Sudan University of Science and Technology

College of Graduate Studies

Research title:

Estimation of Fetal Weight in Pregnant Women by Placenta Thickness Using Ultrasonography

تقدير وزن الجنين لدى الحوامل بواسطة سمك المشيمة باستخدام الموجات فوق الصوتية

A Thesis submitted for Partial Fulfillment of the Requirements of M.Sc Degree in Medical Diagnostic Ultrasound

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2017

الآيـة

قال تعالى

وَفِي أَنفُسِكُمْ أَفَلا تُبْصِرُونَ)

سورة الذاريات (آية-21)

DEDICATION

- To my father who always supported me in every endeavor.

- To my mother who is the reason I am here and made me who I am today.

- To my brother and sister for their valuable supports.

Acknowledgment

First of all I thank **Allah** the almighty for helping me to complete thisProject.

I thank **DrAsma Ibrahim Ahmed** supervisor for herhelp and guidance.

Mythank extend to anyone who help me to complete this study, with hisfull patience cooperation.

I would like to thank also radiology staff in ALTMUZE and ALSODY hospitals for their cooperation.

Finally I would like thank my colleagues.

Abstract

The purpose of this descriptive study is to investigate the relationship between the placenta thickness and estimated fetal weight in normal sudanese pregnant women. The data collected in ATMUZE and ASODY hospitals in Khartoum state from January to July 2017.

The study included seventy pregnant women in second and third trimesters were scanned by ultrasound machine. Fetal weight was estimated by measurement of femur length (FL) and abdominal circumference (AC). Placenta thickness was measured in longitudinal section at the point of insertion of the umbilical cord.

The data is analyzed by using Statistical Package for Social Science (SPSS).Results of the study showed that there is positive strong correlation between placenta thicknesses and estimated fetal weight (r=0.74) and (p=.000) and both are firmly increased with fetal age .The results also showed linear regression between them . The study showed that the fetal weight increases by 118 gm each one mm of placenta thickness .Researcher noticed that with the same placenta thickness there were different fetal weights .However, the normality of fetal weight and fetal development can be followed by measuring placenta thickness.

ملخص الدراسة

يهدف هذا البحث الوصفي لدراسة العلاقة بين سمك المشيمة ووزن الجنين المتوقع في الحمل الطبيعي عند النساء السودانيات. جمعت بيانات هذه الدراسة من مستشفي التميز ومستشفي السعودى بالخرطوم فى الفتره منيناير الي يوليو 2017.

شملت الدراسة70 سيده حامل في الثلثين الثانى والثالث من الحمل . تم الكشف على السيدات بالموجات فوق الصوتية لاجراء الفحص الروتينى للحمل ومن ثم لاجراء هذه الدراسة .تم تقدير وزن الجنين عن طريق قياس طول الفخد و محيط البطن .سمك المشيمه تم قياسه فى نقطة انغراس الحبل السرى فيها .

نتائج الدراسة التي استعمل فيها برنامج التحليل الاحصائ للعلوم الاجتماعية ال (SPSS) اظهرت ان هناك ارتباط قوى و موجب بين سمك المشيمة و الوزن المقدر للجنين (معامل الارتباط = 0.74) حيث ان الاتنين يزدان طرديا بزيادة عمر الجنين . كما ان الرسم البيانى وضح العلاقه الخطية بينهما . الدراسة اظهرت ان وزن الجنين يزيد118 جم عند زيادة سمك المشيمة بقدار 1 مم .الباحث لاحظ من خلال الدراسة انه عند السمك المعين للمشيمة يمكن ان تتعدد الاوزان المقدرة للجنين . الدراسة لخصت الى انه من خلال قياس سمك المشيمة يمكن متابعة وزن الجنين و التطور الطبيعى لنمو الحمل .و يمكن اثبات فعالية هذه الدراسة بزيادة عدد الحالات و متابعة الجنين بعد الولادة .

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Abbreviations

AC	Abdominal Circumference
BPD	Biparital Diameter
EFW	Estimated Fetal Weight
FL	Femur Length
IUGR	IntraUterine Growth Retardation
LMP	Last Menstrual Period
PT	Placenta Thickness
US	Ultrasound

Chapter One

Introduction

1 Introduction

The placenta is a transient organ present only during pregnancy, connects the baby to the mother by invading and attaching to the inside wall of the uterus which provides the physiologic link between a pregnant women and the fetus (metabolic, endocrine and immunologic functions) It dies out after the delivery of the baby. The placenta develops from the chorionic villi at the implantation site at about the 5 week of gestation and by 9-10 week the diffuse granular echo texture of the placenta is clearly apparent at sonography .(Thompson et al .1969).

Ultrasound enables evaluation of the placenta and placental thickness is a relative simple, reproducible and clinical useful way, enables the evaluation of the placenta and the detection of placental abnormalities using different parameter such as placental thickness and volume especial techniques like 3D power Doppler. Placental thickness tends to gradually increase with gestational age in a linear fashion, .Sonographically this can be seen to be approximately 1 mm per week and the placenta can be used to approximate gestational age. (Kurajak et al. 2006).

The maximum thickness of a normal placenta at any point during pregnancy is often taken consider to be 4cm. An abnormally increased placental thickness falls under the spectrum of placentomegally this can happen with number of condition and is associated with increased risk of placental insufficiency .Large placenta may be associated with maternal diabetes, Rh sensitization, congenital neoplasm and Non – immune Hydrops , and small placenta associated with IUGR(Intra Uterine Growth Retardation) and placenta insufficiency. Therefore it is very important to know the dimensions of the placental size especially the thickness.Normal placental function and structure is a necessary factor for formation of a healthy fetus and consequently normal birth weight .On the other hand, any impairment in its development may have a profound impact on fetal development. The ratio of

the birth weight to the placenta weight has been used since the 1940s as an index for the appropriateness of fetal growth. The correct determination of fetal weight prior to delivery is most important and greatly influences the clinical management; the outcome of pregnancy, delivery and survival of new born .Estimation of fetal weight based on ultrasound images plays a key role in prenatal care. (Udealor et al. 2014).

Obtaining accurate estimated fetal weight (EFW) is of paramount importance in the prediction of fetal compromise and management of labor. Ultrasound is a major tool for fetal weight estimation, due to noninvasive, portability and relatively low cost. Numerous formulas have been published for estimating fetal weight from two or more of this parameter: Head Circumference (HC), Biparital diameter (BPD), femur length (FL) and Abdomen Circumfrenc. (rumak et al .2011).

1.2 Problem of the study:

Fetal weight and gestational age estimation consider as one of the effective method of assessing the fetal health and normal delivery, one of the most important issues was the miss determination and estimation of these parameter using the BPD and FL especially in 3rd trimester, therefore an introduction of new method of fetal and gestational age estimation using placental thickness.

1.3 Objectives of study:

1.3.1 General objective:

The estimation fetal weight by placental thickness using ultrasonograghy.

1.3.2 Specific objectives:

- To correlate the placenta thickness in normal Sudanese women with the standard measurement.
- To correlate the placenta thickness with other fetal parameters.
- To correlate the fetal weight with other fetal parameters.

1.4 Significance of the Study:

Study investigates the relationship between placental thickness and BPD, AC, FL, fetal age and estimated fetal weight in normal Sudanese pregnant women. In which introduced a new method of fetal weight estimation in which can be estimated directly without calculation.

Chapter Two

Litterateur Review

Litterateur Review

2-1 Anatomy of placenta:

2-1-1 Development of placenta: After fertilization form the zygote. The zygote undergoes rapid cellular division and form cluster of cells called the morula. The morula continues to differentiate and form blastocyst. The outer layer of blastocyst is comprised of syncytiotrophoblastic tissue, also referred to as trophoplastic cells. The inner part of blastocyst will develop into embryo, amnion, umbilical cord, and the primary and secondary yolk sacs .The outer part; the trophoblastic tissue will develop into the placenta and chorion. (Curry et al. 2004).

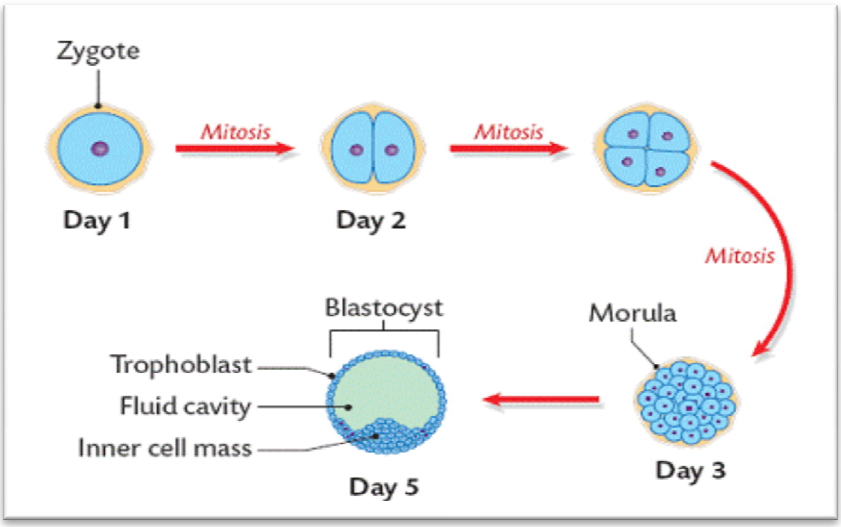

Figure 2-1 shows the staging of fertilization.

(http//www.siumed.edu/dking2/erg/placenta.htm)

2-1-2 Structure of placenta: This is a fetomaternal organ it has two components: Maternal part derived from the endometrium (functional layer – deciduasbasilis) and fetal part develops from the chorion (chorionfrondosum). The fetal part is

attached to the maternal part by the cytotrophoplastic shell. Endometrial arteries and veins pass freely through gap in the cytotrophoplastic shell. And open into the intervillous space. (Salder 2004).

