacrimal groove. The ectoderm in the floor of is groove from the naso-lacrimal duct and lacrimal sac. (John.1983).

The nose is formed in three parts. The bridge of the nose originates from the frontal prominence, the two medial nasal prominences form the crest and tip of the nose, and the lateral nasal prominences form the maxillary prominences lateral to them fuse together to form the upper lip. The medial nasal prominences from the medial aspect of the lip which is the origin of the labial component of the lip, the upper incisor teeth, and the anterior aspect of the primary palate, the lateral nasal prominences from the alae of the nose. The maxillary prominences and lateral nasal prominence are seprated by the naso-lacrimal groove, the ectoderm in the floor of this groove from the naso-lacrimal duct and lacrimal sac. The nose is formed in three parts. The bridge of the nose originates from the frontal prominence, the tow medial nasal prominences from the crest and tip of the nose, and the lateral nasal prominences form the sides, or alae The mandibular prominences merge at the end of the 4^{th} to 5^{th} week and form the lower lip, chin and mandible. (John.1983).

2.1.3. The fetal thorax:

the early development, mesenchymal buds from the early trachea form and penetrate the masses destined to become the lungs. The bronchi, bronchioles, alveolar ducts alveoli are developed through multiple division and budding Between 16 and 20 weeks, the normal number of bronchi has formed between the 16 and 20 weeks a dramatic increase in the number and complexity of air spaces and vascular structures has occurred After 24 weeks, another important developmental phenomenon occurs progressive flattening of the epithelial cells lining the air spaces. The allows closer apposition of capillaries to the fiuid-filled air space lumen and results in further development of the air-blood barrier, which is necessary for efficient gas exchange after birth. The breathing movement that occur before birth result in the aspuration of fluid into the lungs. The lungs at birth are about half filled with fluid in the lungs at birth clears by three routes: Through the mouth and nose, Into the pulmonary capillaries, Into the Lymphatic and pulmonary vessels.

The fetal thorax is examined by sonographer in both the transverse and coronal of parasagittal planes. The normal shape of the thoracic cavity is symmetrically bell shaped, with ribs forming the lateral margins the clavicles forming the upper margins, and the diaphragm forming the lower margin. The lunge serve as the medial borders for the heart and interior border for the diaphragm, the diaphragm may be observed on real time sonographically as a smooth hypo echoic muscular margin between the fetal liver or spleen and the lungs. (John.1983).

The thorax is normally slightly smaller than the abdominal cavity the ratio(thoracic circumference to abdominal circumference) has been reported to remain constant throughout pregnancy(0.94+/0.05).

The central portion of the thorax is occupied by the mediastinum with the majority of the heart positioned in the mid line and left chest. The apex of the heart should be directed towards the spleen. the base of heart lies horizontal to the diaphragm. The location of the heart is important to document in a routine sonographic examination as the detection of the abnormal position may indicate the presence of a chest mass, pleural effusion, or cardiac malformation. (John.1983).

The fetal lungs appear on sonographically as homogenous and of a moderate echogenicty. Early in gestation, the lungs are similar to or clightly less echogenic than liver, and as gestation processes, there is a trend toward increased pulmonary echogenicty relative to the liver. (John.1983).

Fetal breathing becomes more prominent in the second and third trimesters. The mature fetus spends almost on third of its time breathing. Fetal breathing movements were considered to be present if

characteristic seesaw movements of fetal chest or abdomen were sustained for at least 20 seconds.(john.1983).

2.1.4. Fetal abdomen:

The fetal abdominal organs liver, biliary system. spleen, stomach, kidneys and colon are will formed by the second trimester.

The primitive gut forms during the 4th week of gestation as the dorsal part of the yolk sac is incorporated into the embryo during folding The primitive gut is divided into the three sections: foregut midgut and hindgut. The derivatives of the foregut are the pharynx, lower respiratory system, esophagus, and stomach, part of the duodenum, liver, biliary apparatus and pancreas.(john.1983).

2.1.4.1. Esophagus:

Is short in beginning, but it rapidly lengthens as the body grows reaching, its final length by the 7th week, the tracheoesophageal septum partitions the trachea from the esophagus.(john.1983).

2.1.4.2. Stomach:

is appears as a fusiform dilation of the caudal part of the foregut during the 5th and 6th weeks the dorsal border(greater curvature) grows faster than the ventral border(lesser curvature). The stomach is suspended from the dorsal wall of the abdominal cavity by the dorsal mesentery or dorsal mesogastrium is carried to the left during rotation of the stomach and formation of a cavity known as the omental bursa or lesser sac of peritoneum. The lesser sac communicates with main peritoneal cavity or great poritoneal cavity or great peritoneal sac through a small opening walled the epiploic foramen.

the stomach becomes apparent as early as the 11th week of gestation as swallowed amniotic fluid fills the stomach cavity. The full stomach should be seen in all fetuses beyond the 16 week of gestation. (John.1983).

2.1.4.3. Liver and Biliary system:

The liver, gallbladder, and biliary ducts arise as a bud from the most caudal part of the foregut in the 4th week. The hepatic divericulum grows between the layers of the ventral mesentery. where it rapidly enlarges and divides into two parts. The liver grows rapidly and intermingles with the vitelline and umbilical veins, divides into parts, and fills most the abdominal cavity. The large cranial part is the primordium of the parenchyma of the liver. The small caudal part gives rise to the gallbladder and cystic duct. The fetal liver is relatively large compared with the other intra abdominal organs it accounts for 10% of the total of the fetus at eleven weeks and 5% of the total weight term. The hepatic veins and fissures are formed by the end first trimester.(john.1983).

2.1.4.4. Pancreas:

It develops from the dorsal and ventral pancreatic buds of the endodermal cells that arise from the caudal part of the foregut. When the duodenum grows and rotates to the right, the ventral bud is carried dorsally and fuses with the dorsal bud, the ducts of the two pancreatic buds join.(john.1983).

2.1.4.5. Spleen:

its lymphatic organ that is derived from a mass of menchymal cells located between the layers of the dorsal mesogastrium. The spleen is lobulated in the fetal period.

The derivatives of the midgut are the small intestines(including most of the duodenum), the cecum and vermiform appendix, the ascending colon, and most of the transverse colon. All of these structures are supplied by the superior mesenteric artery.

the derivatives of the hindgut are the left part of the transverse colon, the descending colon, the sigmoid colon, the rectum, the superior portion of the anal canal, the epithelium of the urinary bladder, and most of the urethra all of these structures are supplied by the inferior mesenteric artery. (John.1983).

2.1.5. The genito-urinary system:

The urinary system consists of two kidneys that excrete urine, the ureter, which transport urine to the urinary bladder and the urethra through which the urine is discharged to the exterior.(Burwin.1995).

2.1.5.1. Development of the kidneys:

There are three sets of the excretory organs that develop in the embryo, only the third set remains as the permanent kidneys(metanephros). It begins to develop early in the 5th week although they do not begin to function and produce urine until around the 11th week(end of the first trimester), Urine formation continues to fill the amniotic cavity throughout life. The kidneys do not function in utero because the placenta eliminates waste from the fetal blood, the fetal kidneys are subdivided into lobes may be separated by grooves. This lobulation usuallydiminushes by the end of the fetal period, but in some cases the lobes may still be noticeable by the end of the neonatal period.(Elbert.1983).

The kidneys located on either sides of the spine in the posterior are abdomen and are apparent as the 15th week of pregnancy. The appearance of the developing kidney changes with advancing gestational age in second trimester of pregnancy. the kidney appears as ovoid retroperitoneal structures that lack distinctive borders. The pelvocaliceal centre may be difficult to define in early pregnancy. where as with continued maturation of the kidneys the borders become more defined and the renal pelvis becomes more distinct. The renal pelvis appears as an echo-free area in the centre of the kidney.

The arterial vascular supply comes from the arteries that arise from the aorta: Usually these vessels disappear when the kidney ascend, but some of them may persist accounting for the variations one may find in the renal arteries. At least 25% of adult kidneys have two to four renal arteries. (Elbert.1983).

2.1.5.2. Development external genitalia:

The early development is similar for both sexes, distinguishing sexual characteristics begin during the 9th week and external genital organs are fully differentiated by the 12th of gestation.

In the 4th week a genital tubercle develops at the cranial end of the cloacal membranes. Labio-scrotal swellings and uro-genital folds develop on either side of this membrane. The genital tubercle elongates to form a phallus, which is similar in both sexes.(Elbert.1983).

2.1.5.3. Development of the male external genitalia:

The fetal testes produce androgens that cause the masculinization of the external genitalia. The phallus elongates to form the penis. The urogenital folds fuse on the ventral surface of the penis to form the spongy urethra. The labioscrotal swelling grows toward the med plane and fuses the scrotum. The line of fusion of the labioscrotal folds is called the scrotal rape. (John.1983).

2.1.5.4. Development of the female external genitalia:

Both the urethra and vagina open into the urogenital sinus, the vestibule of the vagina. The urogenital fold becomes the labia minora, the labio scrotal swellings the labia majora, and the phallus become the clitoris.(John.1983).

2.2. Physiology of the fetus:

Nutrition: Provisions for the substance of the ovum from cell division until birth are extensive.

In uterine cavity: while the ovum lies in the uterus several days awaiting completion of the trophoplast so that if can implant itself. Its nutrition is provided by pabulum in the uterine cavity, which is provided by the endometrial secretion. (dewbury.1987).

in the endometrium: when the ovum has digested its way into the endometrium, it lies in a little lake(lacuna) of fluid, presumply formed by tissues digested by trophoplast which known to certain atryptic ferment may be assumed that maternal serum and endometrial glycogen continue the nutrition of the ovum. Nourishment from maternal blood occurs very early when the trophoplast open up endometrial vessels, and irregular spaces filled with maternal blood are formed, the foreunners of the intervillous spaces the placenta only buds(rudime ntary villi) of the future villi but they serve. As yet, only to increase the ansorbing surface, for they contain no fetal vessels and nutritive are transmited by osmosis.(dewbury.1987).

