Sudan University of Science and Technology
Collage of Graduate Studies

Study of Relationship between Placental Thickness and Fetal Weight using Ultrasonography

دراسة العلاقة بين سمك المشيمة ووزن الجنين بإستخدام التصوير بالموجات فوق الصوتية

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

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الايـــــــــة

بسم الله الرحمن الرحيم

قال تعالى:

(فَاذْكُرُونِي أَذْكُرْكُمْ وَاشْكُرُواْ لِي وَلاَ تَكْفُرُونِ)

صدق الله العظيم

البقرة الاية {152}

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Dedication

- To my father and my mother
- To my daughter and my son
- To my brothers and my sisters
- To my husband
- To my friends

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Acknowledgement

First of all, I thank Allah the Almighty for helping me complete this project. I would like to express my deepest gratitude and sincere appreciation to my supervisor **Dr. Asma Ibrahim Ahmed** for her help, support, advise and encouragement to complete this work. Without her supervision and constant help this dissertation would not have been possible

Finally I would like to thank everybody especially my brothers in radiological field who helped me prepare and finish this study.

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Abstract

This is across sectional descriptive study aimed to study the relationship between the placental thickness and fetal weight using ultra sonography in normal pregnancy women in Gable Awlia health center. Manual examination of the maternal abdomen was the only approach that could be used to estimate fetal size before the availability of ultrasound, physical examination however provides only a general approximation of fetal weight because the palpated dimensions of the uterus are affected by several factors other than fetal size, including amniotic fluid volume , placental bulk , presence of fibroids, and maternal obesity. The data collected in Om other health center from March 2020 to September 2020 .Hundred pregnant women in third trimester were scanned by Mindary ultrasound machine 3.5 mhz curve linear probe used, study by patient supine. Fetal weight was estimated by measurement of femer length(FL), biparietal diameter (BPD) and abdominal circumference (AC). Placenta thickness was measured in alongitudinal section at the point of insertion of the umbilical cord.

The data is analyzed by using Package Statistical for Social Sciences (SPSS). Results of the study showed that there is strong positive correlation between placenta thickness and estimated fetal weight (r=0.713) and (p=0.05) and both are firmly increase with fetal age .The results also showed linear regression between them. Study showed that the fetal weight increase by 60 gm/mm of the placenta thickness. Researcher noticed that with same placenta thickness there were different fetal weights. However, the normality of fetal weight and fetal development can followed by measuring Placental thickness. Study recommended that further studies should be done with the increasing number of sample and introduced Doppler U/S and follows the fetal weight by placental thickness measuring and fetal weights the same fetus in first and second trimester and after delivery.

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ملخص الدراسة

يهدف هذا البحث الوصفي بدراسة العلاقة بين سمك المشيمة ووزن الجنين في الحمل الطبيعي عند النساء في ولاية الخرطوم جمعت بيانات هذه الدراسة من مزكر ام عشر الصحي في محلية جبل اولياء في الفترة من سبتمبر 2019م – سبتمبر 2020م شملت الدراسة (100) سيدة حامل في الثلث الثالث من الحمل الفحص السريري للحوامل لا يمكن من خلاله تحديد وزن الجنين لانه توجد عدة عوامل تؤثر في زيادة حجم البطن للام الحامل غير وزن الجنين، تم الكشف على السيدات بالموجات فوق الصوتية لاجراء الفحص الروتيني للحمل ومن ثم لاجراء هذه الدراسة تم استخدام جهاز الموجات فوق الصوتية (Mindray 6600) بتردد 3.5 ميغاهيرتز، تم تقدير وزن الجنين عن طريق قياس القطر الجانبي للرأس ومحيط البطن وطول الفخذ. سمك المشيمة تم قياسه في نقطة انغراس الحبل السري فيها .

نتائج الدراسة التي استعمل فيها برنامج التحليل الاحصائي للعلوم الاجتماعية (spss) اظهرت ان هناك ارتباط قوي وموجب بين سمك المشيمة والوزن المقدر للجنين (معامل الارتباط r=0.713) حيث ان الاثنين يزيدان باطراد بزيادة عمر الجنين كما ان السم البياني وضح العلاقة الخطية بينهما الدراسة اظهرت ان وزن الجنين يزيد1 جرام عند زيادة سمك المشيمة 10 ملم الباحث لاحظ من خلال الدراسة انه عند السمك المعين للمشيمة يمكن ان تتعدد الاوزان المقدرة للجنين . الدراسة خلصت الى انه من خلال قياس سمك المشيمة يمكن متابعة وزن الجنين والتطور الطبيعي لنمو الحمل ويمكن اثبات فعالية هذه الدراسة بزيادة عدد الحالات ومتابعة الجنين في الثلثين الاول والثاني وبعد الولادة .

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List of Abbreviations

AC	Abdominal Circumference
BPD	Biparietal Diameter
EFW	Estimated Fetal Weight
FL	Femur Length
GA	Gestational Age
GTD:	Gestational Trophoplastic Disease
HC	Head Circumference
HCG	Human Chorionic Gonadotropin
IUGR	Intrauterine Growth Retardation
SSPS	Statistical Package for Social Science
US	Ultrasound

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Chapter One

Introduction

1-1: Introduction

The placenta is an organ that develops in the uterus during pregnancy. It is a unique characteristic of the higher mammals. In humans it is a thick mass about 7 in. (18 cm) in diameter, liberally supplied with blood vessels. It usually weighs about 1 to 2 pounds (about 1/6 of the weight of the baby). The placenta is attached to the uterus, and the fetus is connected to the placenta by the umbilical cord (http// Wikipedia.com).

The placenta develops from the chorionic villi at the implantation site at about the fifth weeks of gestation and by the ninth or tenth week of diffuse granular echo texture of the placenta is clearly apparent at sonography (callen, 2007).

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 a placenta which appears to extend into the lower uterine segment and is within 1-2 cm 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 (Devin 2005).

The placenta is a vascular structure by which an unborn child is attached to its mother's uterine wall and through which respiratory gas and metabolic exchange occurs. The placenta is formed in part from maternal tissue and in part from embryonic tissue. The embryonic portion of the placenta consists of the chorionfrondosum, whereas the maternal portion is composed of the area of the

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uterine wall called the decidua basalis, into which the chorionic villi penetrate. Blood does not flow directly between these two portions, but because their membranes are in close proximity, certain substances diffuse readily. When fully formed, the placenta is a reddish brown oval disc with a diameter of 15 to 20 cm and a thickness of 2.5 cm, It weighs between 500 and 600 g, about one sixth as much as the fetus. (Graaff 2001).