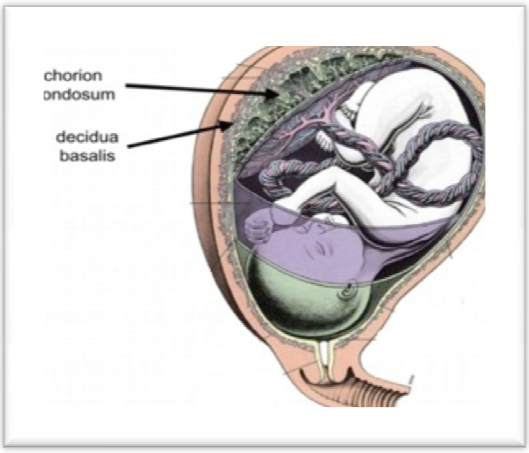

Figure (2.2) shows the components of placenta fetal and maternal components (Http//www .siumed.edu/dking2/erg/placenta .htm)

Fetal part: The chorion surrounds the embryo and other membrances.It consists of two layers, outer layer trophoplast and an inner mesoderm, the trophoblast is made up of two layers, internal layer (cystotrophoplast) and an external (syncytiotrophoblast). The chorion undergoes rapid proliferation and forms number of projections like fingers known as the chorionic villi, which invade and destroy the decidualized endometrium and at time absorbed from it nutritive material for growth of the embryo. The chorionic villi are at first small and non vascular, and consist of trophoplast (primary villi) only, but they increase in size and ramify, while the mesoderm (secondary villi), carry branches of the umbilical vessels (tertiary villi) grows into them, and this way they are vascularized.

Blood is carried to the villi by the branches of umbilical arteries, and after circulating through the capillaries of the villi, is returned to the embryo by the umbilical veins. Until about the end of second month of pregnancy the villi cover the entire chorion, and are almost uniform in size, but after this develop unequally.

The greater part of the chorion is in contact with the deciduascapsularis (superficial part of deciduas overlying concepts that forms the maternal part of the placenta), and over this portion the villi with their contained vessels, undreago atrophy, so that by the fourth month scarcely a trace of them isleft, and hence this part of the-e chorion become smooth, and is named chorionleave, as it takes no share in the formation of placenta. It is also named the non-placenta part of the chorion on the other hand, the villi on that part of the chorion which is in contact with the deciduas increase greatly in size and complexity, and hence this part is named the chorionfrondosum. (Salder 2004).

Maternal part***:***The endomertium after implantation, the deciduas is differentiated into 3 parts: Deciduasbasalis: the endometrium tissue at the implantation site of the maternal contribution of the placenta. Deciduascapsularis: the portion of the decidua opposite the uterine cavity across from the deciduasbasalis. And Decidua parietalis (vera): The decidualized tissue along the uterine cavity adjacent to the deciduasbasalis. In response to increase progesterone level in the maternal blood, the connective tissue cells of deciduas enlarge to form pal –staining decidual cells .The cells enlarge as glycogen and lipid accumulate in their cytoplasm. Many decidual cells degenerate near the chorionic sac in the region of sync and together with maternal blood and inter in secretion provide a rich source of nutrition for embryo. (Salder2004).

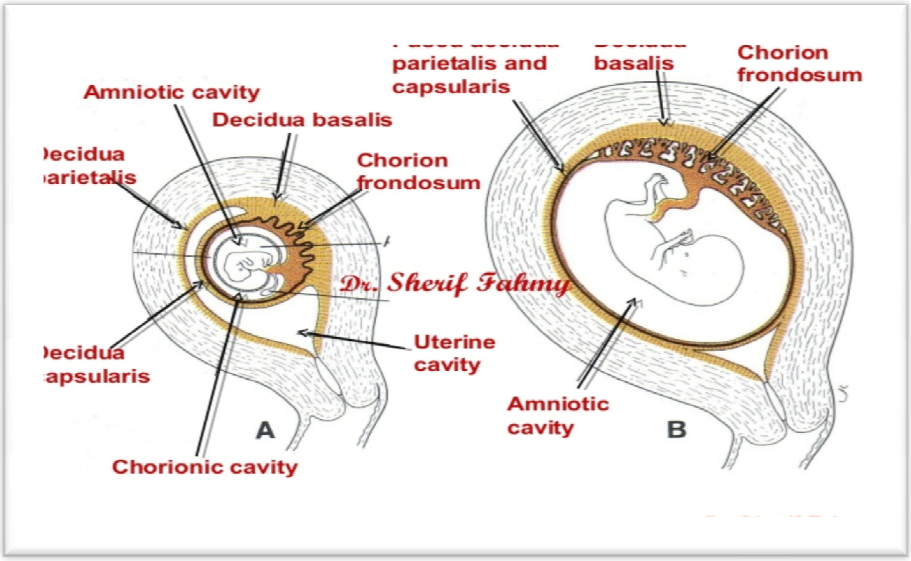

Figure 2-3 shows the components maternal and fetal portions of placenta (Http//www .siumed.edu/dking2/erg/placenta)

2-1-3 Placenta full term*:* At full term, the placenta is discoid with a diameter of 15-20 cm, is approximately 3 cm in thick, and weight about 500-600g. At birth, it is torn from the uterine wall.

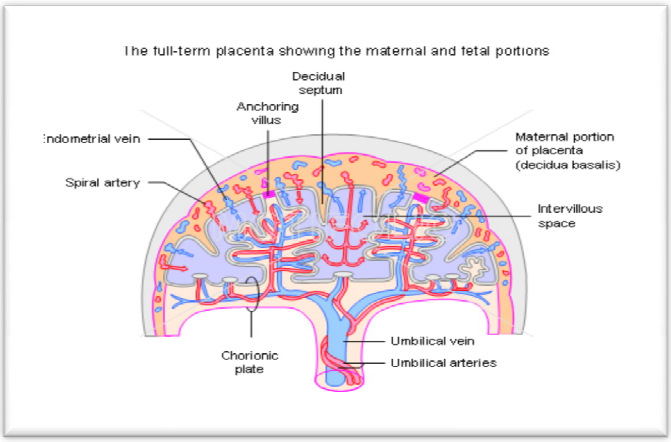

Figure (2-4) the full–term placenta showing maternal and fetal portions (http//www.inharmonybirth .com /placenta–preparation)

The placenta has two surfaces, maternal and fetal surfaces. Maternal surface rough and spongy, dull red coulor and divided to 15-20 convex polygonal areas known as lobes or cotyledons which are limited by fissures. (Sadler 2004).

The fetal surface covered entirely by the chorionic plate. Number of large arteries and veins, the chorionic vessels, converge toward the umbilical cord; the chorion in turn is covered by the amnion with umbilical cord attached at or near center.

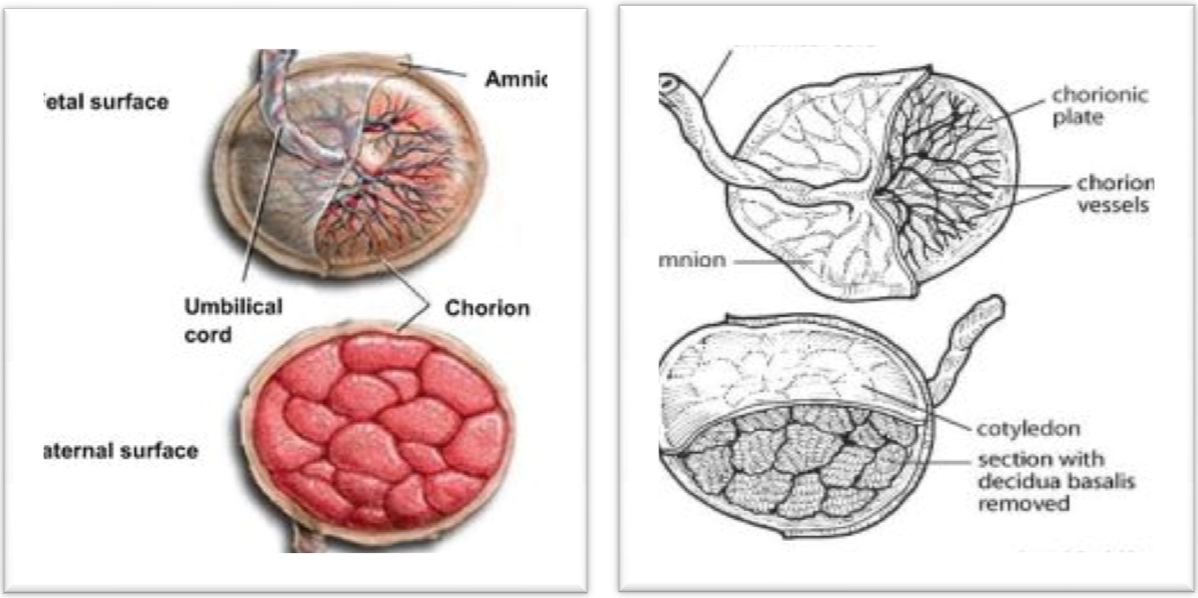

Figure 2-5 shows fetal and maternal surfaces of placenta
(http;//www.biog 1445.org/demo/07/ovaryplacenta .html).

2-1-4 Circulation of placenta: Cotyledons receive their blood through 80 to 100 spiral arteries .the lumen of the spiral artery is narrow ,so blood pressure in the intervillous space is high .This pressure forces the blood deep into the intervillous spaces and bathes the numerous small villi of the villous tree in oxygenated blood.As the pressure decrease , blood flows back from the chorionic plate toward the deciduas ,where it enters the endometrial veins .Hence, blood from the intervillous lakes drains back into the maternal circulation through the endometrial veins (Salder 2004).

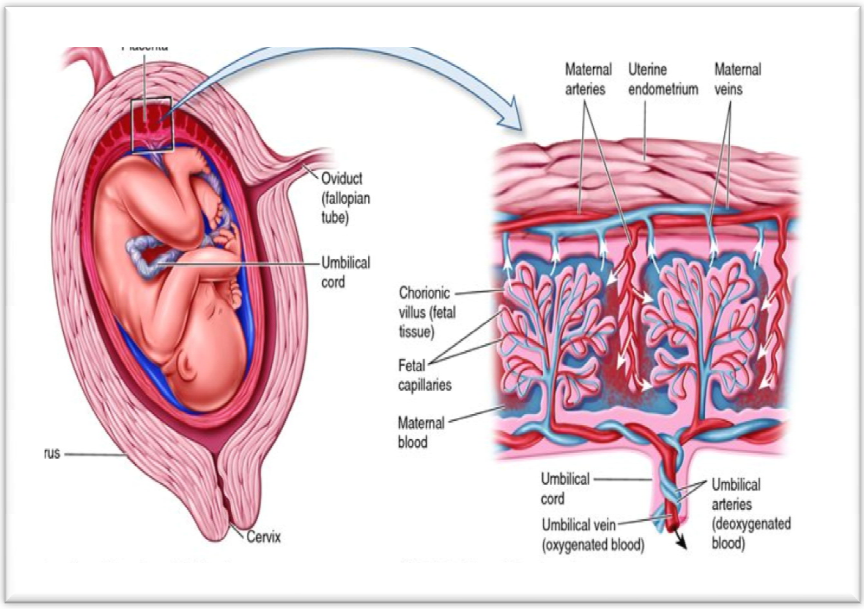

Figure 2-6 shows placenta circulation

(http;//www.biog 1445.org/demo/07/ovaryplacenta .html).