Through fetal circulation In third week of gestation, perhaps, blood vessels from inside in the chorionic membranes and villi. At the same time the branches of umbilical vessels approach the chorion and finally fuse with the vessel that has originated in the chorion.Thus the fetal circulation the fourth week reaches the villi. Hematopoiesis begins in the liver and spleen about the second month although island of blood cells may be seen even earlier in the yolk sac. At first all the red blood cells are nucleated but by the third month only 10% retain their nuclei and term the incidence of nucleated erythrocytes is 5 to 8 The fetal hemoglobin.(dewbury.1987).

(hemoglobin F) is mixed in varying proportion with adult type(a) after mid pregnancy but even at term approximately two; thirds the hemoglobin is of the fetal type amount is advantageous in that fetal hemoglobin, at all level of oxygen tension absorbs oxygen more fully and release it more completely(i.e.has greater oxygen dissociation) than dose adult hemoglobin Essentially complete to adult hemoglobin is accomplished within a few months following birth, fetal hemoglobin is synthesized primarily in the liver, and ferreting, which is essential in it is production, may be found in the liver during the second month. (dewbury.1987).

2.3. The Placenta Development:

The placenta and fetus both arise from the same single cell. The zygote, which is the fertilized ovum: hence, placenta and the umbilical cord and the blood. Flowing and them of embryonic or fetal origin after the blastocyst attaches to the endometrial surface; it begins the process implantation. In the early stages of implantation, the trophoblast begins to differentiate into two cell layers. The outer syncytiotrophoblast and inner cytotrophoblast. As the trophoblast invades the decidua, it breaks down decidual blood vessels and creates a network of blood-filled spaces known as lacunae, the lacunar network involves into the intervillous spaces of the mature placenta. (dewbury.1987).

it is interesting to note that in the trophoblast's invasion of the decidua it normally penetrates just so far and then stops, probably as a result of limits by decidua rather than by the trophoblast itself (in a tubal the pregnancy, trophoblast is not under any local control and invades freely all the tissue layers of the tube(mucosa, muscle, serosa)).

As the syncytiotrophoblast become embedded in the decidua, the inner cytotrophoblast proliferates forming a complicated system of tiny projections that push into the syncytiotrophoblast and the lacunae. The cytotrophoblastic projections, called the primary chorionic villi, eventually become branched and vascularized by fetal blood vessels originating from the arteries in, the umbilical cord, initially, and the entire surface of the developing gestational sac is covered with chorionic villi. As the chorionic sac grows, the villi underneath the decidua capsularis are compressed and their blood supply reduced, subsequently, these villi degenerate, resulting in an avillous of the chorionic sac known as the smooth chorion or chorion leave. Meanwhile, the chorionic villi associated with the deeper decidua basalis proliferate, branch profusely and hypertrophy to form the chorion frondosum or villous chorion(future placenta).(dewbury.1987).

2.3.1.Structure:

The placenta has tow functional components: the main functional component is a fetal portion that develops from the chorion. and another is a maternal portion formed by the decidua the fetal component of the placenta consists of the chorionic plate and the chorionic villi that arise from it and project into the intervillous spaces. The maternal component of the placenta is formed by the decidual basalis This comprises all the endometrium beneath the fetal component of the placenta, except the deepest part, which is called the decidual plate. This layer remains after parturition and is involved in the regeneration of the endometrium during the subsequent menstrual cycle. The placenta is usually round or discoid as the villi invade the decidua basalis, they leave several wedge shaped areas of decidual tissue called placental septa. The placental septa compartmentalize the placenta into 15 to 20 segments known as cotyledons. The decidual septa do not completely extend to the chorionic plate, thus allowing maternal blood in adjacent cotyledons to freely communicate.

Certain large branches of chorionic villi(called anchorinc villi) arise from the chorionic plate and pass through the intervillous space to attach firmly to the decidua basalis, In addition to anchoring the chorionic plate to the decidua basalis. The anchoring villi Give origin to smaller branches called free or floating villi because they float in the blood-filled intrtvillous spaces.(dewbury.1987).

2.3.2. Placental Maternal-Fetal Circulation:

Maternal blood propelled under maternal blood pressure and heart rate enters the intervillous spaces of the placenta via numerous spiral arterioles and to the matemal circulation via the basal veins. oxygenated and nutrient-rich blood passes from the fetal capillary bed in the villi to an enlarging system of veins that eventually converge to form a single umbilical vein in the umbilical cord. In the fetal abdomen, the umbilical vein courses cranially towards the liver where it joins the portal sinus(umbilical portion of the left portal vein) to supply the liver. Most of the fetal blood bypasses the liver via the ductus venosus which originates at the portal sinus and terminates in the inferior vena cave or left hepatic vein. Deoxygenated blood returns from the fetus to the placenta via tow umbilical arteries which originate at the right and left internal iliac in the fetal pelvis. The tow umbilical arteries divide into numerous radiating branches as the cord inserts in the fetal and maternal blood do not normally come into direct contact CD/PD are helpful technologies to demonstrate the normal and deranged anatomic vascular relationships of the maternal and fetal circulations.(journal of medical science.Pakistan).

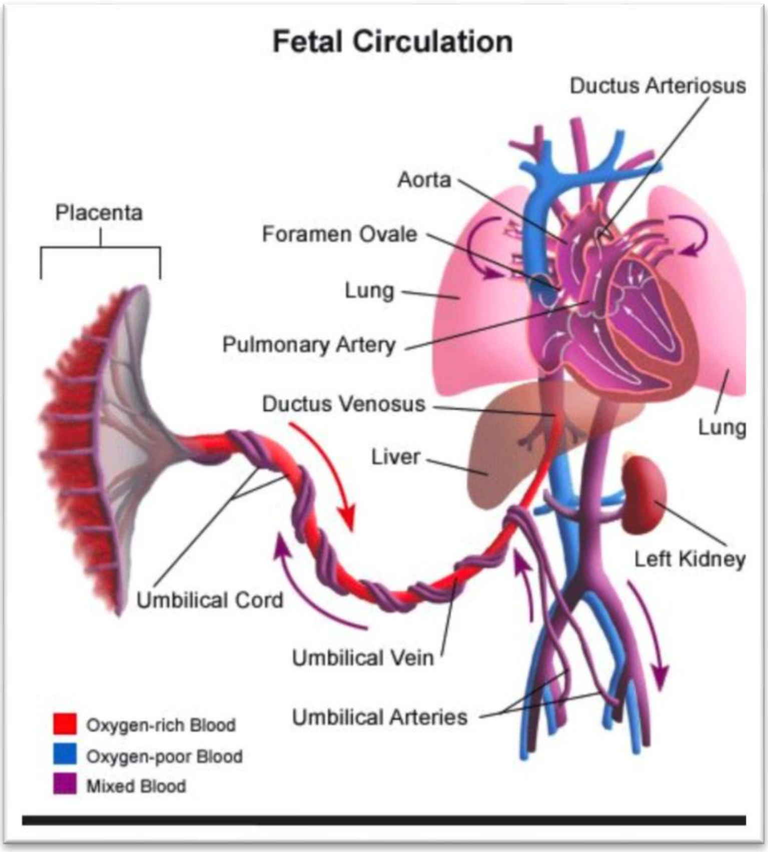

Figure 2.2. Shows Maternal-Fetal Circulation (www.fetal.com)

2.3.3.Location:

Placental location is described with respect to its relative position on the uterine wall and its relationship to the internal os. The placenta may be described as predominantly anterior, posterior, fundal, right or left lateral. A placenta that is distant from the internal os may be described as being in a normal location, central, or non previa. A low-lying placenta describes which appears to extend into the lower uterine segment and is within 1.2cm of the internal os. A placenta previa describes a placenta which appears to partly or completely cover the internal os. Documentation should include an image showing placental location and the relationship to the internal os.(joumal of medical science.Pakistan).

2.3.4.Echo Texture:

The normal placenta appears as a sonographically uniform structure with mid amplitude echoes(in contrast, the adjacent uterine wall(decidua and myometrium) appear less echogenic or hypoechoic) In the third trimester, the placenta generally appears less homogeneous and may have small anechoic or hypoechoic areas of different pathological etiologies Calcium deposits are seen in the majority of placentas in the third trimester and appear as high amplitude(white) linear echoes.

The fetal or amniochorionic surface of the placenta (generally referred to by authors as the chorionic plate) forms a strong interface with the amniotic fluid. This surface is very angling dependent (specular reflector) and appears as bright (white) echo when the sound beam strikes at normal incidence(perpendicular to the interface) .(joumal of medical science. Pakistan).

2.4. Pathology of the fetus:

2.4.1 Fetal growth anomalies:

2.4.1.1.Intrauterine Growth Restriction

Infants who are small-for- gestational age (sGA) at birth(low birth weight) have higher neonatal morbidity and mortality and worse long term prognoses than those who are appropriate size for gestational age(GA) in an attempt to identify fetuses at greatest risk for adverse neonatal outcomes, ultrasound has been used to identify small size in uterus at varying points in gestation. Because it is often difficult to distinguish constitutionally small fetuses form fetuses whose sizes are altered by an intrauterine pathologic process(e.g.)placental insufficientcy), all small fetuses are usually classified together and considered to have IUGR. (journal of medical science. Pakistan).