As a result of the continuous growth of the fetus and expansion of the uterus, the placenta also enlarges. Its increase in surface area roughly parallels that of the expanding uterus and throughout pregnancy it covers approximately 15 to 30% of the internal surface of the uterus. The increase in thickness of the placenta results from arborization of existing villi and is not caused by further penetration into maternal tissues. So Placental thickness is closely related to fetal wellbeing and may be a key factor in perinatal outcome. (Sadler 2004).

The use of ultrasound to evaluate the placenta is routine among the majority of pregnant women. A wide range of pregnancy complications result from abnormal placental development, including preeclampsia, intrauterine growth retardation (IUGR) and abruption. Other placental abnormalities, such as placenta previa, percreta or vasa previa, may cause major maternal and fetal complications. Timely recognition of these abnormalities can lead to improve management of pregnancy and delivery. Thus, careful examinations of the placenta by ultrasound can contribute directly to enhance patient care and improve outcomes. (Rumack et al 2011).

Before the availability of the ultrasound, manual examination of the maternal abdomen was the only approach that could be used to estimate fetal size. The physical examination, however, provides only a general approximation of fetal

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weight because the palpated dimensions of the uterus are affected by several factors other than fetal size, including amniotic fluid volume, placental bulk , presence of fibroids and maternal obesity.

Sonographic measurements of the fetus provide information about fetal age and growth. These data are used to assigngestational age, estimated fetal weight and diagnose growth disturbance. The measurements of fetal body parts provide a direct way of assessing fetal size.

Numerous formulas have been published for estimating fetal weight from one or more of these fetal body measurements: head (bi-parietal diameter BPD or head circumference HC), abdomen (abdominal diameter AD or abdomen circumference, AC), and femur length (FL). Estimation of fetal weight, on its own and in relation to the gestational age, can influence obstetric management decisions concerning the timing and route of delivery. Early delivery may benefit a fetus that is small for dates. Such a fetus may be inadequately supplied by its placenta with oxygen and nutrients and therefore may do better in the care of neonatologist than in uterus. When the fetus is large, cesarean section may be the preferred route of delivery, particularly in pregnancies complicated by maternal diabetes. In view of these considerations, fetal measurements should be a component of every complete obstetric sonogram. (Rumack et.al 2011).

1-2: Problem of the Study:

Before the availability of ultrasound, manual examination of the maternal abdomen was the only approach that could be used to estimate fetal size. The physical examination, however, provides only a general approximation of fetal weight because the palpated dimensions of the uterus are affected by several factors other than fetal size, including amniotic fluid volume, placental bulk, presence of fibroids, and maternal obesity.

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1-3: Objectives of the Study:

1-3-1: General objectives:

To assess the association of the placental thickness and estimated fetal weight in pregnant women in third trimester.

1-3-2: Specific objectives:

-To measure the placental thickness, fetal weight, fetal age

-To correlate between the placental thickness and the femur length, abdominal circumference, Biprital diameter and estimated fetal weight.

1-4: Significance of the Study:

Study explains the idea about the relationship between the placental thickness and fetal age and estimated fetal weight.

1-5: Overview of the Study:

The study falls into five chapters: chapter one included introduction, problem, justification, objectives, as well as the overview of the study.

Chapter two includes anatomy, physiology, pathology, ultrasound scanning, previous studies related to the same topic, Chapter three deals with the material and methods by which we conduct the study, Chapter four represents the results and Chapter five includes discussion, conclusion, recommendations, followed by the references, and appendices.

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Chapter Two

Theoretical background and previous studies

2-1 Anatomy of Placenta

The placenta is a "vascular (supplied with blood vessels) organ in most mammals that unites the fetus to the uterus of the mother. It mediates the metabolic exchanges of the developing individual through an intimate association of embryonic tissues and of certain uterine tissues, serving the functions of nutrition, respiration, and excretion." (Online Britannica encyclopaedia). As the fetus is in full development, it requires a certain amount of gases and nutrients to help support its growth. Because the fetus is unable to do so on its own, the placenta provides these gases and nutrients throughout pregnancy.

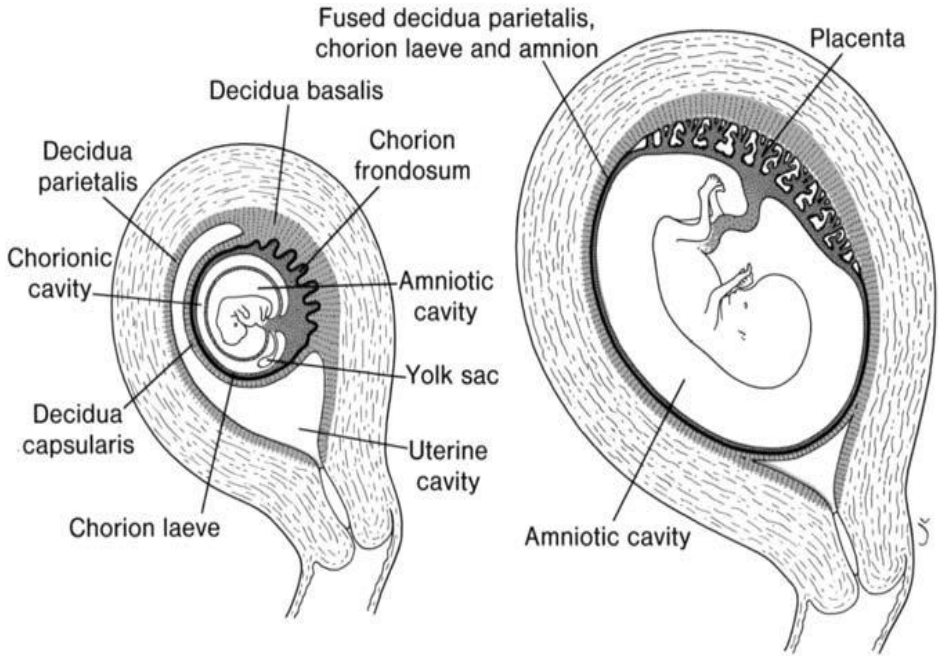

Fig: 2-1 Relation of fetal membranes to wall of the uterus (penny-2011).

2.1.1. Development:

The placenta and fetus both arise from the same single cell - the zygote, which is the fertilized ovum; hence, the placenta and the umbilical cord and the blood flowing in them are of embryonic or fetal origin (Plascencia, et.al 1998).