The intervillous spaces of a mature placenta contain approximately 150 ml of blood, which is replenished about 3 to 4 times per minute .This blood moves along the chorionic villi, which have a surface area of 4 to 14m^2. However, placenta exchange does not take place in all villi, only in those whose fetal vessels are in intimate contact with the covering syncytial membrane. In these villi, the syncytium often has a brush border consisting of numerous micro villi , which greatly increases the surface area and consequently the exchange rate between maternal and fetal circulation. The placenta membrane which separates maternal and fetal blood is initially composed of four layers: the endothelial lining of fetal vessels, the connective tissue in the villus core, and the cytotrophoblastic layer and the syncytium. From the fourth month on, however the placenta membrane thins, since the endothelial lining of the vessels comes in intimate contact with the syncytial membrane, greatly increasing the rate of exchange. Sometimes called the placental barrier ,the placenta membrane is not a true barrier, since many substances pass through it freely .Because the maternal blood in the intervillous

spaces is separated from the fetal blood by a chorionic derivative, the human placenta is considered to be of the hemochorial type (Salder 2004).

2-1-5 Placenta grading: Calcium deposition in the placenta is a normal process of placenta aging or maturation which occurs sat different rates in normal pregnancies. Sonographically, macroscopic areas of placenta calcification appear as hyerechoic densities in different areas of the placenta. Calcium is deposited primarily along the basal surface and placenta septa. Macroscopic and sonographic evidence of placenta calcification is not evident until the third trimester. Previously, investigators found it useful to assign placenta numerical grade 0-3 based on the degree of calcification.

Placenta grade 0**:** Earliest placenta grade with a smooth, well defined chorionic plate, homogenous placenta tissue, regular basal plate without echogenic densities typical grade for placenta. Late 1st trimester –early 2nd trimester. Placenta grade 1 (18-29 wks): Subtle indentation of chorionic plate with echogenic areas randomly dispersed throughout the placental substance and a regular basal layer. Placenta grade 2 (30wks to delivery): Indentation of the chorionic plate with linear comma – like densities extending from the chorionic plate into the placental substance but not reaching the basal plate. Placenta grade 3 (39wks-post dates): The comma – like densities reaches the basal plate and is deposited with calcium, resulting in complete circler of calcium.(Burwin Institute Notes).

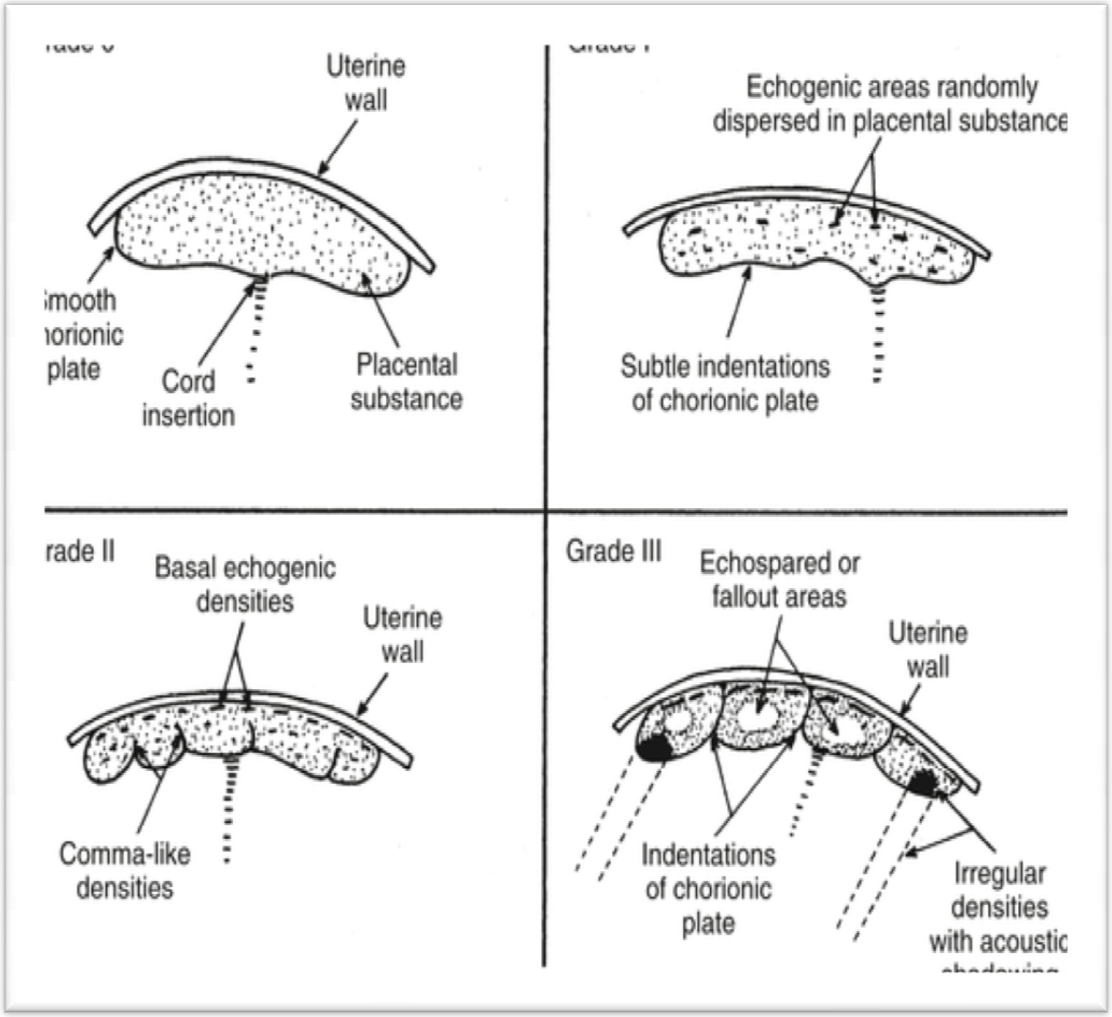

Figure 2-7; shows the ultrasound appearance of placenta grading

(ChudleighThilaganathan 2004)

Fig 2-8: Grade 3 Placenta: US image of an anterior placenta shows calcification of the placenta extending from the maternal to fetal surface, (arrows).(Burwin Institute Notes).

2-2 Placenta function:

Placenta makes many of function: Nutrition: the perforation of the intervillous spaces of the placenta with maternal blood allows the transfer of nutrients and oxygen from the mother to the fetus and the transfer of west products back from the fetus to the maternal blood supply. Respiration: through the placenta oxygen passes from the maternal blood to the fetal blood and carbon dioxide passes from fetal blood to the maternal blood. Storage**:** the placenta storage fat and glycogen and iron for the fetus before liver are formed.Immunity: antibodies developed in the mother against certain diseases pass from mother to the fetal blood through the placenta. Endocrine function: placenta it secret hormones such as estrogen, progesterone, HCG and HPL.

2-2-1 Hormones of the placenta:

Human chorionic gonadotrophin *(HCG):*Its main function it's maintain the corpus luteum of pregnancy beyond the period of the menstrual cycle. It stimulate the corpus luteum to secrete large amount of progesterone and estrogens .the latter are essential for maintenance of the endometrium. Sukkar et al. (2005).

Progesterone: Progesterone increases the endometrial nutrient stores in early pregnancy, prevents uterine contraction by decreasing the contractility of the myometrium and together with estrogens prepares the breast for lactation. Sukkar et al. (2005).

Oestrogens: Placenta estrogens have several function, promote the growth and enlargement of the uterus to accommodate the developing of embryo and fetus also promote the growth of glandular tissues of the breast and enlarge external genitalia. Sukkar et al. (2005).

Human placental lactogen *(HPL):*Promotes mammary gland growth in preparation for lactation in the mother .it also regulates maternal glucose, protein and fat.HPL levels increase proportional to placenta size.

2-3 Pathology of placenta:

2-3-1 Abnormal shape*:*Placenta Bilobata: the placenta consists of two equal lobes connected by placenta tissue.

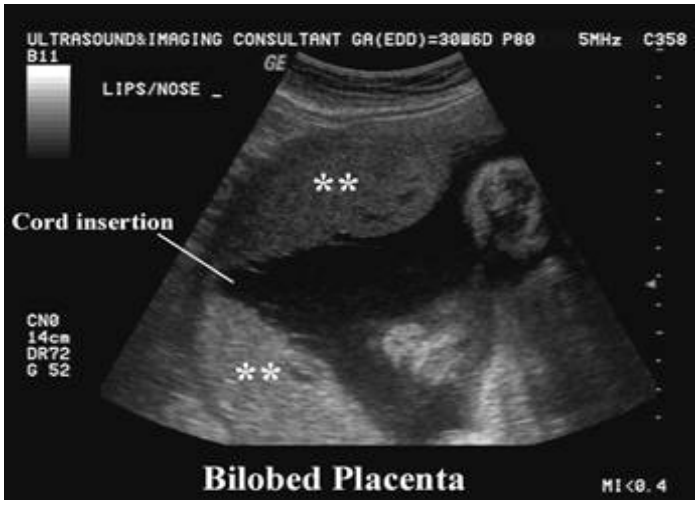

Fig 2-9 shows the bilobed placenta

www.fetalultrasound

- Placenta bipartite: the placenta consists of two equal parts connected by membranes. The umbilical cord is inserted in one lobe and branch from it cross membranes to the other lobe.
- Placenta succenturiata: the placenta consists of a large lobe and a small lobe connecting together by parts connected by membranes. The umbilical cord is inserted in one lobe and branch from it cross membranes to the other lobe. .