2.4.1.2.Small for gestational age:

Small for gestational age: The most common definition or SGA refers to a weight below the 10th percentile for gestational age. However, this definition dose not make a distinction among infants who are constitutionally small.

growth restricted and small, and not small but growth-restricted relative to their potential, As example, as many as 70 percent of fetuses who weigh bellow the 10th percentile for gestational age are small simply because of constitutional factors such as female sex or maternal ethnicity, parity, or body mass index: they are not at high risk of perinatal mortality or morbidity. Fetal biometries have an important role. Particularly in the third trimester and for fetal Wight. (journal of medical science. Pakistan).

2.4.1.3. causes of Intra utrain growth retardation (IUGR):

There are numerous causes of Intra utrain growth retardation which can be divided into matemal, placental, and fetal factors. The most common maternal factor associated with IUGR is hypertensive disease. Other significant maternal factors include smoking, collagen vascular disease (i.e. systemic Lupus) poor nutrition, and alcohol abuse. The most common uterine factors associated with IUGR are fibroids and mullein anomaly (i.e. bicornate uterus) the most common placental factor associated with IUGR is significant placental hemorrhage. The majority of IUGR cases (2/3) are due to chronic placental insufficiency or dysfunction related to matemal uterine or placental factors. The two most common fatal factors associated with IUGR are chromosome abnormalities (trisomy 18 and 13 are the two most common reported), and fetal infection (cytomegalovirus or CMV is the most common reported). Genetic studies and amniotic fluid cultures are indicated to rule out the possibility of a chromosomal abnormality or fetal infection when early onset symmetric IUGR is suspected.(journal of medical science. Pakistan).

2.4.1.4. Classification of Intra utrain growth retardation (IUGR):

IUGR is generally broadly classified as being either symmetric or asymmetric however it is recognized that growth-restricted fetuses fall on a continuum with respect to the degree of asymmetry versus symmetry of their body parts.

Symmetric IUGR: is generally characterized by early-onset(beginning of the 2nd trimester) and a proportional reduction in fetal parameters This form of

IUGR is typically seen in fetuses with chromosome anomalies or infections Even if recognized in uterus, very little can be done to improve fetal outcome. Asymmetric IUGR: accounts for about two-thirds of cases and is generally characterized by late onset(end of the 2nd or carly 3rd trimester) and relative"brain sparing" at the expense of abdominal and soft tissue growth, with varying degrees of compromise in fetal length (journal of medical science. Pakistan).

2.4.2.Macrosomia:

is defined as fetal weight above the 90th percentile for gestational age.

Macrosomia is most offer defined as fetal weight greater than 4.000 grams with most complications occurring fetuses weighting more than 4.500 grams. Fetal growth acceleration is most commonly associated with maternal diabetes although only 2% of macrosomic fetuses will be bom to diabetic mothers.(Mosby.2001).

2.5. Estimation of gestational age:

Introduction: Assessment of gestational age is a cornerstone in the delivery of optimum obstetric care. The ability to diagnose and treat conditions such as the premature labor, premature rupture of membrane, IUGR, and postdatism, depends on knowing precisely gestational age. The timing of certain diagnosis procedures, for example, early amniocentesis, chorionic villous sampling, or maternal serum alpha-fetoprotein testing is also influence by the accurate dating of the pregnancy. (Mosby.2001).

Human gestation lasts for 266 to 294 days, averaging 280 days or 40 weeks, from the last menstrual period(LMP) Usually in cases of planned pregnancies the information relating to gestational age is available charting, evidence of menstrual, menstrual cyclist and the exact date of the last menses and ovulation. When the gestational age or LMP is unknown however, or there is a history of irregular menstrual cycles. irregular bleeding or IUGR, alternative means for the estimation gestational age should be sought.

An assessment of gestational age is possible if uterine size is examined by an experience practitioner before 12week gestation, after the first trimester, factors, such as maternal obesity or the presence of uterine fibromas or malformations can confuse determination of gestational age (Mosby.2001).

From about 20 to 36 weeks gestation, the fundal height from the pubic symphysis to the top of the utering Findus approximates the gestational age, i.e.this distant in centimeters is approximately equal to the gestational age in week. Fetal heart tones should be audible no earlier than 12 week. Quickening, the mother first perception of fetal movement, is also valuable for pregnancy dating, some women are unable in provide a reliable date for their LMP, Wenner and young reported that one third of their patients had anon specific date of LMP Grennert et al reported that 4.8% of 5468 women were unable to provide the date of their LMP 9.8% had irregular cycles or oligomenorrhea, 32% had been on oral contraceptives, and 7 had bleeding in the first trimester johnson and coworkers proposed afigureic method of recording gestational estimators and suggested that a might be possible to predict that LMP by the best fit straight line through several clinical methods of estimating gestational age. Ultrasound is one of the main tools used in obstetrics, and it principal function still remains the estimation of gestational age (Mosby.2001)

2.5.1.Ultrasound assessment of gestational age biometric measurement:

2.5.1.1. Gestational sac diameter (GS):

The gestational sac can be visualized as early as 4.5 weeks, it increases by about 1 mm per day. As the sac is not usually round. an average of the length, width and depth is made, the accuracy of dating using GS size is low and can be off by a whole week This is therefore not recommended fetal **Crown-rump length** should be used wherever possible for dating a pregnancy.(www.gestation.com**)**

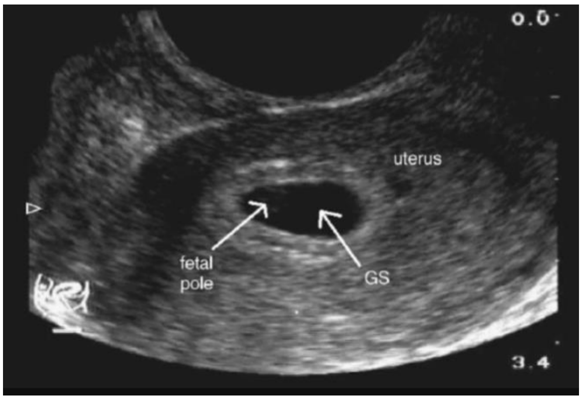

Figure 2.3 Show the structure of the gestational sac (www.gestation.com)

2.5.1.2. Yolk sac diameter (YS):

From about 7weeks onward, it is usually possible to see around cystic structure about 4-5mm in diameter adjacent to the fetus. This is the yolk sac. The site of the earliest blood cell formation. It disappears at about the eleventh week. The yolk sac may not be seen in all pregnancies, even when quite normal. (palmer.1995).

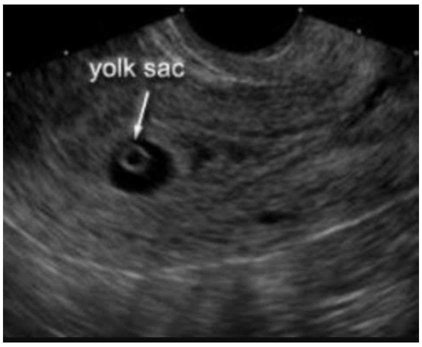

Figure 2.4 shows the yolk sac (palmer.1995).

2.5.1.3 Crown-rump length measurememnt CRL:

The crown-rump length is the most reliable parameter for estimating gestational age up to the eleventh week. After that, the curvature of the fetus affects the reliablity of the measurment. From the twelfth week onwards, the biparietal diameter is more accurate.

There is excellent correlation between the crown-rump length and gestational age from the 7th to 11th week of pregnancy: biological varibilty is minimal and growth is not affected by pathological disorders.

Using scans in different directions, the longest length of the embryo should be found and ameasurement made frome the head (the cephalic pole) to the outer edge of the rump. (palmer.1995).

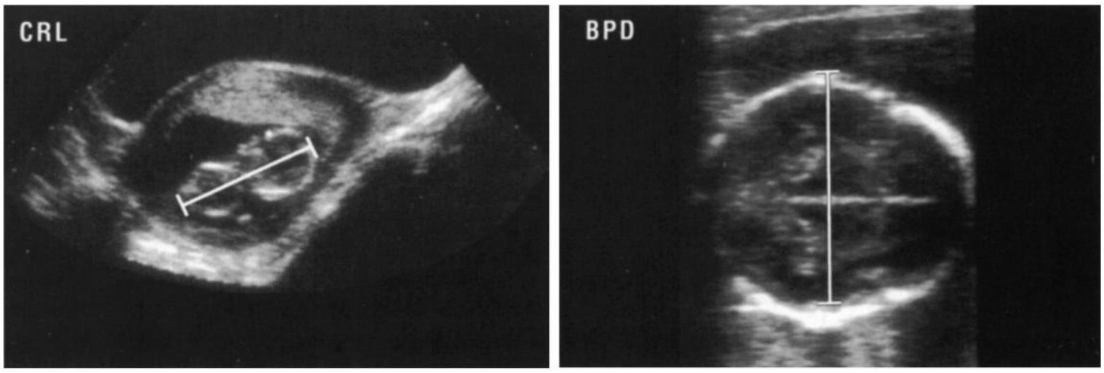

Image 2.5. ShowCrown-rump length measurememnt CRL. (palmer.1995).

2.5.1.4. Biparietal diameter:

This is the most reliable method of estimating gestational age between the 12^{th} and the 26^{th} weeks. After that, its accuracy may be lessened by pathological disorders and biological variations that affect fetal growth. It must be considered together with other measurements, such as femoral length and abdominal circumference.

The biparietal diameter (BPD) is the distance between the parietal eminences on either side of the skull and is, therefore, the widest diameter of the skull from side to side. Using scans at different angles, the transverse section will be recognized when the shape of the fetal skull is ovoid and the midline echo from the falx cerebri is interrupted by the cavum septi pellucidi and the thalami. When this plane is found. The gain on the ultrasound unit should be reduced and measurement made from the outer table of the proximal skull to the inner table of distal skull. The soft tissues over the skull are not included. This is the "leading-edge-to-leading-edge" technique. (palmer.1995).