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After the blastocyst attaches to the endometrial surface, it begins the process of implantation. In the early stages of implantation, the trophoblast begins to differentiate into two cell layers - the outer syncytiotrophoblast and the inner cytotrophoblast. As thetrophoblast invades the decidua, it breaks down decidual blood vessels and creates a network of blood-filled spaces known as lacunae; the lacunar network evolves into the intervillous spaces of the mature placenta. (Moore, 2016).

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 imposed by the decidua rather than by the trophoblast itself (in a tubal pregnancy, trophoblast is not under any local control and invades freely all the tissue layers of the tube (mucosa, muscle, serosa). As the syncytiotrophoblast becomes 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, the entire surface of the developing gestational sac is covered with chorionic villi. As the chorionic sac grows, the villi underneath the decidua scapsularis are compressed and their blood supply reduced; subsequently these villi degenerate, resulting in an avillous portion of the chorionic sac known as the smooth chorion or chorion laeve. 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).(Moore , 2016)
(Fig 2.2)

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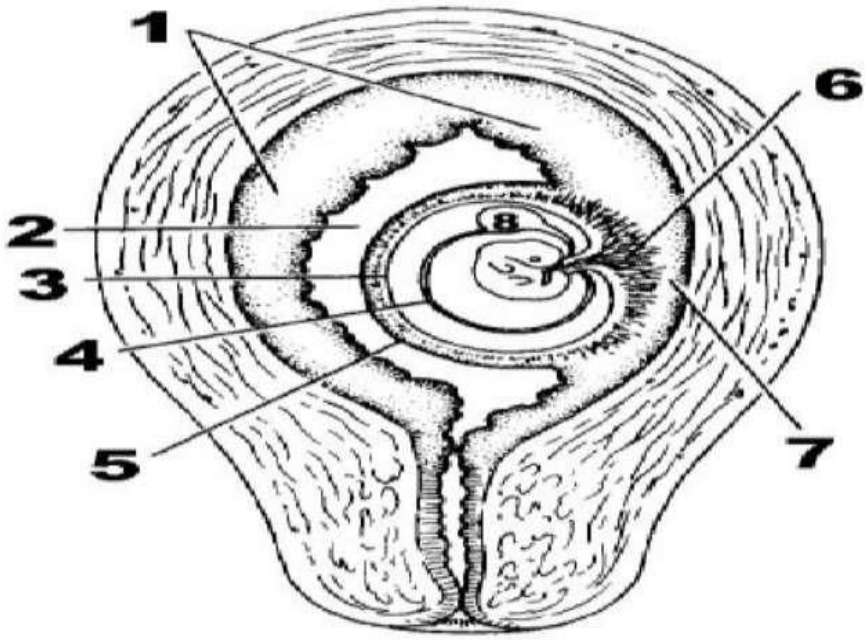

Fig 2.2: Relationship of the Gestational sac and surrounding deciduas (Moore , 2016**)**

2.1.2: Structure:

The placenta has two functional components: 1) a fetal portion that develops from the chorion, and 2) a maternal portion formed by the deciduas

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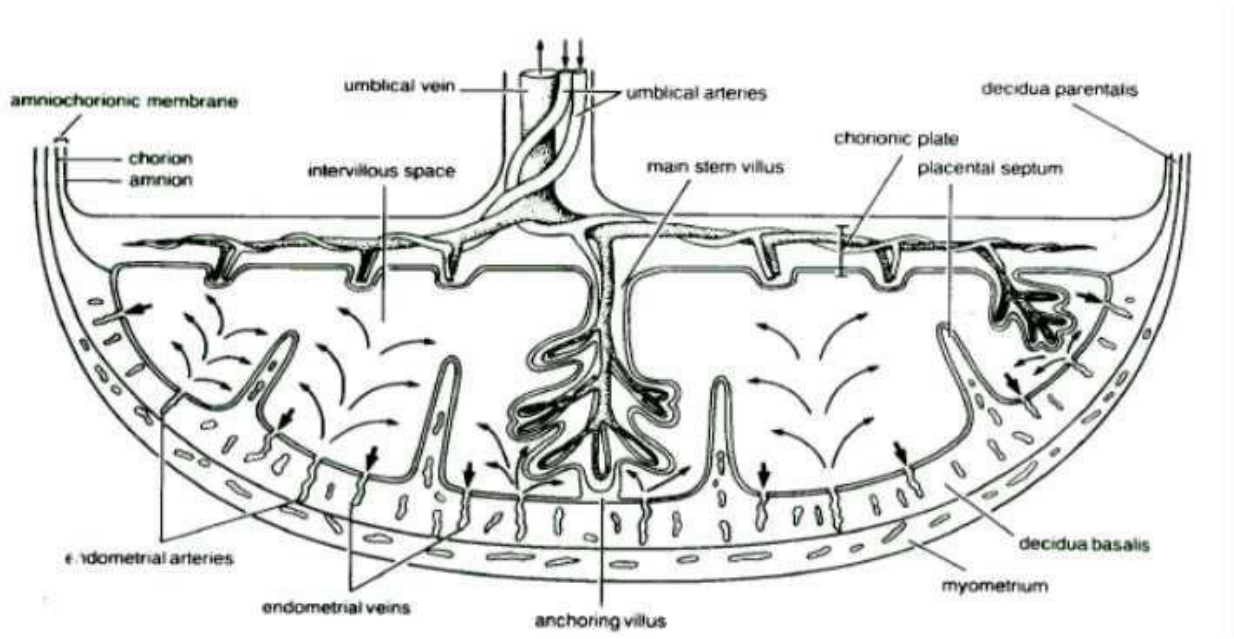

Fig 2.3: Fetal and maternal circulation (Moore , 2016).

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 ascotyledons. 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 anchoring villi) arise from the chorionic plate and pass through the intervillous space to attach firmly to the deciduas basal basalis, the anchoring villi give origin to smaller branches called free or floating villi because they float in the blood-filled intervillous spaces). (Devin 2005**)**.

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2.1.3: 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 maternal circulation via the basal veins. Oxygenated and nutrient-rich fetal 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 cava or left hepatic vein. Deoxygenated blood returns from the fetus to the placenta via two umbilical arteries which originate at the right and left internal iliac arteries in the fetal pelvis. The two umbilical arteries divide into numerous radiating branches as the cord inserts in the placenta. Fetal and maternal bloods 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. (Moore , 2016).