Fig 2-10: showPlacenta succenturiata

www.fetalultrasound

- Placenta fenestrate: gap is seen in the placenta covered by membranes giving appearance of a window.

***2-3-2* Abnormal position:**Placenta preavia**:** is a condition in which the placenta attaches to the wall of the uterus very low down. There are two types of placenta previa: marginal and complete Marginal placenta previa is when the placenta only partially covers the cervix. Complete placenta previa fully covers the cervix.

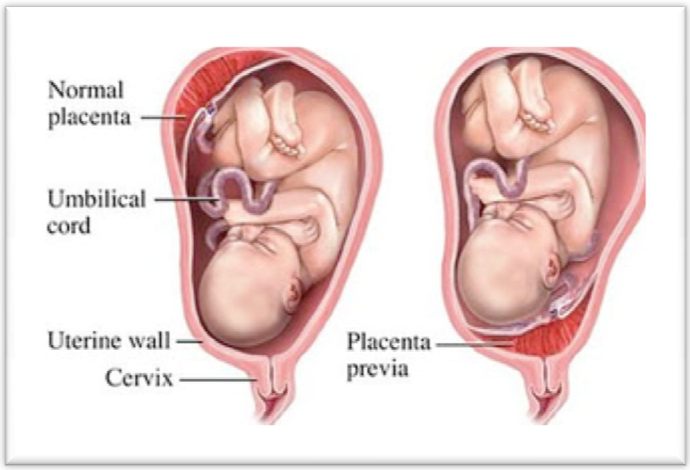

Figure 2-11 shows the placenta previa

(http;//www.siumed .edu/dking2/erg/placenta htm)

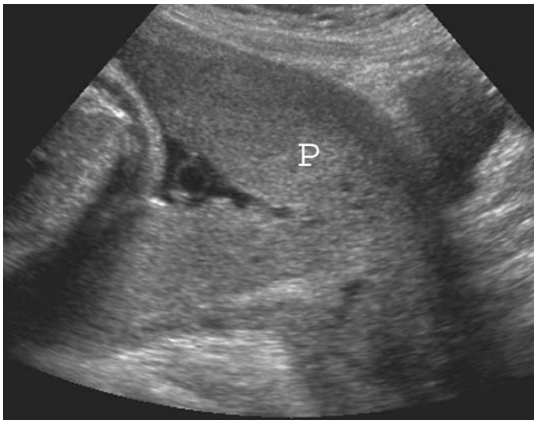

Figure 2-12: placenta previa: Transabdominal sagittal image shows the placenta (P) Centered over the internal os.(Chie & Levine 2006)

- ***Placenta abruption:*** Occurs when the placenta separates from the uterus during pregnancy. Abruption can be either partial or complete. Placental abruption is the leading cause of fetal and newborn death. It also causes high rates of premature delivery and fetal growth restriction.

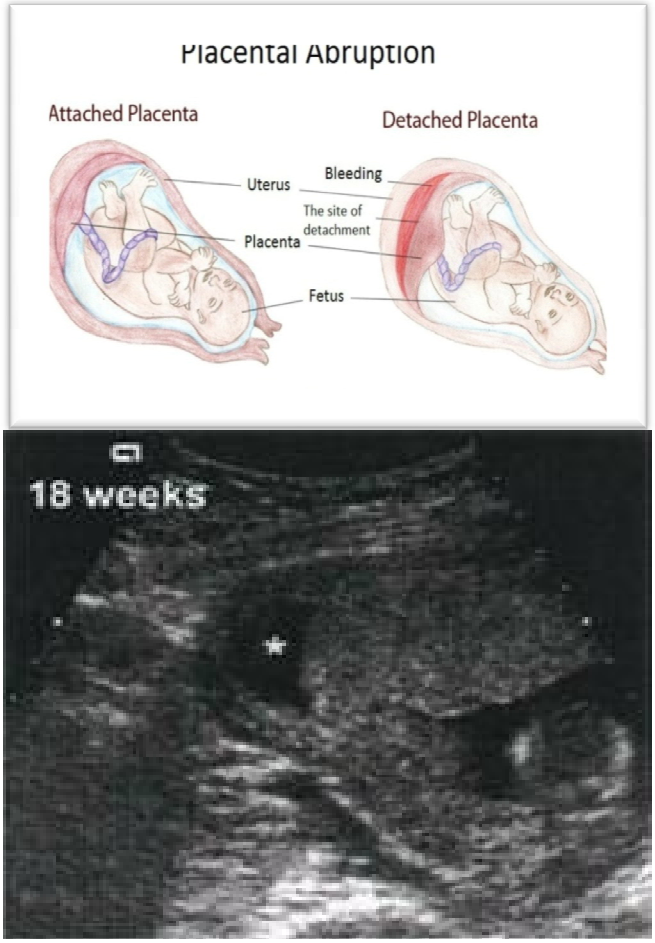

Figure 2-13 Placental abruption: Sonogram of the placenta shows a cystic area behind the placenta (*) which is the Retroplacental Hematoma. ***(****Burwin Institute Notes)*

- ***Abnormal adhesion:***Placenta accretes: thechorion villi penetrate deeply into the uterine wall to reach the myometrium. Placenta increta: the chorin villi penetrate deeply into the myometrium. Placenta percreta: the chorion villi reach the peritoneal coat.

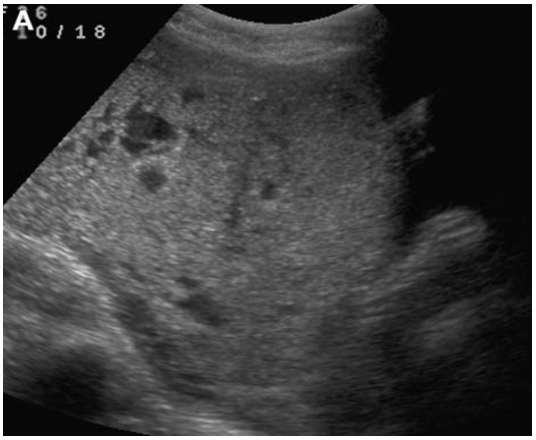

Figure 2-14: Placenta accreta at 26 weeks gestational age. A transabdominal sagittal image shows a thickened placenta with cystic spaces. There is loss of the normal myometrium anteriorly..(Chie& Levine 2006)

- ***Abnormal lesion:***Hydatidiform Mole: A-Total Hydatidiform Mole: It is abnormal pregnancy, whir all placenta villi change to molar vesicles and fill uterine cavity , while there is no embryo, fetus, umbilical cord and no capillary vessels is noted in the molar cyst. B-Partial Hydatidiform Mole: It is partial change of placenta villi into the mole, which is associated with embryo; fetus or fetal parts. Fetal anomalies are common. Capillary vessels are found is molareinterstitium. C-Invasive Hydatidiform Mole: It is the invasion of molar cysts into myometrium with destruction and hemorrhage, intravascular mole and placental polyp are excluded from the invasive mole .The lesion is formed either in total or partial mole. D-placenta infarction: Area of dead tissue found within the placenta, typically caused by blood vessels complication. (kurjak and Chervenak 2006).

2-4 Previous Study

Relationship between placental thicknessand birth weights during the second and third trimesters, January 2011 to June 2012,done bySalafia C.etal . His study done in 250 singleton pregnant women , placental thickness was measured trans-abdominally by placing the ultrasound transducer perpendicularly to the plane of the placenta in the area of the cord insertion at second and third trimester. Resulte of this study there was a significant positive correlation between placental thickness and birth weight in the second and third trimesters (r=0.15, p=0.03; r=0.14, p=0.04 correspondingly).

Estimation of placenta thickness in third trimester to determine fetal weight in sudanese women 2016, done by KhairyS.etal.his study done in Omdurman Maternity Hospital (Sudan). The study group included 207 women. Ultrasound growth parameters used for fetal weighing are Biparietal Diameter (BPD), Femur Length (FL) The Abdomen Circumference (AC). Resulte of this study there was strong correlation between placental thickness and biparietal diameter, femur length, abdominal circumference, and so with the estimated fetal weight.

Correlation between placental thickness and estimated fetal weight in Nigerian women 2009 done by OhagwuA.etal.his study done in Six hundred and forty-fiveNigerian women with singleton pregnancies in the second and third trimesters were studied by transabdomina ultrasound. Fetal weight was estimated by measurement of biparietal diameter (BPD) and abdominal circumference (AC). Gestational age was estimated by measuring the BPD and fetal femur length (FL). Placental thickness was measured in a longitudinal section at the point of insertion of the umbilical cord. Results showed that both placental thickness and estimated fetal weight increased in fairly linear manner with gestational age. There were significant positive correlations between placental thickness and estimated fetal weight in the second and third trimesters ($p< 0.05$, r = 0.616).

Relationship between two-dimensional ultrasound measurement of placental thickness and estimated fetal weight by Ademola A et al,2015, four hundred and twenty apparently healthy pregnantNigerian women at gestational age 15-40 weeks ,Placenta thickness in millimeters, and fetal weight, in grams. Correlation between the two parameters was. r = 0.668; P = 0.000. Conclusion: The study established a fairly linear relationship between placental thickness and EFW.

The correlation between placental thickness and fetal a.ge in Sudan done by Afra et al 2009 -2010 The aim of this study was to investigate placentathickness as parameter for estimating gestational age of fetus This study was carried out at Khartoum state Sudan,. 110 cases of pregnant women in thirdtrimester had been selected randomly. The data was collected by designed clinical data collection sheets which containing all the variables of the study (Placenta thickness, FL, BPD, and AC). There were significant correlations between the placental thickness, Femur length and Bi-parietal diameter in which correlation coefficients are 0.85 and 0.80 respectively. The placental thickness is considered one of the parameters for estimating the GA in the third trimester.

Chapter Three

Material and Methods

Material and Methods

3.1 Materials:

Different types of ultrasound machine were used: including ALPINON ETUBE 9 in altamuze hospital and SONSCAPE China model S 11 in alsaody hospital. Withtransabdominal convex transducer with frequency of 3.5 MHz and ultrasound gel.