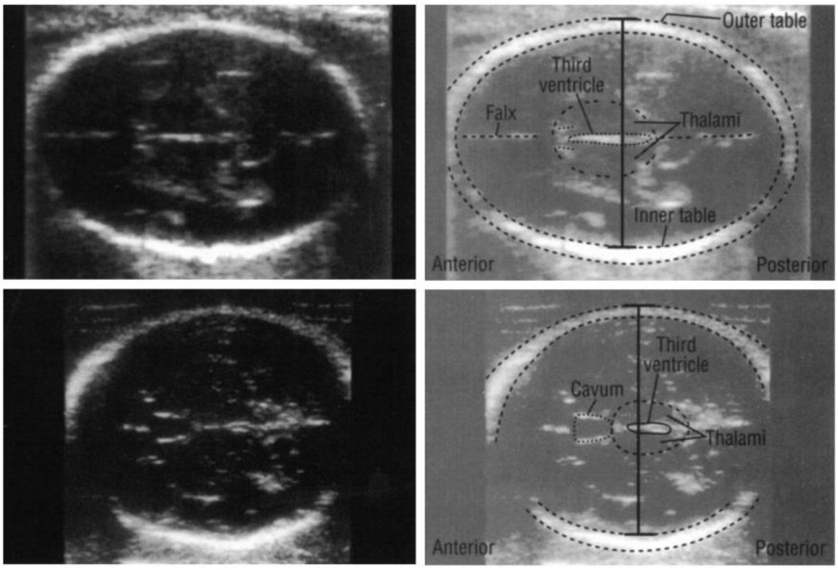

Image 2.6. show Bipraietal diameter (BPD). (palmer.1995).

2.5.1.5. Head circumference HC:

If the cephalic index is within the normal range, the BPD is acceptable as an estimate of gestational age. If the cephalic index is outside this range (less than 70 or greater than 86), the measured BPD should not be used to determine the gestational age. Instead, the head circumference can be used. On some ultrasound machines, this may be measured directly. It can also be calculated.(palmer.1995).

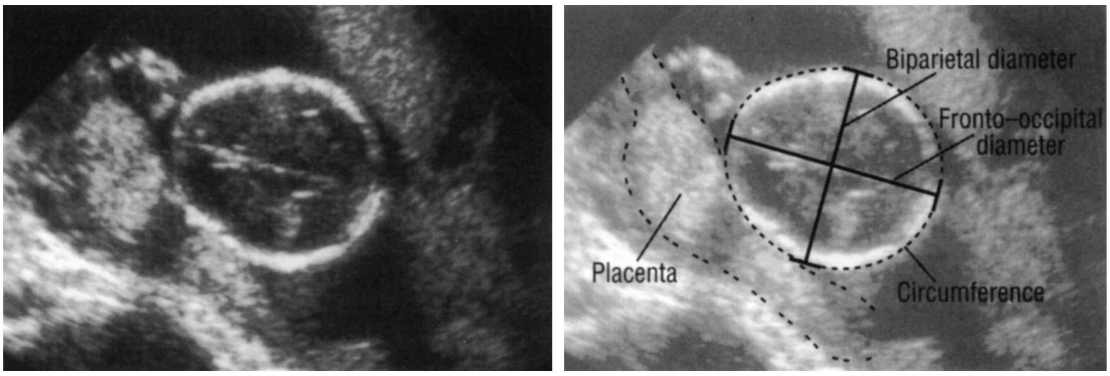

Image 2.7. show Head circumference HC. (palmer.1995).

2.5.1.6. Abdominal circumference AC:

Abdominal circumference is used to detect intrauterine growth disturbances. The measurement must be taken at the level of the fetal liver, which is very sensitive to deficient nutrition. If the measurement is less than normal there has probably been intrauterine growth retardation. .(palmer.1995).

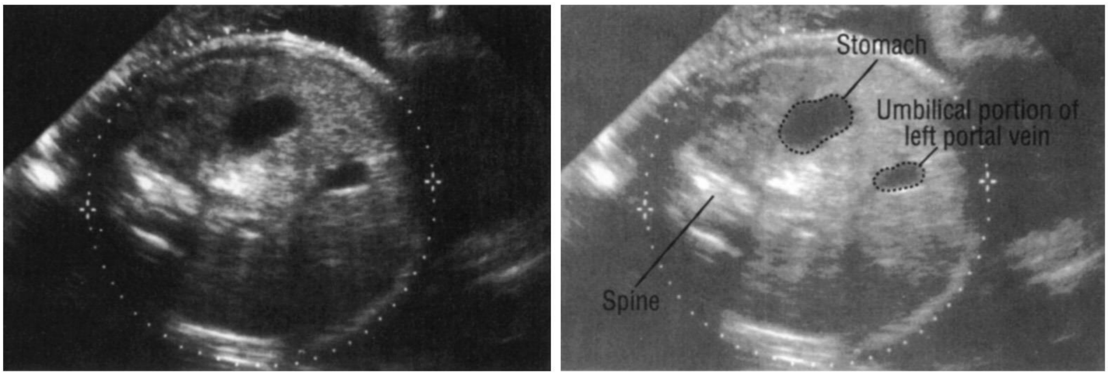

Image 2.8 show abdominal circumfernc.(palmer.1995).

2.5.1.8. Fetal long bone measurements:

When measuring bone length, it is necessary to reduce the gain. It is usually easy to see fetal long bones from 13weeks onwards, find aprojection that shows a transverse section of one of the long bones: then scan at 90° to this to obtain a longitudinal section. Measurements are made from one end of the bone to the other end. The femur is the easiest bone to recognize and measure. If there is any doubt, also measure the limb on the other side.

The lengh of abone, particularly the femoral lengh, can be used as a measure of gestational age when the head measurement is unreliable because of intracranial pathology. This occurs most frequently in the third trimester.

Bone length may also be compared with gestational age or biparietal diameter. A femoral or humeral measurement can be considered normal if it falls within two standard deviations of the mean for the known gestational age. It is proportional to the biparietal diameter if that measurement falls within two standard deviations of the mean bipraietal diameter a femur is short if it is more than tow standard deviations below the mean. A skeletal dysplasia is likely only if the femur length is even smaller-5mm smaller than two standard deviations below the mean.(palmer.1995).

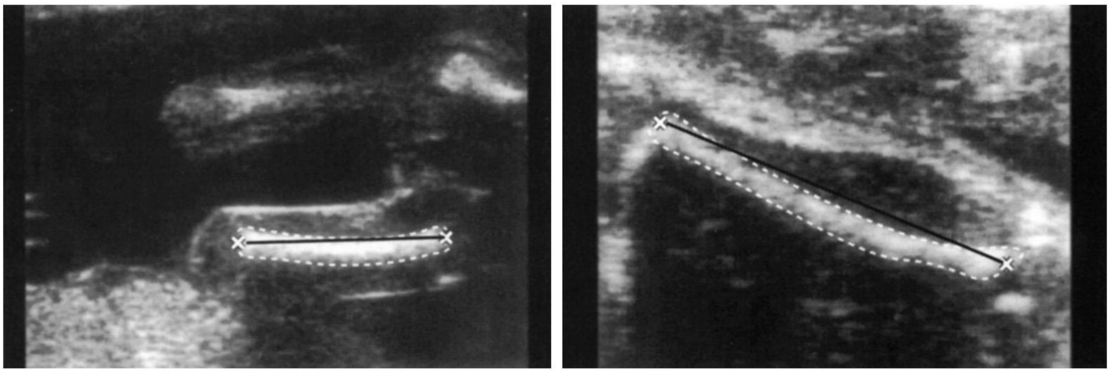

Image 2.9. Femur length measured from end to end (palmer.1995).

2.6. Previous study:

Ahmed Mokhtar (2015) fetal Biometry of Pregnant Women in Khartoum State,Central sudan ,Ultrasonic measurement of femur length(FL) and Bi-Parital diameter (BPD) is a precise tool for estimation of fetal growth and development . Accurate estimation of gestational age is vital for efficient obstetric planning and for detection of fetal malformation. This was cross section study done in Khartoum –Sudan involving 256 of healthy pregnant women aged between 18-40 years that were examined by ultrasound for FL and BPD. Women selected were with singleton pregnancy in third trimester (30-40weeks).

The result demonstrated a linear relationship between FL and BPD measurements and the GA throughout the third trimester ($p<0.001$). The mean BPD values for Sudanese fetuses measured between 30to 40 weeks showed that they are lower than mean BPD values of Causation fetuses measured during the same period. The mean of FL measured was higher when compared to Chinese and Singaporean fetuses, but was not significantly different when compared to fetuses from European countries.

Dare and smith (2004) evaluates the use of ultrasonic measurement of biparitel diameter and femur length in fetal age determination

This study examined the accuracy of gestational age assessment based on bibraitel and femur length measurement for (14-40) weeks .

The study population consisted of pregnant women how had ultrasound done at ultrasound scan unit of abdomen maternity hospital united kingdom. All the patient included were certain of their data and had their gestational age confirmed in the first trimester by ultrasonic measurement of crown rump length .

The ultrasound machine used for this study was altra-mark 4 real time ultrasound equipped with 5 MHZ linear transducer. All the biparitel measurements were obtained at the level of the thalamus according the standard technique patiricra etal. The femur length was measured electronically with calipers along the axis of the calcified points at both ends of the femur.