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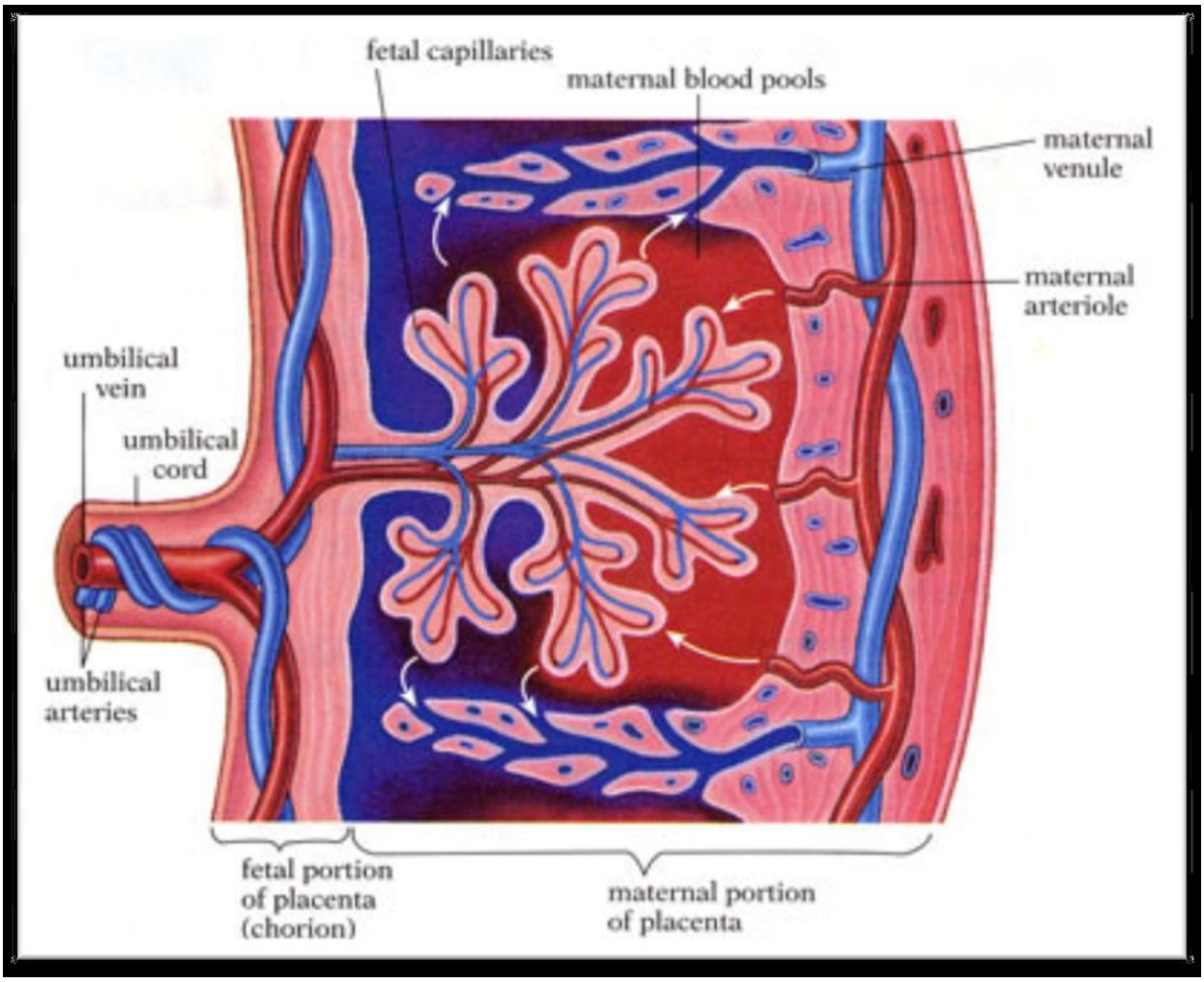

Figure 2-4: placental circulation: gas, nutrient, and waste exchanges between the mother and the fetus take place in the placenta, where fetal blood passes through capillaries alongside those containing maternal blood. (http://www.biog1445.org/demo/07/ovaryplacenta.html).

2.1.4: 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 a placenta which appears to extend

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into the lower uterine segment and is within 1-2 cm 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. (Devin 2005)

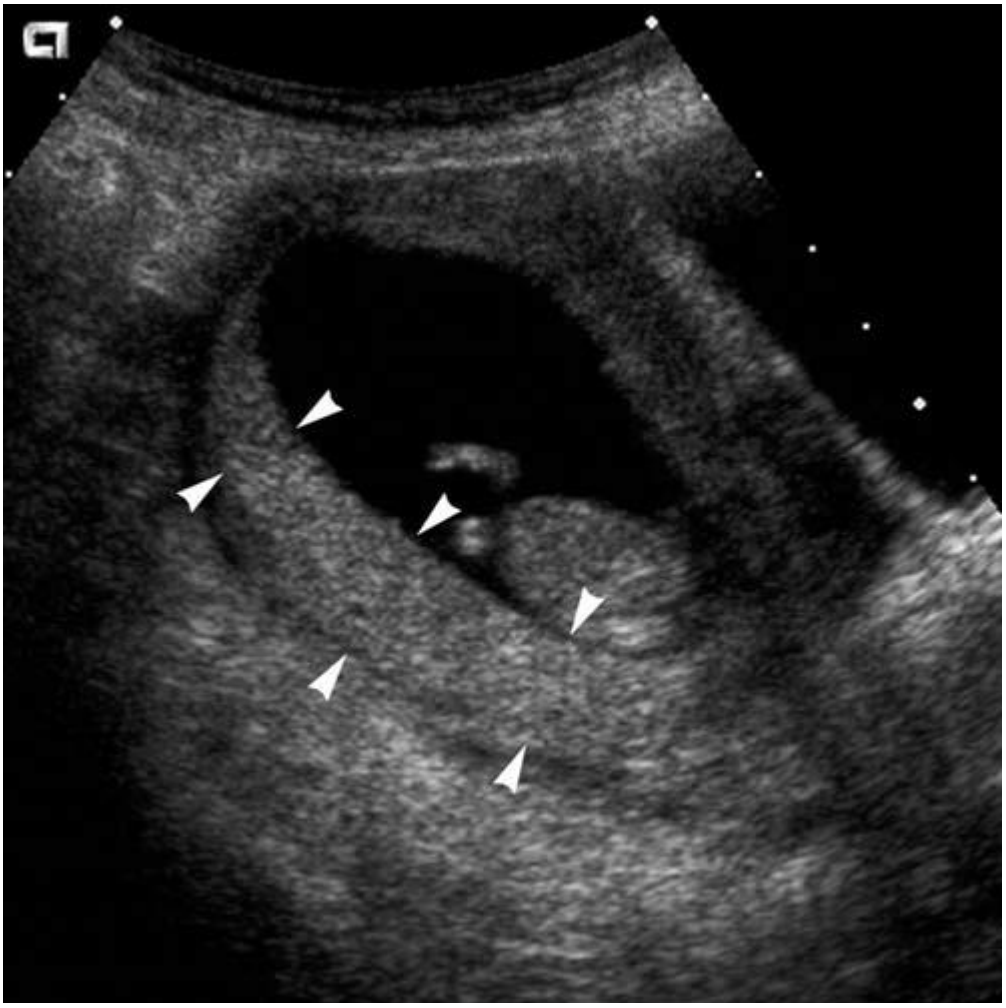

Fig 2.5. Normal Early Placenta Longitudinal TAS image of the uterus (bladder is empty) shows a normal anterior placenta (1) and a retroplacental FMC (2) (Devin 2005).