3.2 Methods:

In this study, seventy Sudanese pregnant women scanned by transabdominal probe in second and third trimesters after checking that the pregnancy is normal, the fetal weight was estimated by ultrasound machine formula devised by Hadlock II basis of biparietal diameter (BPD), femoral length (FL) and abdominal circumference (AC). Fetal age was estimated by measuring BPD, FL and AC.

3.2.1. Ultrasound techniques:

Nopreparation needed .The patient was scanned in supine position, water- soluble coupling gel then applied. Measurement tacked place at the cord insertion with one caliper placed at the amniochorionic surface (chorionic plate) and the second caliper placed at the pasal surface perpendicular to the amniochorionic surface .the measurement exclude retroplacnta veins ,myometrium and contraction of placenta.

3.2.2. Study Design:

This is descriptive analytical study deals with estimation of fetal weight using ultrasound.

3.2.3. Area of the study

This study was done in Khartoum state in two hospitals:Altamuze hospitaland Alsaody hospital.

3.2.4. Duration of the study

This study conducted in period from January to July 2017.

3.2.5. Sample of the study

The sample of the study was consisting of 70 pregnant sundaes women in second and third trimesters come to the ultrasound department for regular checkup.

3.2.6. Inclusion criteria:

All pregnant ladies with normal pregnancy in 2^{nd} and 3^{rd}trimester.

3.2.7. Exclusion criteria:

Patients with pregnancy include hypertension, diabetic, history of previous intrauterine growth retardation, congenital malformation, twin gestation and placenta anomalies were excluded from the study.

3.2.8 Data collection

The data collected using data collection sheet.

3.2.9. Methods of data analysis:

The data was analyzed using SPSS version (21.0) and excel program.

3-2-10 Ethical consideration

- The patients to be selected according only to our inclusion criteria .No patient identification or individual patient details is published.
- Informed consent was taken to take the data.

Chapter Four

Results

Chapter Four

Results

Table (4.1) shows descriptive statistic of mother age , BPD mm, AC mm, FL mm, GA BPD , GA FL,GA AC , GA LMP , EFW and placenta thickness

	N	Minimum	Maximum	Mean	Std. Deviation
Age of mother	70	17	41	27.57	6.421
BPD mm	70	32.20	95.80	77.5275	13.52850
AC mm	70	109.10	898.00	291.072	109.99688
FL mm	70	16.40	99.50	61.4529	13.52274
GABPD per weeks	70	15.57(15 wks. 4days)	39.57(39wks 4days)	31.4041	5.04689
GALMP per weeks	70	14.29(14wks 2days)	40.00	31.7000	5.80248
GAFL per weeks	70	14.71(14 wks. 5days)	40.00	31.7867	5.34425
GAAC per weeks	70	14.57(14 wks. 4days)	39.43(39wks3 days)	31.6898	5.34677
EFW per gram	70	109	3672	2025.73	871.860
Placenta thickness by mm	70	15.00	40.00	32.8714	5.51052
Valid N (listwise)	70				

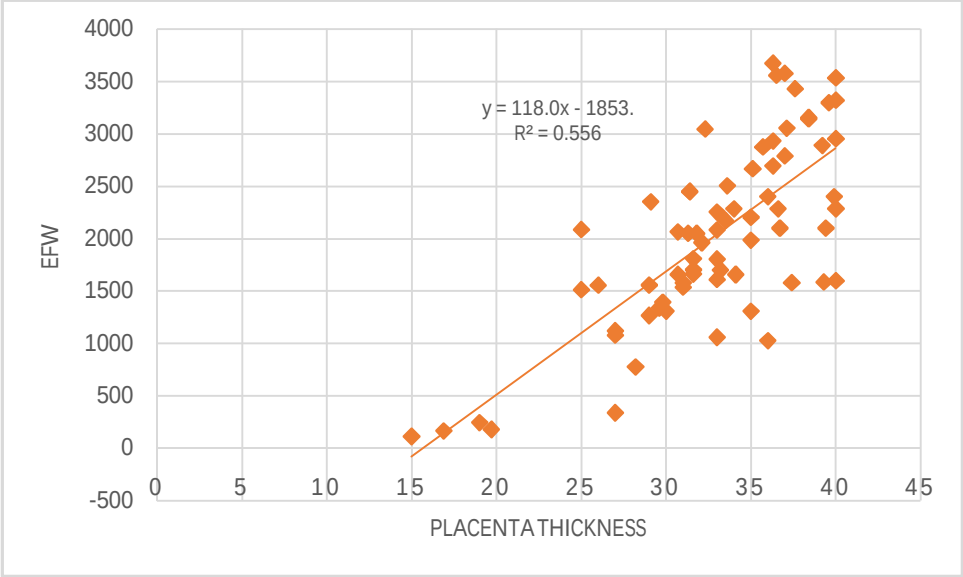

Figure (4.1) scatterplot shows relation between fetal weight and placenta thickness