The finding revealed: linearity through out pregnancy using the femur length measurements while that of the bipraitel diameter demonstrated poor correlation after 32 weeks of gestation. The standard deviation and the correlation coefficient of the femur length measurement were 0.0042 and 0.9920 respectively while the corresponding values for biparitel diameter were 0.0045 and 0.9850 respectively .the standard error for femur length estimate was 0.2251 as against 0.3009 for biparitel estimate.

The result suggest that femur length measurement is a more reliable index of late third trimester gestational age prediction than BPD.

Zaidi Zeeshan(2013) used Fetal Femur Length in Assessment of Gestational Age in Third Trimester in Women of Northern India (Lucknow, UP) and a Comparative Study with Western and Other Asian Countries **.** This study was an attempt to correlate fetal FL with GA and to ascertain if fetal FL can be used as a parameter to calculate the GA in third trimester of pregnancy in Indian women with moderate accuracy. Findings have been compared with the work of sonologists from other countries. Pregnant women in the third trimester of pregnancy with single live fetus and having no other complication either in mother or fetus, were selected for the study, fetal FL along with other parameters was measured. The results were analyzed for accuracy in estimation of GA by FL and were compared with findings of other workers. **The result concluded that** GA estimated from FL in 512 cases between 27-39 weeks of gestation showed that quadratic model has a good fit to the data and r2 = 0.785 with standard error + 8 days. There was a significant difference with Iranians and Bangladesh women in comparison to our findings. The paired *t*-test between Indian and Bangladesh, women was significant, ($p < 0.001$). The findings in our study were similar to the results of Western fetal FLs.The data can be useful in estimation of GA by FL. Our error was + 8 days. A bigger study involving same number of cases in each week of gestation in third trimester is necessary to get an accurate formula for assessment of GA by FL.

Mangala (2014)A single ultrasonic biparietal diameter, femur lengthin term pregnancy and their use in predicting gestational age. evaluated the usefulness and accuracy of fetal growth monitoring by comparing a single reading of fetal femur length, biparietal diameter in predicting gestational age. Comparison of gestational age as obtained by BPD and FL with the known gestational age as got from LNMP. The study was conducted in Basweshwar Teaching and General Hospital and Sangameshwar hospital attached to M.R.Medical college Gulbarga between september2012 to September 2013.100 women at term were selected by simple random sampling technique after considering all inclusion criteria in the study.

All 100 patients were singleton pregnancies with unengaged head, with no malpresentation and any other medical disorder. From the results above following conclusions were derived:In this study 44%patients fell in the age group of 20-23years, 36% between 24-26 years, and only 20% in the age group of 27-30years. Out of 100patients 48% were primigravidas, 48%being multiparas and only 4%being grand multiparas.96%of cases were booked and only 4 % were unbooked out of 100 patients. Our study shows that, average accuracy of gestational age in weeks when LMP was compared with FL and BPD are+/-1.62 and +/-2.14 weeks showing that FL is a better predictor of gestational age at term than BPD.studied showed BPD and FL are equal estimators of GA in normal pregnancy,FL is a more stable estimator of GA when fetal growth deviated from normal.

Chapter Three

Materials and methods

Chapter Three

Materials and methods

3.1. Materials:

3.1.1. Machine:

Different types of ultrasound machine were used

1. Aloka(SSD-500) with transabdominal probe 3 5MHr 2,
2. Zoncale 3.5MHZ curvelinear probe

3.1.2. Patient:

They are 50 pregnant women in the third trimester ,age (16-46ys).

3.1.3. Inclusion criteria:

- Informed consent to participate in the study.
- Regular menstrual cycle and certain last menstrual period date.
- Single fetus with absence of any maternal disease.

3.1.4. Exclusions criteria:

- Fetuses diagnosed to have congenital anomalies.
- Prenatally or after birth.
- Maternal medical illness known to affect fetal size(renal disease hypertension).
- Multiple pregnancies.

3.2. Method:

3.2.1. US Technology:

Patient preparation and scanning technique:

All patient were examined in supine position with US using the abdominal route, many section were performed (longitudinal and transverse). Put the coupling gel on the transducer surface and put it lust above the symphesis pupic and perform longitudinal and transverse section of the tow fetal biometric parameters were done which include biparietal diameter(BPD), femur length (FL).

3.2.2. Date collection:

The date was collected by clinical data sheets, ultrasound images and personal computer.

3.2.3. Dataanalysis:

Data was collected from 50 women at third trimester sonographic fetal biometries measurement are performed for head(BPD) femur length and compared with previous study. Statistical computer analysis (SPSS) was performed by completely randomized block design with each patient representing a block of related measurement.

Chapter Four

Results

Chapter Four

Results

The results of this study were presented in tables and Figures. The tables showed the mean, median, standard deviation, min and maximum for age, parity, BPDmm, BPD(GA), FL(mm), FL(GA), EDD.

Table 4.1 show statistical parameters for all patients:

	Mean	***Median***	***STD***	***Min***	***Max***
Age	30.38	29	6.52	16	46
Parity	4.32	4	1.80	1	9
BPD mm	81.56	86	11.74	57	98
BPD GA W	33.78	35	4.71	26	44
FL mm	63.44	64	10.92	45	79
FL GA W	33.82	34.50	4.76	26	41
EDD GA W	33.57	34	4.54	26	40

Table4.2 show frequency distribution of age period:

Age Period	*Frequency*	*Percentage*
16-21	4	8 %
22-26	9	18 %
27-33	20	400 %
34-40	14	28 %
41-46	3	6 %

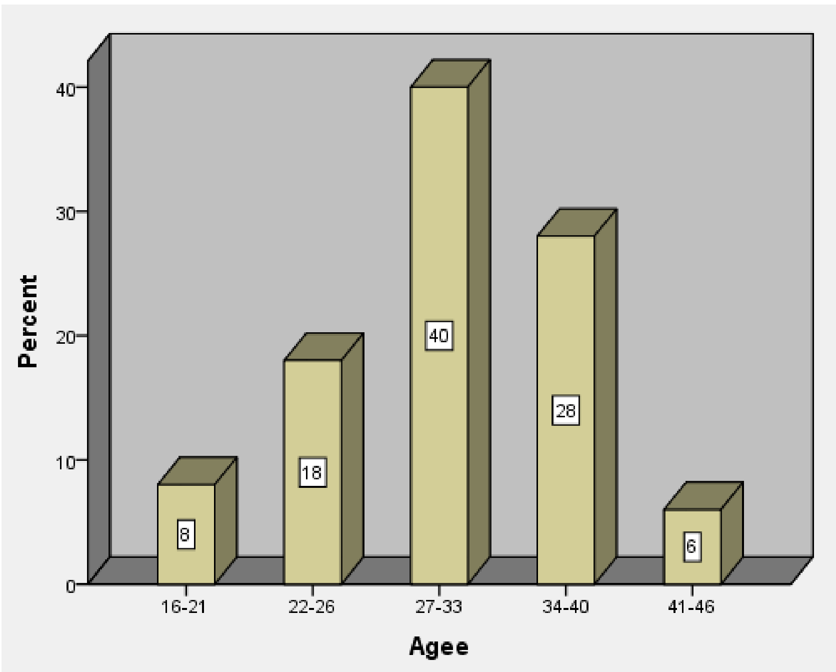

Figure 1.4. Show **frequency distribution of age period**

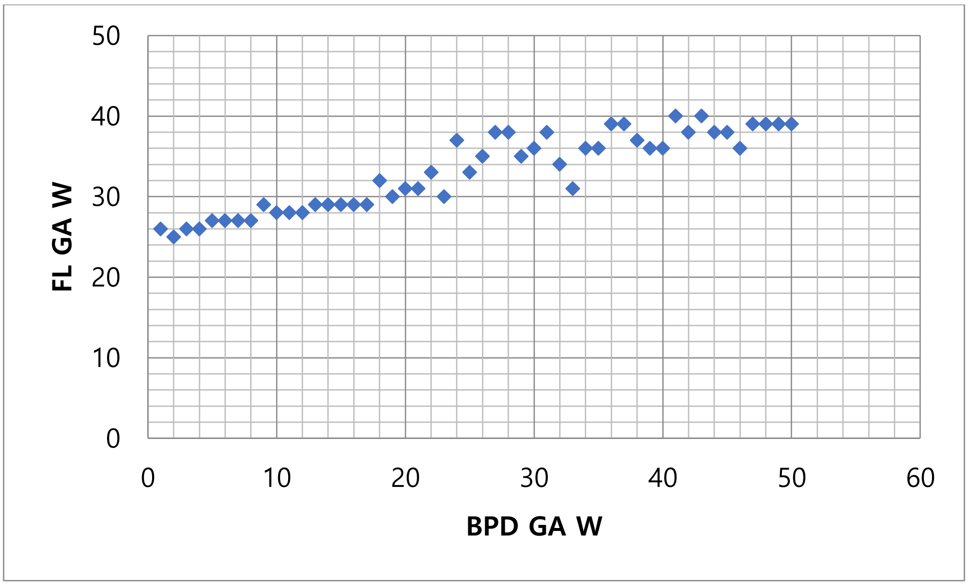

Figure 4.2 show correlation FL(GA) with BPD(GA) for all patients:

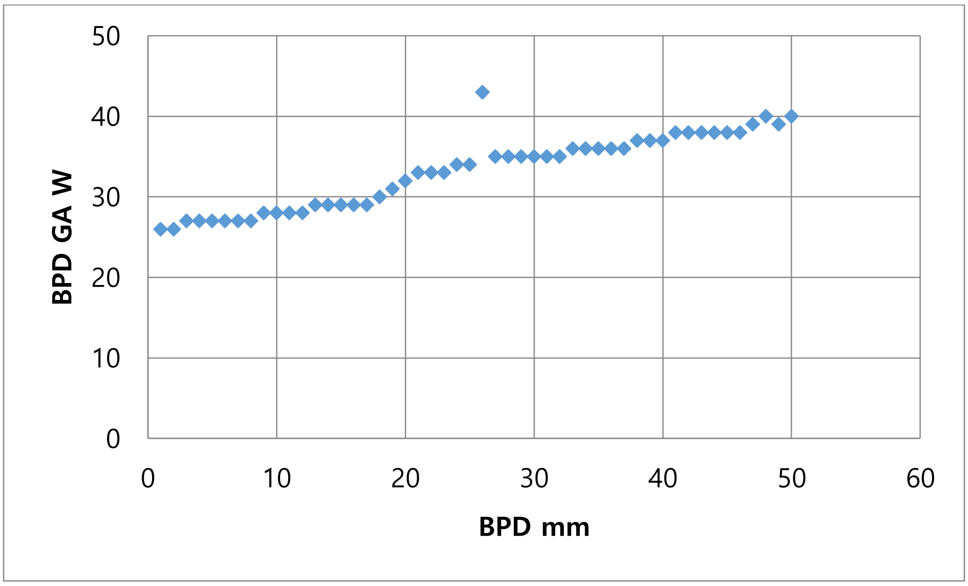

Figure 4.3 show correlation BPD(GA) with Age BPDmm all patients:

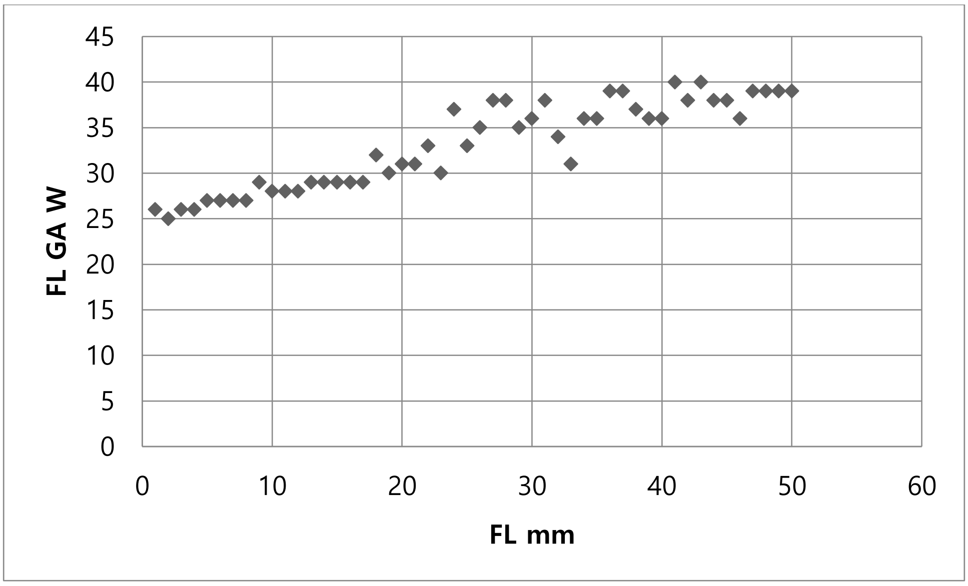

Figure 4.4 show correlation FL(GA) with FLmm for all patients:

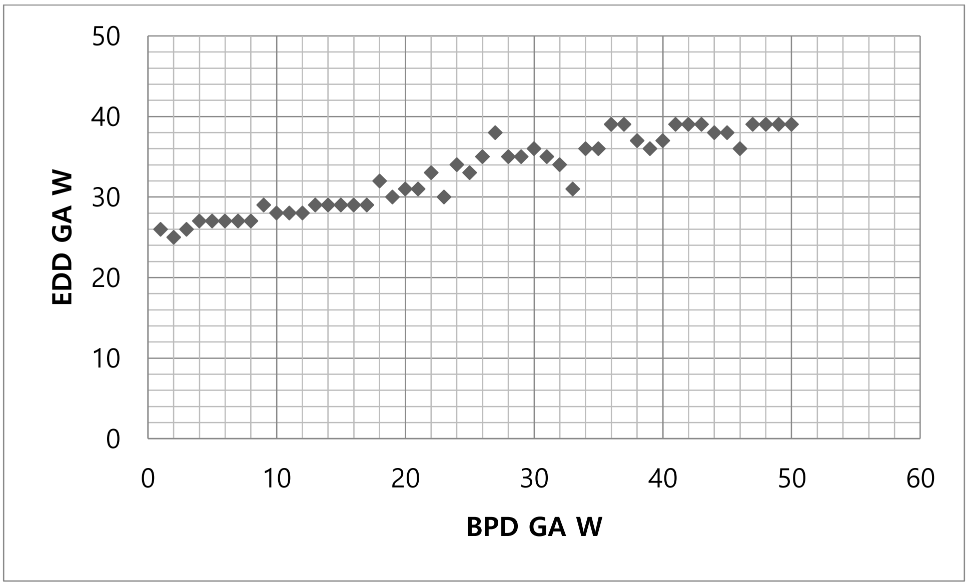

Figure 4.5 show correlation EDD(w) with BPD(w) for all patients:

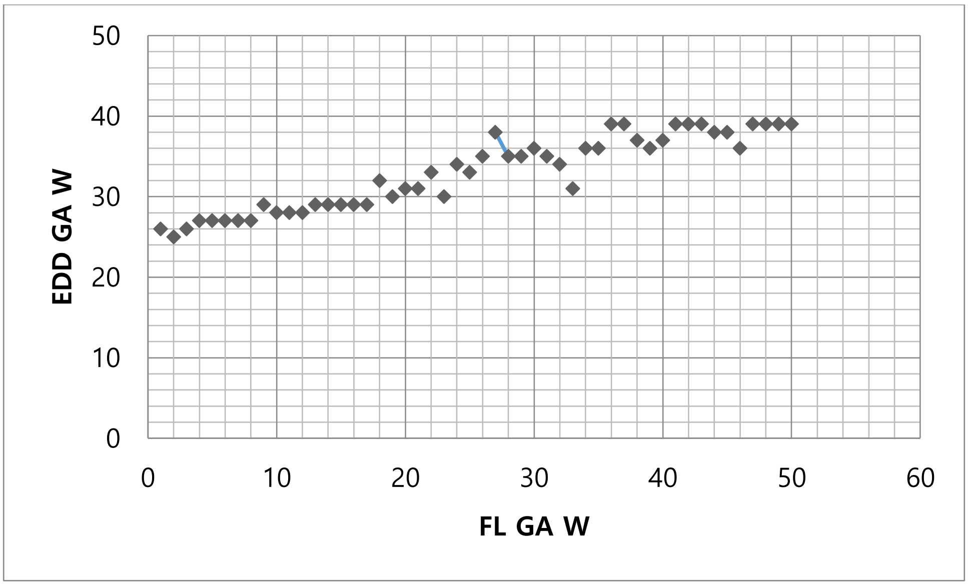

Figure 4.6 show correlation EDD(w) with FL(w) for all patients:

Table 4.3 show the independent T.test of BPD and FL.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
BPD GA W	Equal variances assumed	.110	.741	98	.966	-.040	.948
	Equal variances not assumed			97.988	.966	-.040	.948

Chapter Five

Discussion, Conclusion and Recommendations

Chapter Five

Discussion, Conclusion and Recommendations

5. Discussion:

The main objective of this study was done to assessment of fetal age using biparietal diameter and femur length measurement in the third trimester, this study was conducted at Bashair and Turkey educational hospitals Khartoum state in the period from September to November and the data was collected from 50 pregnant women patients.

In this study we found that the mean of age ±SD was 30.38 ±6.52, and for parity, BPDmm, BPD GA, FLmm, FL GA and EDD GA was 4.32± 1.80, 81.56± 11.74, 33.78± 4.71, 63.44± 10.92, 33.82± 4.76 and 33.57± 4.54 respectively.table 4.1.

The study show that the highest percent of pregnancy 400% was between 27-33 age period. table 4.2,figure4.1.

We found that in relation of gestational age by femur length with gestational sac by bipraietal diameter (R^2= 0.849) was strong relationship this agree with **Mangala (2014).** Figure4.2.

In correlation of gestational by BPD(weeks)with BPD mm(R^2= 0.882) was strong relationship.This mismatch **Dare and smith (2004)** Figure 4.3

In correlation of gestational age by FL(weeks) with FLmm (R^2= 0.980) was strong relationship. This agree with Zaidi Zeeshan(2013) figure 4.4

We found that in relation of gestational age by BPD(weeks) with EDD(weeks) there was strong correlation (R^2= 0.853) . This mismatch **Dare and smith (2004)** figure.4.5.

This study show that in relation of gestational age by FLmm with EDD(weeks)there was strong correlation this match with (Zaidi Zeeshan, 2013 and Dare and smith,2004).figure4.6.

This study using linear regression between EDD and BPD,the rate of relation increase by 0.853 per week and between EDD and FL the relation increase by rate 0.97 per week.

And by using independent T.test the P.value (0.966) show that there is no significant difference between BPD and FL. this agree with **Mangala (2014)** table 4.3.

Our study found that the estimation of gestational age by femur length and bipareital were near to equal with femur length was more accurate.

More sensitive in the second and third trimester for estimating GA. And these researches support that. Other center should consider to do femur length when scan pregnant women for more accuracy to reduce risk of delivery and improve quality control for estimation of the gestational age.

5.2. Conclusion:

The study concluded that there was strong correlation between femur length and bipraietal diameter and excepectd date of delivery with little variation between them .