2-1-5 Placental Grading

Calcium deposition in the placenta is a normal process of placental aging or maturation which occurs at different rates in normal pregnancies. Sonographically, macroscopic areas of placental calcifications appear as hyperechoic densities in

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different areas of the placenta. Calcium is deposited primarily along the basal surface and placental septa. Macroscopic and sonographic evidence of placental calcification is not evident until the third trimester. Previously, investigators found it useful to assign placentas numerical grade (0 to 3) based on the degree of calcification however such grading schemes have proven to be of limited value in clinical practice in predicting fetal maturity, fetal well being, or perinatal outcome. These placentas show an irregular amniochorionic surface (chorionic plate) with calcification extending alon gthe cotyledenal division from the chorionic plate to the basal surface. The grade 3 placenta may also have larger areas of calcification that produce shadowing and the placental parenchyma may contain hypoechoic or anechoic areas**.** Grade 3 placentas are the most heavily calcified and are not seen before 36 weeks gestation in normal pregnancies.(Burwin Institute Notes).

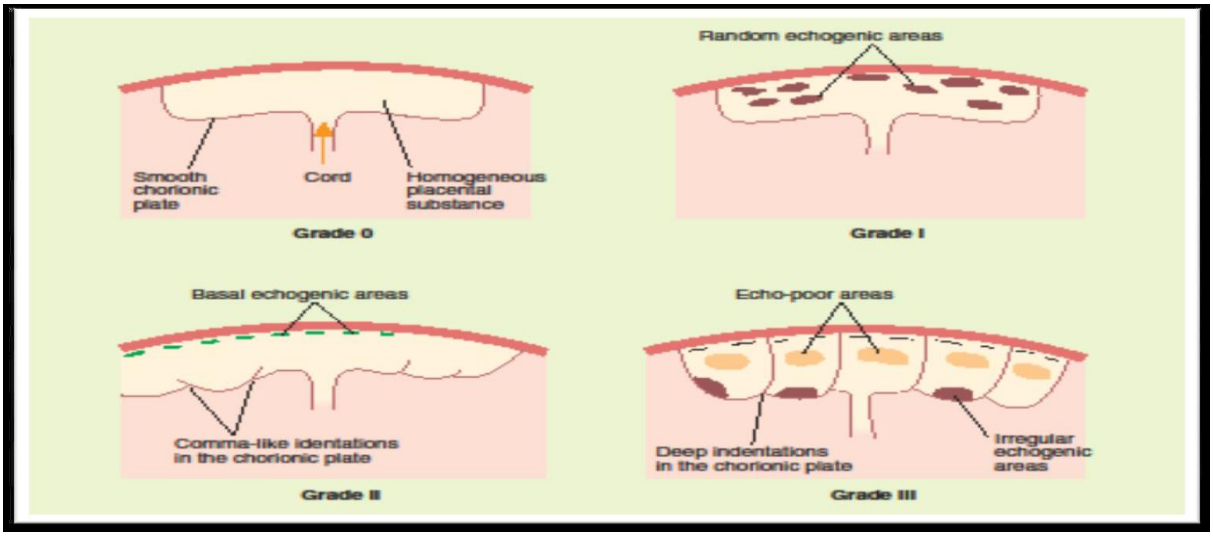

Fig 2-6: show the ultrasound appearance of placental grading(Chudleigh & Thilaganathan., 2004)

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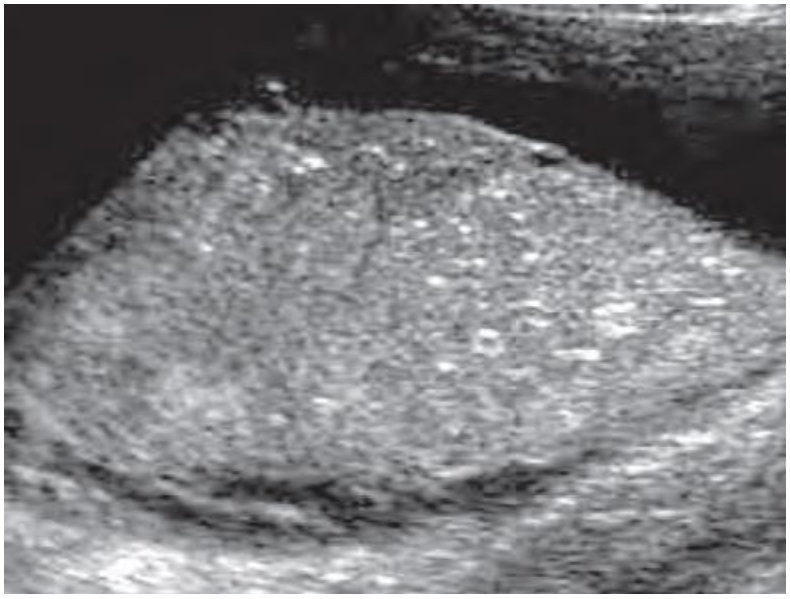

Fig:2-7 Note the increasing echogenicity in the placenta as it matures (Rumack et al 2011).