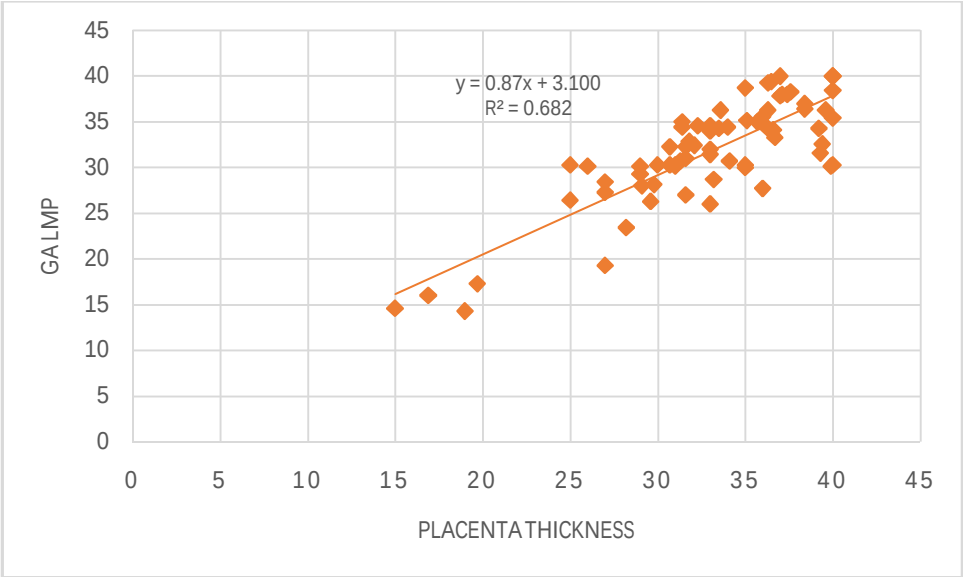

Figure (4.2) scatterplot shows relation between GA LMP and placenta thickness

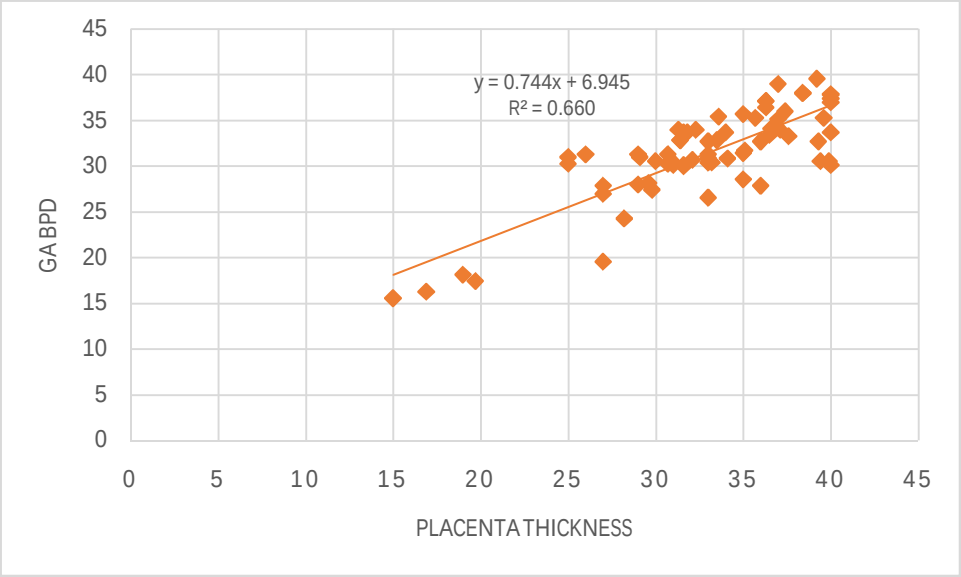

Figure (4.3) scatterplot shows relation between GA BPD and placenta thickness

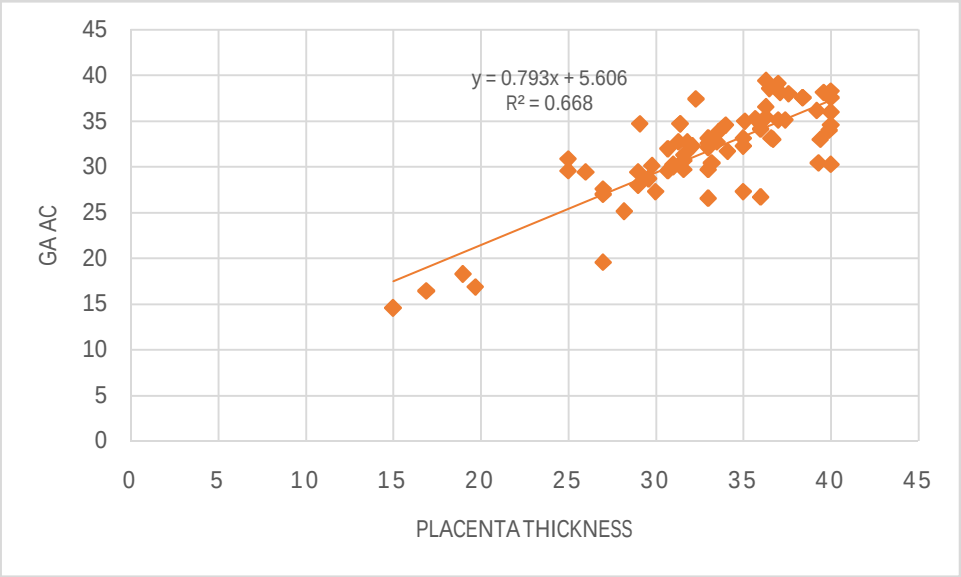

Figure (4.4) scatterplot shows relation between GA AC and placenta thickness

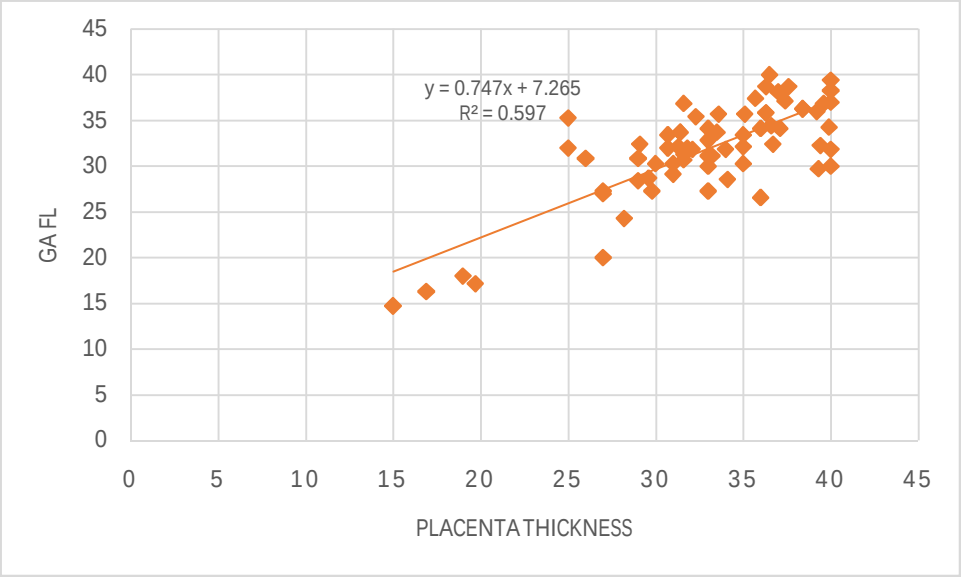

Figure (4.5) scatterplot shows relation between GA FL and placenta thickness

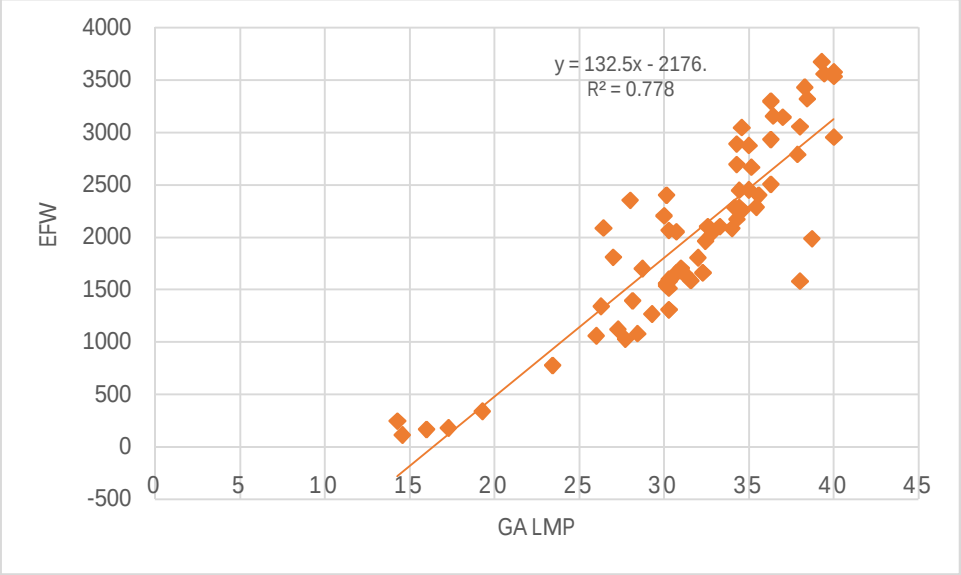

Figure (4.6) scatterplot shows relation between GA LMP and EFW

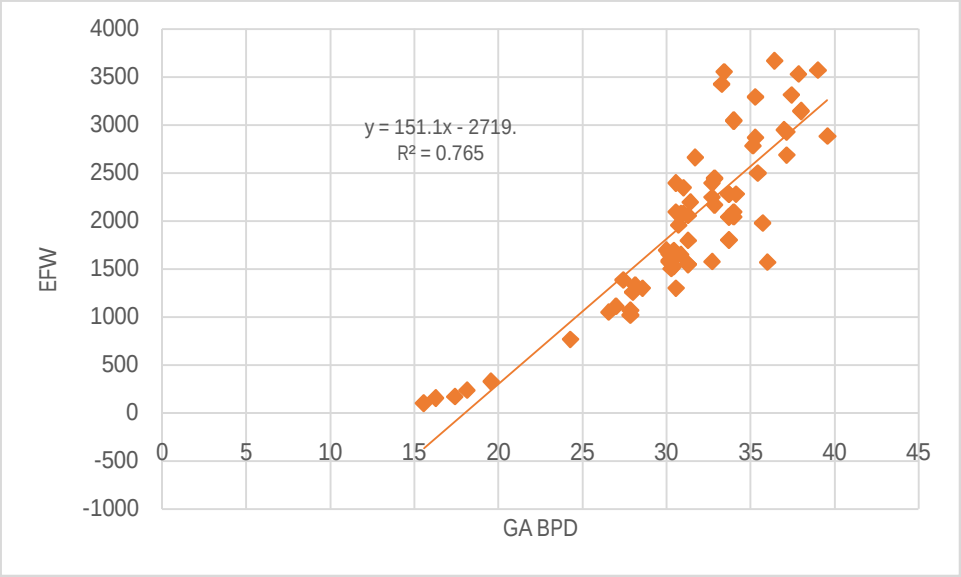

Figure (4.7) scatterplot shows relation between GA BPD and EFW

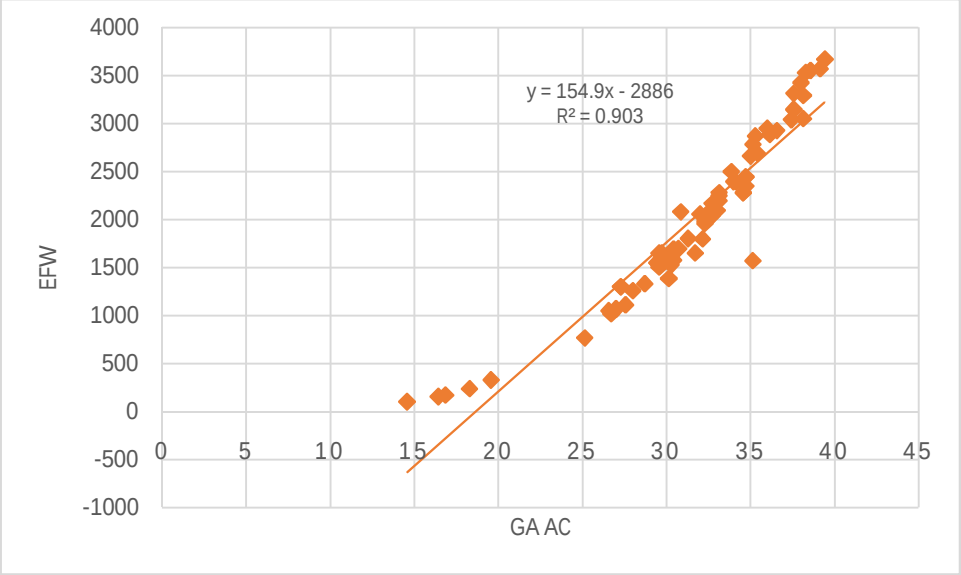

Figure (4.8) scatterplot shows relation between GA AC and EFW

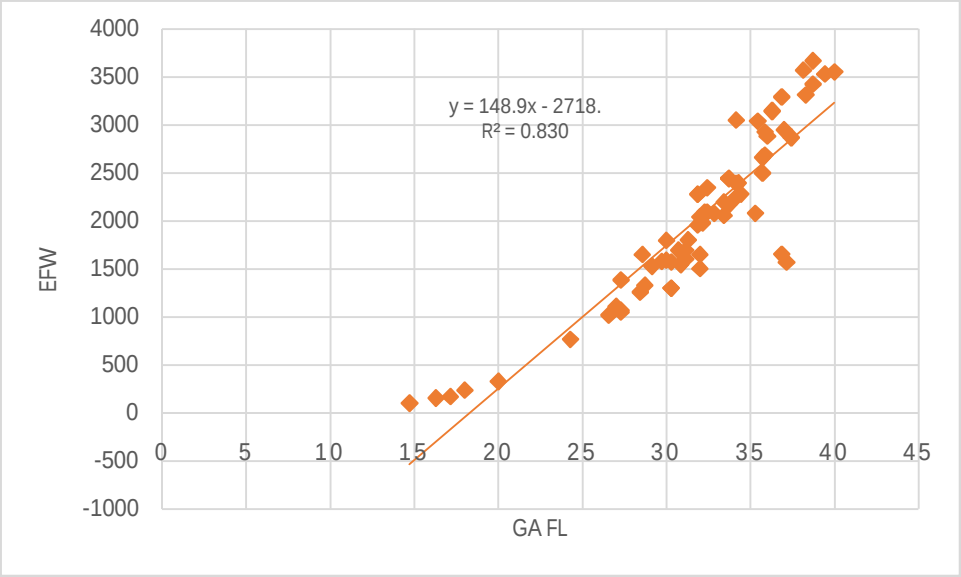

Figure (4.9) scatter plot shows relation between GA FL and EFW

Table (4.2) prediction formulae for estimation of fetal weight by GA BPD, GA LMP, GAFL,GAAC
And placenta thickness

a-

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.954[a]	.911	.904	270.674

a. Predictors: (Constant), GAFL, PTH, GABPD, GALMP, GAAC

b-

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.724E7	5	9448893.210	128.969	.000[a]
	Residual	4615672.934	63	73264.650		
	Total	5.186E7	68			

a. Predictors: (Constant), GAFL, PTH, GABPD, GALMP, GAAC

b. Dependent Variable: EFW

c-

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2751.676	219.940		-12.511	.000
	PTH	-11.905	10.989	-.075	-1.083	.283
	GALMP	1.333	18.311	.009	.073	.942
	GABPD	-31.018	21.121	-.180	-1.469	.147
	GAAC	165.189	23.737	1.016	6.959	.000
	GAFL	27.078	20.993	.166	1.290	.202

a. Dependent Variable: EFW

EFW = -2751.676 -11.905 placenta thickness + 1.333GA LMP-31.018GA BPD +165.189GA AC + 27.078GA FL[(1)]