The correlation between the expected date of delivery with bi peraitel diameter and femur length per week estimated by the following linear equations:

EDD = 0.9193 (BPD week) + 2.4316

EDD = 0.9768 (FL week) + 1.1913

The Sudanese measurement of fetal age using biparietal diameter and femur length as same as Americans measurement of fetal age.

Finally this is study was predict the femur length sensitive and more accurate than BPD for estimate of GA.

5.3. Recommendation:

- All pregnant women in third trimester must be follow up by US to confirm from gestational age and to evaluate expected data of delivery.
- To confirm from EDD using FL rather than BPD because FL is more accurate than BPD.
- Using another different method for measuring to estimate gestational age during pregnancy or in third trimester for pregnant women.

5.4 Reference:

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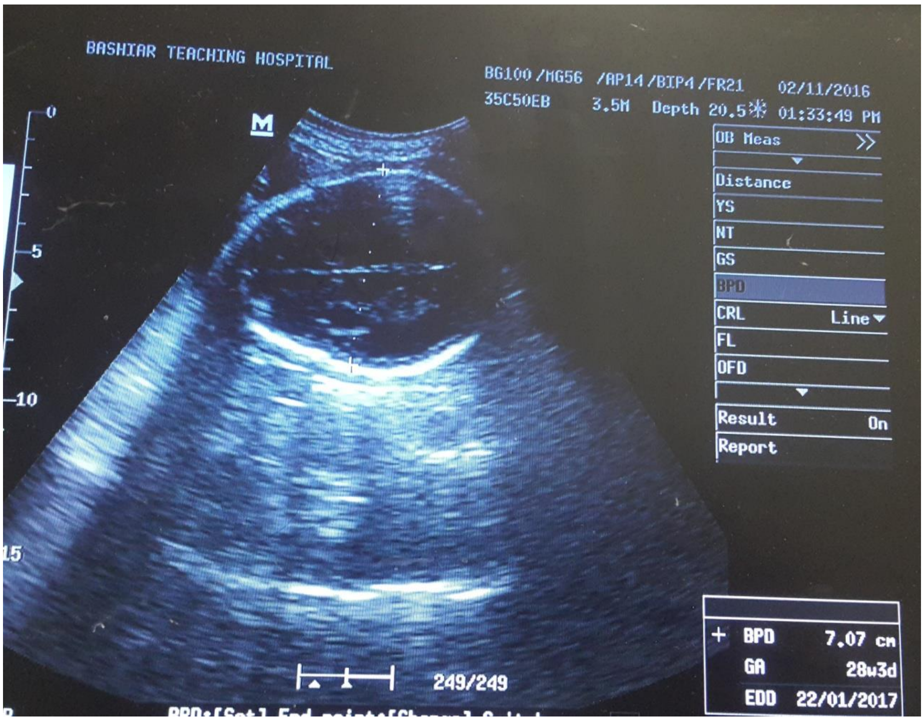
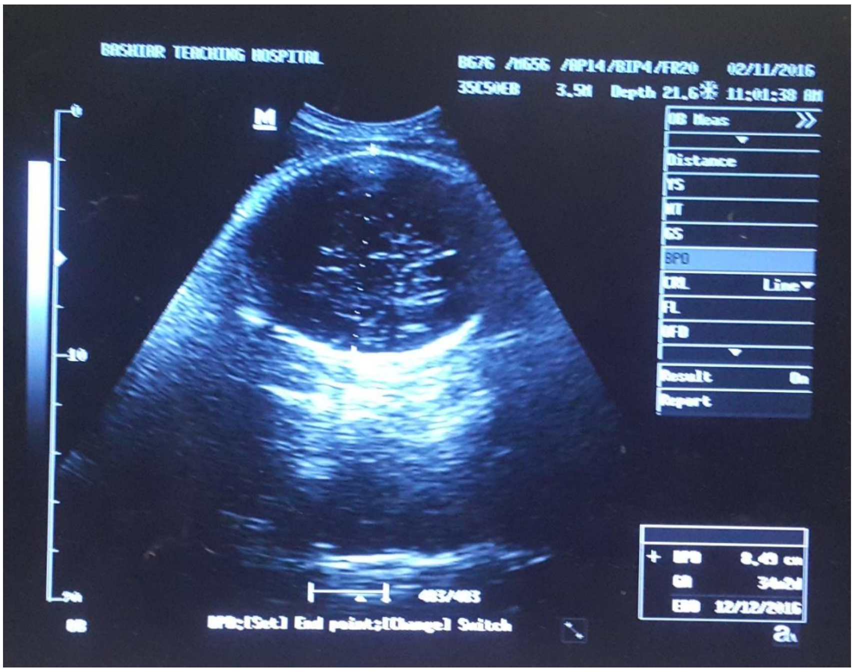
Appendix: (I)

Ultrasound Image (1)35ys female longitudinal scan of FL=53mm, GA=27w+3d, EDD=22/12/2017.

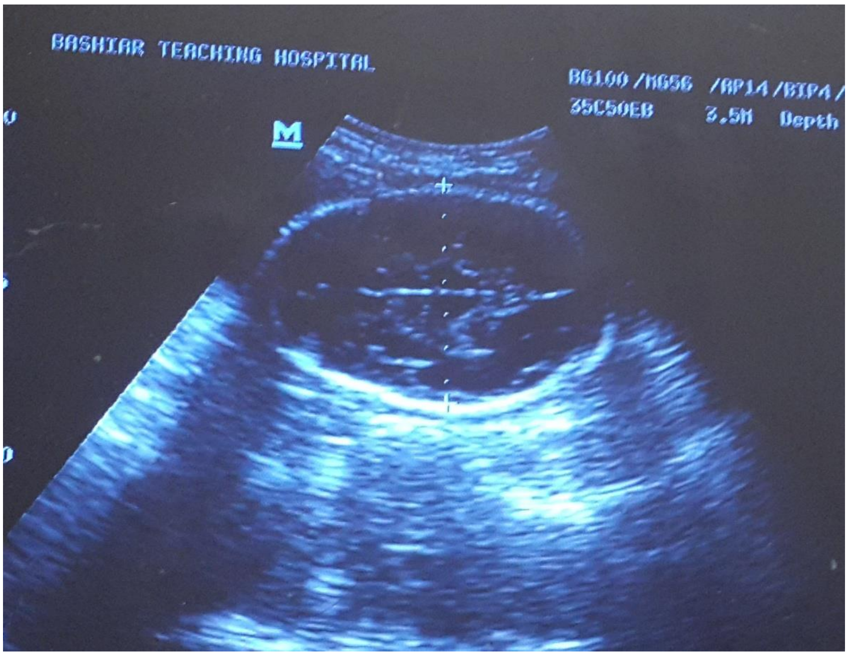


Ultrasound Image (2) 35ys female transverse scan of BPD=70mm, GA=28w+3d, EDD=22/1/2017.

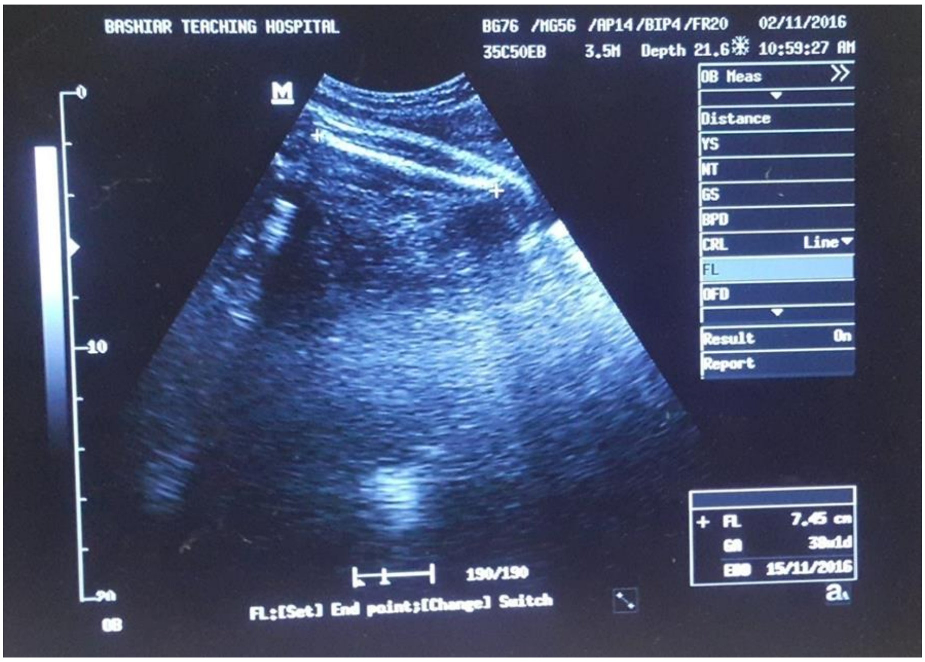
Ultrasound Image (3) 29ys female transverse scan of BPD=67mm,GA=27w+2d, EDD=30/1/2017.



Ultrasound Image (4) 35ys female transvers scan of BPD= 70mm, GA=28w+3d, EDD=19/11/2016.