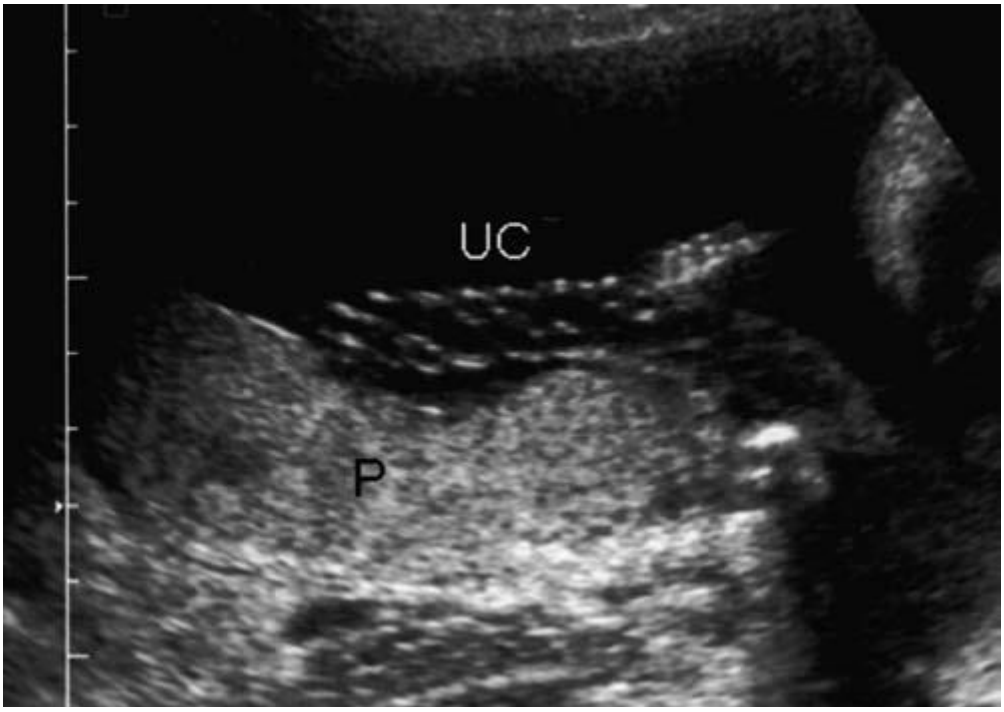

Fig:2-8 Normal placenta (*P*) at 17 weeks. The umbilical cord (*UC*) insertion into the placenta is noted in this image (penny-2011)

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2.1.6: Placental Size and Growth:

There is less emphasis nowadays in measurements of the placenta largely because the information is of limited diagnostic value. Thus, the placenta is not routinely measured. The most popular measurement is placental thickness (data on placental area, volume, and weight estimates have all been studied and reported in the literature). As a guideline, placental thickness should be measured if the placenta appears to be either thick or thin. Placental thickness measurements should be made near the mid portion or center of the placenta with one caliper placed at the amniochorionic surface (chorionic plate) and the second caliper placed at the basal surface perpendicular to the amniochorionic surface. The measurement should exclude retroplacental veins, myometrium, fibroids, and contractions of the uterus that might incorrectly increase the measurement. In a normal pregnancy, placental Thickness increases with gestational age. As a rule of thumb, the mean thickness of the placenta in millimeters is roughly equal to the gestational age in weeks (e.g. 20 weeks, mean placental thickness is 20 mm; 28 weeks, mean placental thickness is 28 mm; and 36 weeks, mean placental thickness is 36 mm). (Shaheen F 2003)

If the placenta thickness is greater than 4 cm (40 mm) before 24 weeks, an abnormality should be suspected. These abnormalities include ischemic-thrombotic damage, intraplacental hemorrhage, chorioangioma, and fetal hydrops.(Rumack-2011).

Representative image of the posterior placenta shows caliper placement for placental thickness measurement. One caliper is positioned on the amniotic surface of the placenta and the other is positioned at the boundary between the placentas!

Tissue and the hypoechoic basal vessels (Shaheen 2003).

False thickening of the placenta may be seen with placental abruption if the retroplacental hematoma has the same echogenicity (isoechoic) as the normal placental tissue. Colour Doppler may be helpful in distinguishing true placental

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thickening from pseudothickening. With true placental thickening, the normal intraplacental vascular network should be seen from the chorionic to basal surface; with abruption and a retroplacentl hematoma,colour will be seen in the placental tissue and be lacking in the hematoma.(Shaheen F 2003).

A placental thickness greater than 4 cm is considered abnormal at any gestational age. Less than 2.5 cm at or greater than 35 weeks is considered too thin. The four conditions most commonly associated with placental thickening are:

a) Diabetes mellitus, especially gestational diabetes.

b) Immune and no immune fetal hydrops.

c) Fetal infections (e.g. cytomegalovirus)

d) Chromosomal abnormalities, especially triploidy

Small or thin placentas are most commonly associated with maternal hypertensive disease, severe IUGR, and severe diabetes mellitus. (Rarely, a thin placenta may be due to a membranous placenta (placenta membranacea or diffusa) which is a thin, poorly functional placenta that covers the entire surface of the chorionic sac. The placenta may also appear unusually thin with severe polyhydramnios as it is stretched over a large surface area of the uterine wall. (Shaheen 2003).

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2.2: Physiology

In order to grow and to differentiate into the various tissues that form the placenta, the placenta must be able to metabolize raw materials from the maternal blood pumped into the intervillous spaces. The metabolism of proteinin the placenta is largely governed by the demands of fetal and placental growth. No other organ carries out the synthesis of such a diverse group of proteins for such a wide range of purposes. The vast quantities of structural proteins that will be incorporated into proliferating fetal and placental tissues must be derived from maternal sources. Little of the raw material in the massive flow from the mother, however, is in the precise forms required for the different stages of fetal and placental development. Hence, in addition to the placenta's prefabrication of specific proteins for its own purposes it must sort through the available supply, matching the quality and quantity of the material available to the current fetal demand. (Moore , 2016).

The production of hormonesto regulate the activities of pregnancy is one of the most interesting special functions of the placenta. It is the placenta that bears this responsibility and not the mother or the fetus. From the first days after fertilization, thecells of the trophoblast and their successors in the placenta manufacture a large variety of hormones. The first to be manufactured in appreciable amounts is human chorionicgonadotropin (hCG). As pregnancy proceeds, large amounts of progesterone are synthesized in the placenta. In addition to sustaining the necessary decidual reaction of pregnancy, this hormone serves as a raw material for the production of placentalestrogen which in turn act on many organs and tissues of both the mother and fetus. (Moore , 2016)

Large amounts of progesterone are produced during the first months of pregnancy by the corpus luteum but the placenta takes over this activity after the third month of pregnancy. The processes influenced by estrogen and progesterone include thesynthesis of protein and the metabolism of cholesterol, the functioning of

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specific organs such as the maternal uterus and breast and the regulation of many aspects of fetal development. Another hormone produced by the placenta is human chorionicsomatomammotropin (hCS) or human placental lactogen. HCS can be detected in maternal serum as early as the sixth week of pregnancy. It rises steadily during the first Functional Representation of the Placenta Featuring Fetal and Maternal Circulation. (Moore , 2016).