Table (4.3) prediction formulae for estimation of fetal weight by BPD mm, , FL mm, AC mm
and placenta thickness

a-

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.903[a]	.815	.804	388.419

a. Predictors: (Constant), FLMM, ACMM, PTH, BPDMM

b-

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.261E7	4	1.065E7	70.602	.000[a]
	Residual	9655654.557	64	150869.602		
	Total	5.226E7	68			

a. Predictors: (Constant), FLMM, ACMM, PTH, BPDMM

b. Dependent Variable: EFW

c-

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2520.626	318.084		-7.924	.000
	PTH	34.010	15.033	.213	2.262	.027
	BPDMM	13.331	9.170	.206	1.454	.151
	ACMM	1.481	.438	.187	3.383	.001
	FLMM	32.087	7.974	.498	4.024	.000

a. Dependent Variable: EFW

EFW = -2520.626+ 34.010 placenta thickness + 13.33 BPD mm+ 1.481AC mm+ 32.087 FL mm[(2)]

Table (4.4) correlation of estimated fetal weight with placenta thickness, GA BPD, GA FL, GA AC , GA LMP

		EFW	PTH	GALMP	GABPD	GAAC	GAFL
EFW	Pearson Correlation	1	.746**	.882**	.875**	.951**	.911**
	Sig. (2-tailed)		.000	.000	.000	.000	.000
	N	70	70	70	70	70	69

Chapter Five

Discussion, Conclusion and Recommendation

5.1 Discussion:

The purpose of this study was to develop model for estimation of fetal weight using ultrasound measurement, in normal Sudanese pregnant women. The research includes 70 pregnant women. The variables used to establish this study was placenta thickness, BPD, FL, and AC.

According to table (4-1) the study found that the means measurements of the BPD(mm), AC(mm), FL(mm) and placenta thickness(mm) were (77.5 +_ 13.5Std, 291.07 +_109.9 Std, 61.4+_ 13.5 Std, 32.8 +_ 5.5 Std) respectively.

Regarding to GA BPD per week the study done in rang from (15weeks+ 4 days to 39weeks+4 days), LMP per weeks ranged from (14weeks+2days to 40 weeks), the GA FL per weeks ranged from (14 weeks +5 days to 40 weeks), the GA AC per weeks ranged from (14 weeks +4 days to 39 weeks+3 days) and EFW per gram ranged from (109 to 3672).

The study showed that there is a linear relationship between placental thickness and fetal weight (r=0.55) shown in figure (4-1), where logarithmic correlation was investigate this relationship reveals that (fetal weight = 118 placenta thickness _ 1853), and there is strong positive correlation between them (r=0.74) with probability (p = 0.000) (table 4-4). These results establish that there is a firmly fixed increase in placental thickness (PT) with the increase of fetal age, which typically go with those studies done bySalfiaC .et al 2012, OhagwuC.etal, 2009, and Khairy et.al 2006.

According to figures (4-2), (4-3), (4-4) and (4-5) showed that there were linear correlation between GA LMP and placenta thickness, GA BPD and placenta thickness, GA AC and placenta thickness, and GA FL and placenta thickness (r=0.68, r=0.66, r=0.66 and r =0.6) respectively. Where logarithmic correlations was investigate this relationship reveals that (EFW = 132.5 GA LMP _ 2176), (EFW = 151.1 GA BPD _ 2719), (EFW = 154.9 GA AC _ 2886).Respectively.

All above results agreed with study of AfraA et al 2009 -2010, andOhagwuC.et.al, 2009.

The study found that there were strong linear correlation between EFW and GA LMP and EFW and GA BPD in figure (4-6) and (4-7) (r=0.77), (r=0.76) respectively,logarithmatic correlation was investigate this relationship reveals that ((EFW = 132.5 GA LMP _ 2176),(EFW = 151.1 GA BPD _ 2719)) this agrees withOhagwuC.etal, 2009.Afra Aet al 2009 -2010.

The study found that there were very strong linear correlation between EFW and GA AC and EFW and GA FL in figure (4-8) and (4-9) r=0.9, r=0.83 respectively.Logarithmic correlation was investigating this relationship revealsthat((EFW = 154.9 GA AC _ 2886), (EFW =148.9 GA FL _ 2718)).Respectively.

Thatalso my study agrees with many other studies (KhairyS.etal.his study done in Omdurman maternity hospital (Sudan).

Table(4-2) shows significant strong correlation between EFW and BPD,GA LMP ,GA FL ,GA AC and placenta thickness(r= 0.95) with probability (p=.000) demonstrated in tables(a) ,(b).and in table(c) found that formulae for estimated of fetal weight by GA BPD ,GA LMP ,GA AC,GA FL and placenta thickness.

(EFW =_2751.676 _11.905 placenta thickness + 1.333GA LMP _31.018 GA BPD +165.189 GA AC +27.078 GAFL).

Table(4-3) shows significant strong correlation between EFW and BPD mm, , FL mm , AC mm and placenta thickness mm(r= 0.9) with probability (p=.000) demonstrated in tables(a) ,(b).and in (c) found that formulae for estimated of fetal weight by BPD mm , AC mm, F L mm and placenta thickness mm.

(EFW = _2520.626+34.010 placenta thickness + 13.33 BPD mm +1.481AC mm +32.087 FL mm).

The study found that there was significant strong correlation between EFW and placenta thickness(r=0.74) with (P=.000).there was also strong correlation between EFW and GA LMP ,GA BPD ,GA AC ,GA FL(R=.88),(R=.87),(R=.95),(r=.91) and(p=.000) respectively.

GA LMP = 0.87 placenta thickness + 3.1.

GA BPD = 0.744placenta thickness + 6.945.

GA AC = 0.793 placenta thickness + 5.606.

GA FL = 0.747 placenta thickness+ 7.265.

EFW = 118 placenta thickness _ 1853.

EFW = 132.5 GA LMP _ 2176.

EFW = 151.1 GA BPD _ 2719.

EFW = 154.9 GA AC _ 2886.

EFW =148.9 GA FL _ 2718.

EFW = -2751.676 -11.905 placenta thickness+1.333GA LMP-31.018GA BPD +165.189GA AC + 27.078GA FL.

EFW = -2520.626+ 34.010 placenta thickness + 13.33 BPD mm+ 1.481AC mm+. 32.087 FL mm.

5-2 Conclusion

The placenta is a fetal organ which provides the physiological link between pregnant woman and the fetus.

In this study the researcher used the placenta thickness to estimated fetal weight instead of BPD and FL for lack of accuracy, and because the weight is very important during obstetric ultrasound; it can influence obstetric management decisions concerning the timing and route of delivery.

This study was done in Khartoum state in altmuze and alsoudyhospitals, included seventysudanese pregnant women scanned by transabdominal probe in second and third trimesters after checking that the pregnancy is normal, their aged from 17 to 41 years and the means measurements of the BPD (mm), AC (mm), FL (mm) and placenta thickness (mm) were (77.5 +_ 13.5Std, 291.07 +_109.9 Std, 61.4+_ 13.5 Std, 32.8 +_ 5.5 Std) respectively.

After collected data analyzed by SPSS, found thatthe fetal weight haslinear relationship and strong positive correlationwith placental thickness, also the study showed linear relationship and strong positive correlation between estimated fetal weight and gestation age by biparietal diameter (BPD), abdomen circumference (AC) and femur length.

5-3 Recommendation

- The placental thickness helps in determination of normal growth of fetus in second and third trimester, so it can be used as an additional sonographictool in correlating both gestational age and birth weight. Thus it should be recommended routinely during obstetric ultrasound.
- Subnormal placental thickness for a particular gestational age may represent sign of intrauterine growth retardation.
- Is important to know true area of placenta measurement at the level of cord insertion. The myometrium and sub placental veins will be excluded in these measurements.
- I recommended another study to correlate the blood supply to placenta with fetal weight using Doppler ultrasound machines.

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Http//www.inharmonybirth .com /placenta–preparation.