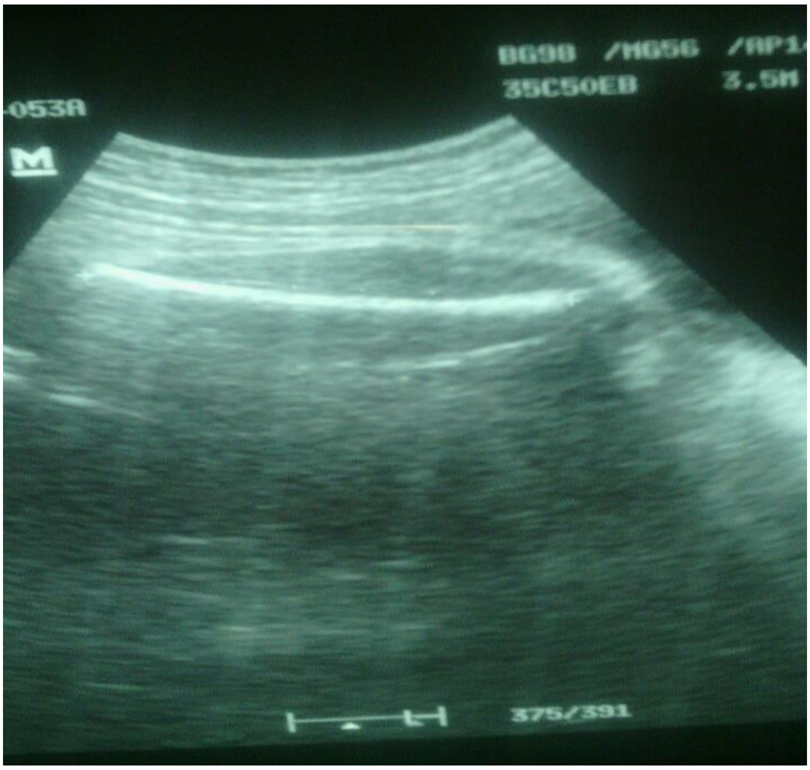


Ultrasound Image (5) 24ys female transverse scan of BPD=84mm, GA=34w+2d, EDD=12/12/2016.

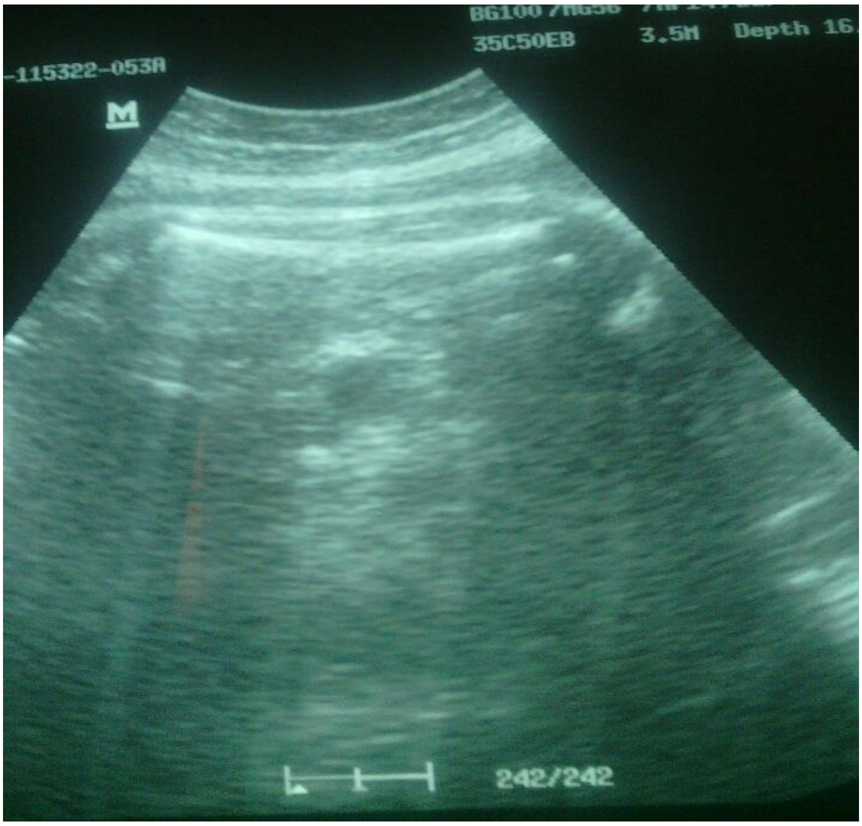


Ultrasound Image (6) 24ys female longitudinal scan of FL=74mm,

Ultrasound Image (9) 25ys female transverse scan of BPD=77mm, GA=30w+5d, EDD=16/11/2016.



Ultrasound Image (10) 25ys female longitudinal scan of FL=63mm, GA=32w+5d, EDD=16/11/2016.



Ultrasound Image (8) 24ys female longitudinal scan of FL=63mm, GA=33w+5d, EDD=16/12/2016.

Appendix: (II)

EDD	FL(W)	FL(mm)	BPD(W)	BPD(mm)	LMP(W)	LMP	gravity	age	N
2.2.2017	26w+4d	49	26w+5d	66	26w+2d	28.3.2016	4	27	1
21.12.2016	25w+6d	45	26w+3d	57	25w+6d	16.3.2016	4	29	2
4.12.2016	26w+6d	49	27w+1d	67	26w+6d	26.2.2016	5	29	3
6.12.2016	26w+5d	49	27w+6d	69	27w+4d	27.2.2016	4	22	4
6.12.2016	27w+2d	51	27w+5d	66	27w+5d	28.2.2016	5	37	5
12.12.2016	27w+0d	50	27w+0d	67	27w+0d	5.3.2016	5	32	6
6.12.2016	27w+5d	49	27w+6d	69	27w+6d	1.3.2016	2	25	7
12.2.2017	27w+0d	48	27w+4d	66	27w+3d	28.4.2016	3	28	8
25.11.2016	29w+4d	56	28w+6d	72	29w+3d	19.2.2016	7	30	9
19.11.2016	28w+4d	53	28w+3d	70	28w+6d	12.2.2016	4	35	10
8.12.2016	28w+1d	51	28w+2d	60	28w+0d	3.3.2016	4	28	11
5.2.2017	28w+1d	50	28w+2d	68	28w+1d	23.4.2016	2	27	12
26.11.2016	29w+4d	52	29w+0d	71	29w+3d	19.2.2016	3	28	13
27.112016	29w+3d	53	29w+1d	71	29w+3d	21.2.2016	1	16	14
23.11.2016	29w+3d	53	29w+5d	72	29w+0d	17.2.2016	7	34	15
26.11.2016	29w+3d	53	29w+6d	72	29w+4d	20.2.2016	7	40	16
29.11.2016	29w+6d	52	29w+0d	70	29w+6d	11.4.2016	2	19	17
11.11.2016	32w+5d	63	30w+5d	77	32w+3d	5.2.2016	4	25	18
22.1.2017	30w+5d	54	31w+2d	62	30w+0d	15.4.2016	5	36	19
8.1.2017	31w+2d	56	32w+3d	79	31w+2d	1.4.2016	6	32	20
1.1.2017	31w+6d	57	33w+6d	81	31w+6d	28.3.2016	2	22	21
4.11.2016	33w+5d	63	33w+2d	83	33w+5d	29.1.2016	3	26	22
24.11.2016	30w+5d	59	33w+3d	83	30w+4d	8.2.2016	5	36	23
2.12.2016	37w+2d	72	34w+6d	86	34w+5d	26.2.2016	2	24	24
4.11.2016	33w+4d	65	34w+3d	85	33w+4d	29.1.2016	4	29	25
2.12.2016	35w+6d	69	34w+6d	86	35w+3d	26.2.2016	3	21	26
13.10.2016	38w+1d	74	35w+5d	88	38w+4d	7.1.2016	8	39	27
2.11.2016	35w+1d	70	35w+6d	88	35w+2d	27.2.2016	3	35	28
2.11.2016	35w+1d	70	35w+0d	86	35w+2d	25.1.2016	1	37	29
30.11.2016	36w+4d	71	35w+1d	87	36w+4d	24.2.2016	4	27	30
6.11.2016	38w+4d	75	35w+5d	88	35w+5d	31.1.2016	6	28	31
25.12.2016	34w+4d	63	35w+6d	88	34w+0d	18.3.2016	5	33	32
19.11.2016	31w+4d	60	36w+4d	90	31w+4d	13.2.2016	3	42	33
25.10.2016	36w+2d	70	36w+1d	89	36w+6d	19.1.2016	6	31	34
23.10.2016	36w+2d	70	36w+4d	90	36w+1d	17.1.2016	4	29	35
1.11.2016	39w+3d	76	36w+5d	91	39w+6d	26.1.2016	5	35	36
1.11.2016	39w+2d	79	36w+1d	89	39w+1d	20.1.2016	3	23	37
7.10.2016	37w+6d	73	37w+1d	91	37w+3d	1.1.2016	4	37	38
19.11.2016	36w+2d	70	37w+3d	92	36w+2d	13.2.2016	3	32	39
4.12.2016	37w+4d	69	37w+5d	93	37w+2d	11.3.2016	5	28	40
28.10.2016	40w+0d	78	38w+2d	94	39w+6d	22.1.2016	3	19	41
8.10.2016	38w+6d	75	38w+3d	95	39w+2d	2.1.2016	7	35	42
25.10.2016	40w+4d	77	38w+4d	92	39w+6d	19.1.2016	3	26	43
8.10.2016	38w+6d	75	38w+5d	93	38w+4d	2.1.2016	6	33	44
25.11.2016	38w+5d	75	38w+6d	95	38w+0d	19.2.2016	4	25	45
7.11.2016	36w+5d	71	38w+5d	95	36w+2d	1.2.2016	5	38	46
1.11.2016	39w+3d	77	39w+2d	96	39w+1d	26.1.2016	7	43	47
28.10.2016	39w+6d	78	40w+4d	98	39w+5d	22.1.2016	9	46	48
5.11.2016	39w+6d	78	39w+5d	97	39w+6d	30.1.2016	3	27	49
7.11.2016	39w+3d	77	40w+0d	98	39w+5d	1.2.2016	6	34	50