In the second trimesters with little variation. HCS has several important physiologic effects on the mother and is referred to as the "growth hormone" of the second half of pregnancy because it promotes good fetal growth by ensuring a good supply of energyto the mother. Maternal HCS serum measurements have been used as a test to measure placental function however it lacks sensitivity and specificity to be of clinical value (Devin D 2005).

Among the physiological processes in pregnancy that call for particular precise coordination are those concerned with protecting the embryo from immunological rejection by maternal tissue. One of the many mechanisms that seem to play a part inthis task is the non-specific suppression of lymphocytes, the cells that would normally mediate the rejection of a foreign tissue to the host tissue. Another highly specific immunological function of the placenta is to supply the fetus at the end of pregnancy with maternal antibodies of the type known as immunoglobulins. These antibodies summarize the mother's experience of and resistance to various infections and provide the newborn infant with a ready-made prophylaxis against infection until its own immune system can begin to function. (Devin D 2005).

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2.3: Pathology

2.3.1: Placental Infarcts:

Small placental infarcts are common and of no clinical significance. Large infarcts (e.g. greater than 10% of the placental volume) are most commonly associated with maternal hypertensive disease and may cause IUGR, fetal hypoxia and fetal demise. Fresh placental infarcts appear as non-specific anechoic spaces in the placenta and are undistinguishable from other anechoic placental lesions. Aging or healing infarcts appear as hyperechoic lesions (more echogenic than the surrounding placental tissue) and may become calcified. (Shaheen F 2003).

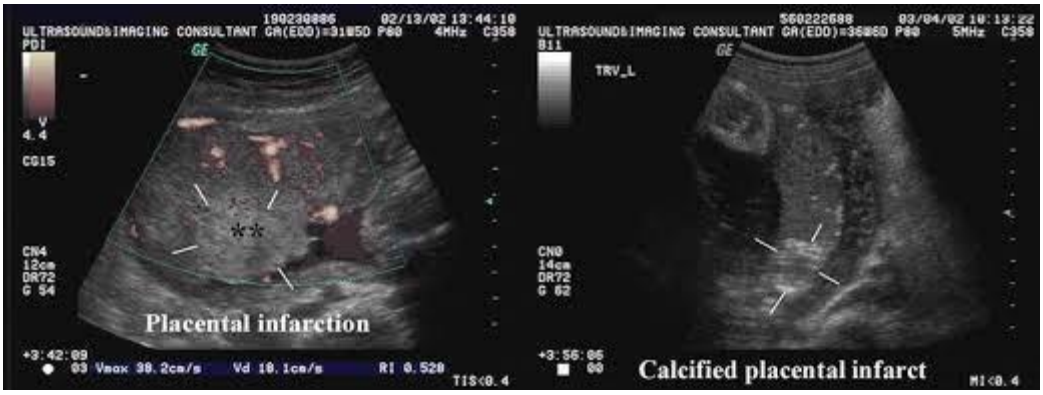

Fig 2-9: show Placental Infarcts

(http:://en.wikipen.ord.placenta image)

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2.3.2: fetal hydrops: (Fig. 2-10). (Rumack-2011).

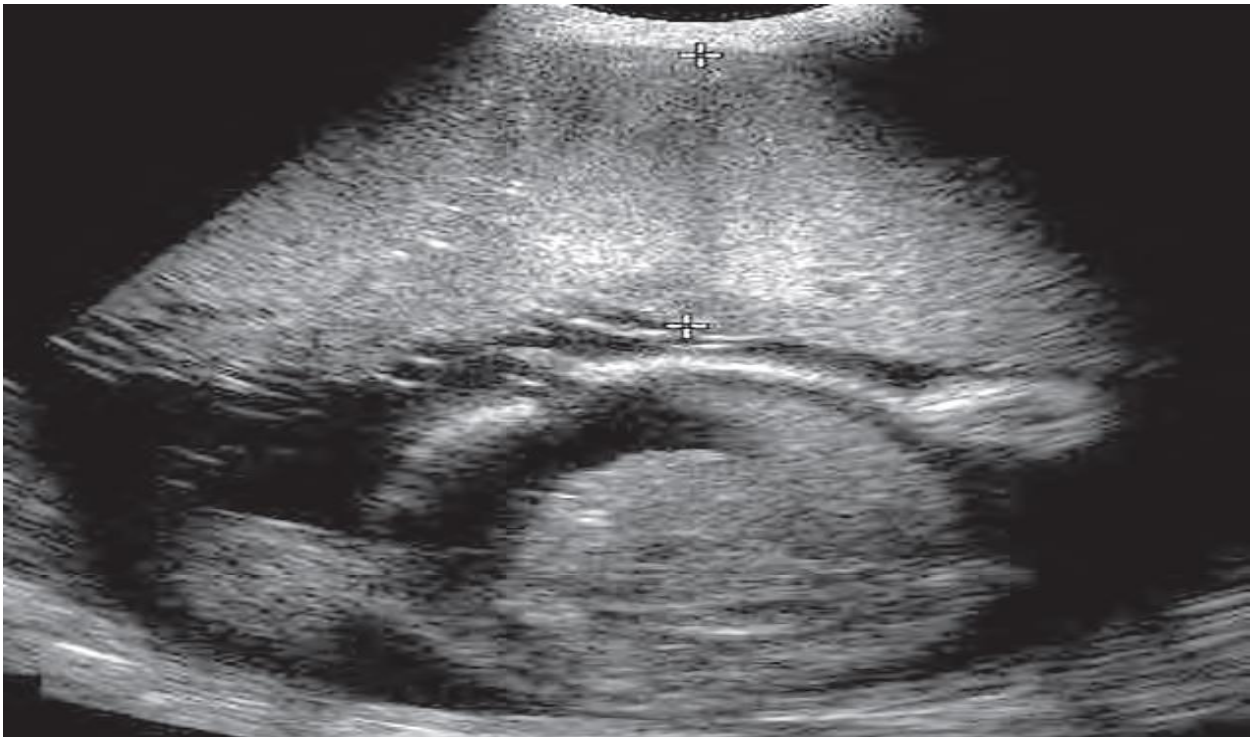

Fig:2-10 Thick placenta in fetal hydrops**.** Note the ascites *(* Rumack et al 2011)

2.3.3: Placental Tumours:

All primary and secondary tumours of the placenta are rare. The most common tumour of the placenta by far is chorioangioma. Other primary tumours of the placenta include teratoma and choriocarcinoma. Choriocarcinoma is most likely to develop secondary to hydatidiform mole. Melanoma is reported to be the most common tumour to metastasize to the placenta (Devin 2005).