Appendix 1

The data collection

N0	AGE	LMP	BPD/mm	BPD/GA	AC/mm	AC /GA	FL/mm	FL/ GA	PTH	EFW
1	30	36w.2d	91.3	35w.2d	300	38w.1d	72.8	36w,6d	39.6	3296
2	23	35w.4d	80.6	32w.5d	288	34w.1d	66.8	34w.1d	36	2399
3	17	30w.2d	74.8	30w.2d	253	29w.4d	62.4	32w	25	1509
4	17	38w.5d	87.3	35w.5d	281	32w.2d	62.5	32w.1d	35	1984
5	27	35d.3d	82.7	33w.5d	305	34w.4d	62.1	31.6d	4	2285
6	24	27w	82.7	33w.5d	272	31w.2d	60.8	31w.2d	31.6	1807
7	30	34w.3d	81.9	32w.6d	307	34w.5d	65.1	33w.5d	31.4	2445
8	25	30w.5d	84.5	34w	286	32w.5d	64.1	32.w.1d	31.3	2049
9	30	30w.5d	76.3	30.6d	277	31w.5d	54.1	28w.4d	34.1	1655
10	30	30w.2d	78.2	31w.2d	280	32w	64.9	33w.3w	30.7	2063
11	28	14w.2d	40	18w.1d	127	18w.2d	26.2	18w	19	243
12	27	34.1d	84.9	34w.1d	292	33w.1d	66.9	34w.3d	36.6	2284
13	24	35w	87.3	35.2d	313	35.2d	73.2	37.3d	35.7	2873
14	31	34.2d	95.4	39.4d	320	36.1d	68.7	36w	39.2	2889
15	37	36w.3d	91.2	38w	335	37w.4d	69.2	36w.2d	38.4	3155
16	32	26w.2d	72.8	28w.1d	462	28w.5d	51.6	28w.5d	29.6	1337
17	36	34w.4d	86.2	34w	782	37.3d	64.4	35w.3d	32.3	3044
18	27	26w.3d	81.8	31w	252	30w.6d	68.8	35.2d	25	2084
19	32	39w.3d	87.3	33w.3d	308	38w.4d	78.3	40w	36.5	3558
20	33	28w	82.9	31w	284	34w.5d	62.6	32w.3d	29.1	2351
21	39	26w	65.7	26w.4d	222	26w.4d	50.8	27w.2d	33	1056
22	20	33w.2d	84.6	34w	290	33w	62.6	32w.3d	36.7	2098
23	27	32w.4d	76.3	30w.4d	290	33w	64	32w.2d	39.4	2098
24	28	39w.2d	88.5	36w.3d	352	39w.3d	75.8	38w.5d	36.3	3672
25	24	36w.2d	87.7	35w.3d	298	33w.6d	99.5	35w.5d	33.6	2503
26	32	16w	34.4	16w.2d	109	16w.3d	21.7	16w.2d	16.9	162
27	22	35w.1d	83.3	31w.5d	286	35w	69.7	35w.5d	35.1	2666
28	30	38w.2d	87	33w.2d	312	38w	75.6	38w.5d	37.6	3429
29	30	17w.2d	38.1	17w.3d	115	16w.6d	25	17w.1d	19.7	176
30	41	30w.2d	76.2	28w.4d	218	27w.2d	59.7	30w.2d	35	1306
31	22	28w.5d	75.7	30w.3d	264	30w.3d	59.9	31w.1d	33.2	1698
32	27	19w.2d	44.9	19w.4d	142	19w.4d	32.1	20w	27	335
33	25	14w.4d	32.2	15w.4d	898	14w.4d	16.4	14w,5d	15	109
34	17	30w.1d	77.2	31w.2d	252	29w.3d	60	30w.6d	26	1552
35	20	23w.3d	59.6	24w.2d	206	25w.1d	43.7	24w.2d	28.2	773
36	22	27w.5d	69.4	27w.6d	223	26w.5d	49.3	26w.4d	36	1025
37	19	31w.4d	81.3	32w.5d	264	30w.3d	56.6	29w.5d	39.3	1583
38	32	30w.1d	78.8	30w.4d	280	34w	62.5	34w.2d	39.9	2400
39	30	34w.2d	64.7	37w.1d	229	35.3d	78	35w.6d	36.3	2692

40	23	29w.2d	72	28w	240	28w	53.7	28W.3D	29	1264
41	39	40w	92	37w.6d	340	38w.2d	77	39w.3d	40	3534
42	39	28w.1d	68	27w.3d	265	30w .1d	50.8	27w,2d	29.8	1391
43	33	38w.3d	92.7	37w.3d	335	37w.4d	74.3	38w,2d	40	3318
44	35	32w.6d	81.9	33w.5d	279.4	32w.5d	61.7	32w	31.8	2047
45	30	40w	91.3	37w	320	36w	73.3	37w	40	2953
64	40	38w	89	36w	315	35w.1d	73	37w.1d	37.4	1577
47	25	40w	95.8	39w	350.5	39w.1d	74.2	38w.1d	37	3575
48	24	27w.2d	68	27w	235	27w.4d	51	27w	27	1117
49	27	30w.1d	74.6	30w.3d	258.7	30w.2d	57.4	29w.1d	31	1534
50	29	31w	76.8	30w	260	30w.5d	60	30w.5d	31.6	1701
51	19	28w.3d	67	27w.6d	230	27w	51.3	27w.2d	27	1075
52	35	38w	84.2	34w	340.8	38w.1d	68	34w.1d	37.1	3054
53	30	30w.2d		30w.1d	259	30w.2d	59	30w	4	1596
54	25	30w	78.2	31w,3d	292	33w.1d	64.9	33w.3d	3.5	2202
55	23	30w.2d	75	30w.1d	260	30w	58.7	30w.2d	31	1578
56	17	30w.1d	77.2	31w.2d	252.2	29w.3d	60	30w.6d	29	1554
57	30	35w	81.9	32w.6d	307.3	34w.5d	65.1	33w.5d	31.4	2450
58	37	37w	91.2	38w	335.3	37w.4d	69.2	36w.2d	38.4	3143
59	30	36w.2d	91.7	37w.1d	325	36w.4d	76	35w.6d	36.3	2930
60	41	30w.2d	76.2	30w.4d	230	27w.2d	59.7	30w.2d	30	1305
61	22	31w.3d	75.7	30w.3d	255.8	29w.5d	59.9	31w.1d	33	1608
62	24	32w	78	31w.2d	280	32w.1d	58.7	30w	33	1802
63	27	34w.3d	82.7	33w.5d	305	34w.4d	62.1	31w.6d	34	2282
64	17	32w.3d	76.3	30w.5d	281.3	32w.2d	62.1	31w.6d	32.1	1961
65	17	32w.2d	74.8	30w.2d	253.2	29w.4d	62.4	32w	30.7	1656
66	23	34w.4d	80.6	32w.5w	290	33w.1d	66.8	34w.1d	33	2252
67	30	37w.6d	87	35w.1d	310	35w.1d	72.8	36w.6d	37	2788
68	17	32w.2d	75	30d.1d	225	29w.5d	62.1	31w.6d	31.6	1659
69	25	34w	77	30w.6d	285	32w.4d	63	32w.6d	33	2081
70	30	34w.2d	81.9	32w.6d	285	32w.5d	65.1	33w.5d	33.5	2171

Appendix 2

Data collection sheet

General information :

(1) Maternity Age: ☐ years

Ultrasound Findings:

(1) BPD ☐ mm ……GA ☐ Weeks.

(2) AC ☐ mm ……GA ☐ Weeks.

(3) EFW ☐ gm.

(4) Placenta thickness ☐ mm.

Appendix 3

The Images of the Researcch

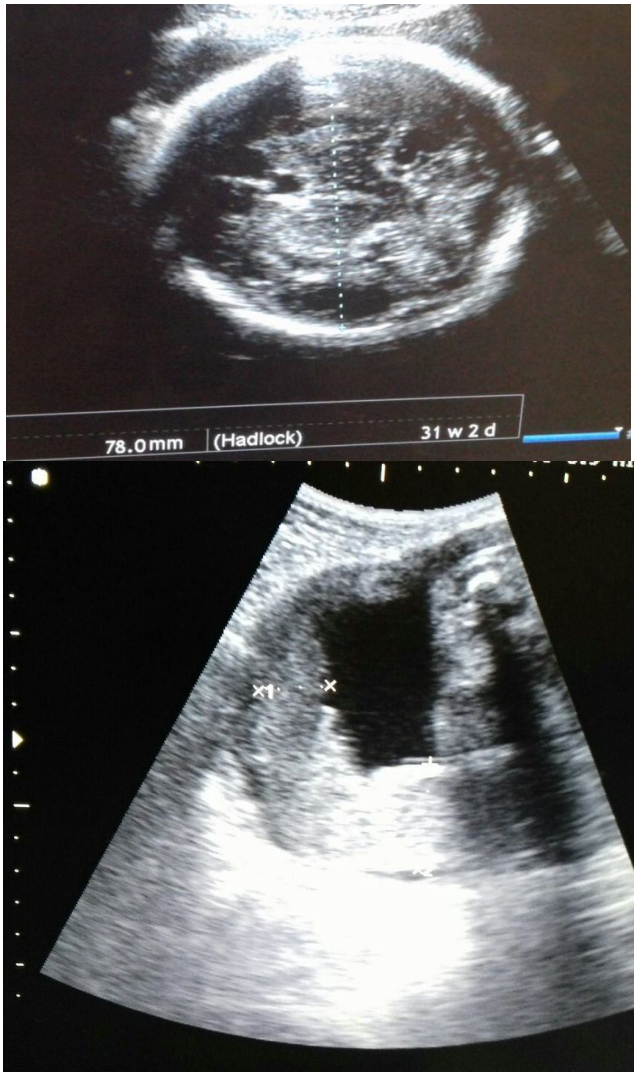

Image 1: Transabdominal ultrasound image for 27 years pregnant woman shows placental thickness = 30 mm, gestational age = 31 weeks and 2 days.

Image 2: Transabdominal ultrasound image for 33 years pregnant woman shows placental thickness = 30 mm, gestational age = 35 weeks and 1 days.

Image 3: Transabdominal ultrasound image for 34 years pregnant woman shows placental thickness = 35.1 mm, gestational age =35weeks +3 days.

Image 4: Transabdominal ultrasound image for 25 years pregnant woman shows placental thickness = 28.0 mm, gestational age =27weeks +3 days.

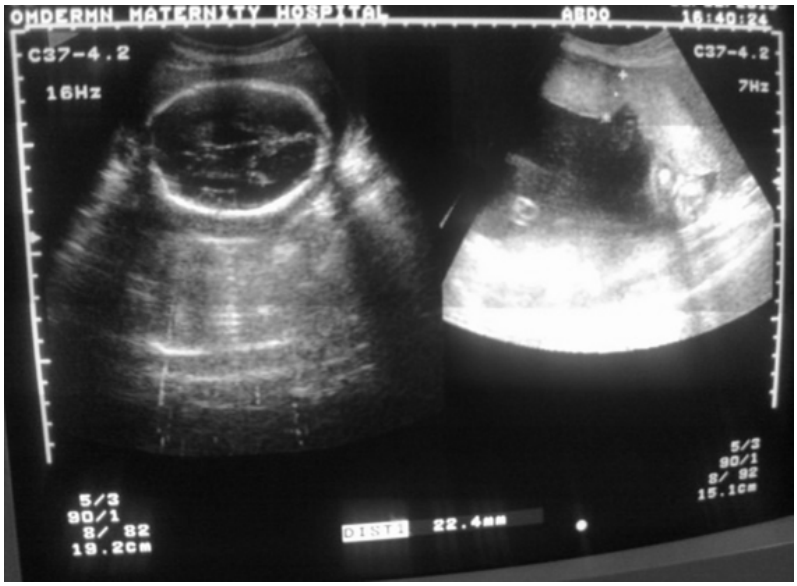

Image 5:Transabdominal ultrasound images for 26 years pregnant woman shows placental thickness = 22.4 mm, gestational age = 24 weeks and 5 days.

Image 6: Transabdominal ultrasound images for 20 years pregnant woman shows placental thickness = 16 mm, gestational age = 16 weeks and 5 days.