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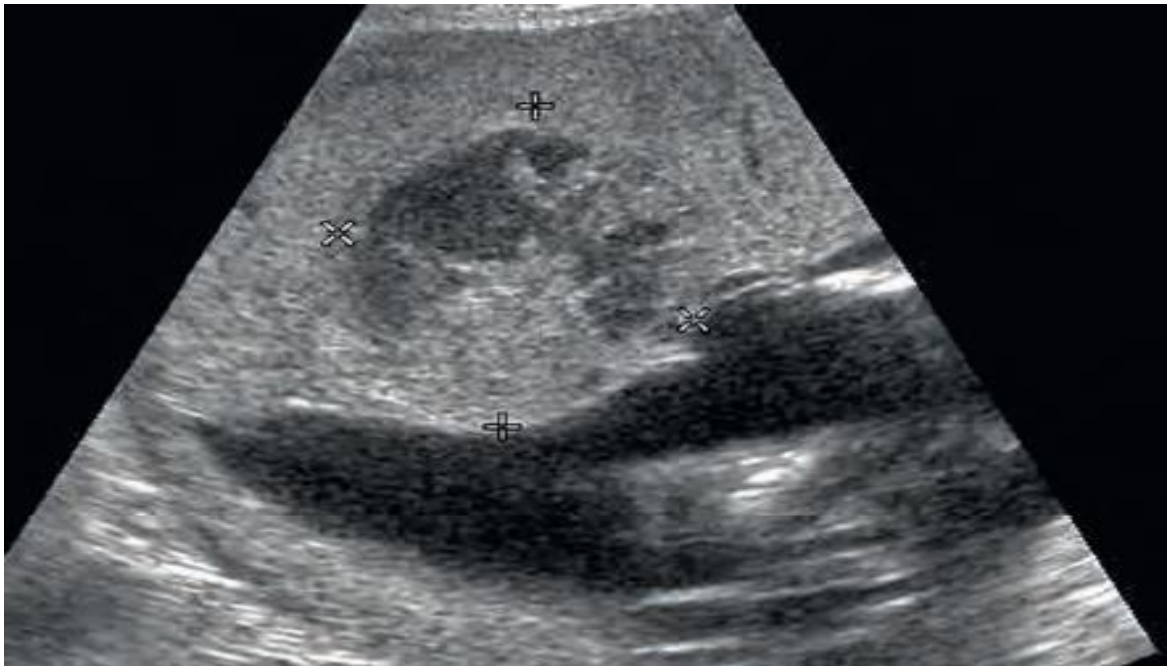

Fg:2-11Chorioangioma(Rumack -2011)

2.3.4: Hydatidiform Mole

a- Total Hydatidiform Mole It is abnormal pregnancy where all placental villi change to molar vesicles and fill uterine cavity while there is no embryo fetus nor umbilical cord Amnion is , however , found in some cases ,No capillary vessel is noted in the molar cyst which is covered by proliferated trophoblast ,Microscopically found molar cyst of diameter less than 2mm is called microscopic mole Trophoblast are scattered in the decidua and myometrium aer called syncytial endometritis ,Molar cysts may spread into blood vessel which is intravascular mole , and rarely metastasis appear in distant organ [Kurjak and Chervenak 2006], It is partial change placental villi into the mole . which is associated with embryo, fetus or fetal parts Fetal anomalies are common Capillary vessels are found in molar interstitium [Kurjak and Chevernak 2006]

b- Invasive Hydatidiform It is the invasion of molar cysts into myometrium with destruction and hemorrhage .Intravascular mole and placental polyp are excluded

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from the invasive mole .The lesion is formed either in total or partial mole usually afer the molar evacuation, although the invasive may develop before the termination, The microscopically confirmed where the trophoblast proliferate , hemorrhage and necrosis are found in the myometrium [Kurjak and Chervenak 2006].

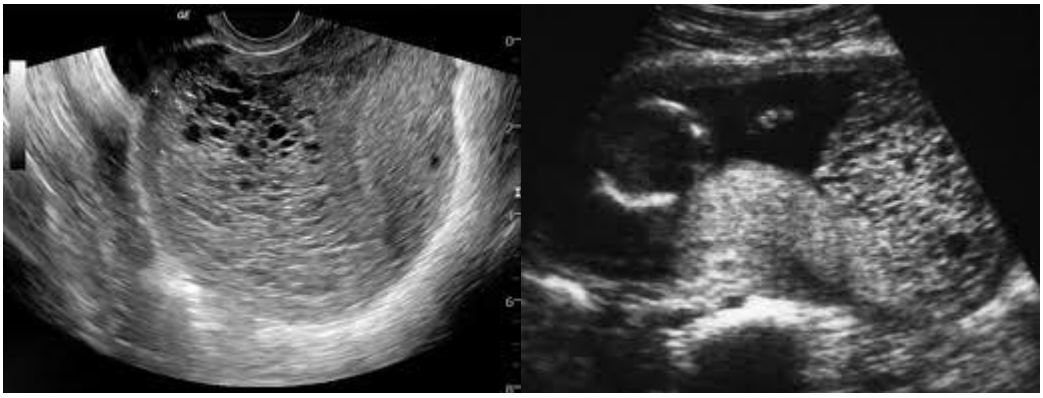

Fig 2-12: Invasive Hydatidiform
(http:://en.wikipen.ord.placenta image)

2.3.5: Abnormal Placental Attachment:

The normal placenta should attach to the decidua basalis and not invade the underlying myometrium. Abnormal placental attachment to the myometrium is a significant maternal risk. This condition varies in severity depending on the degree of invasiveness in the myometrium. Three grades are described based on the depth of penetration of placental tissue:

Placenta accreta: villi invade decidua but not the myometrium

Placenta increta: villi invade myometrium but not the serosa

Placenta percreta: villi invade myometrium and the serosa and can also invade local tissues like the bladder wall.

The true incidence of this condition is unknown and difficult to ascertain. The average incidence is reported to be about 1 in 7,000 pregnancies, with placenta

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accrete accounting for approximately 60% of cases. Most cases in the ultrasound literature are based on placenta accreta with very few cases describing the sonographic findings associated with placenta increta or percreta. Our discussion with therefore focus on theclinical and sonographic features of placenta accreta. (Devin D 2005).

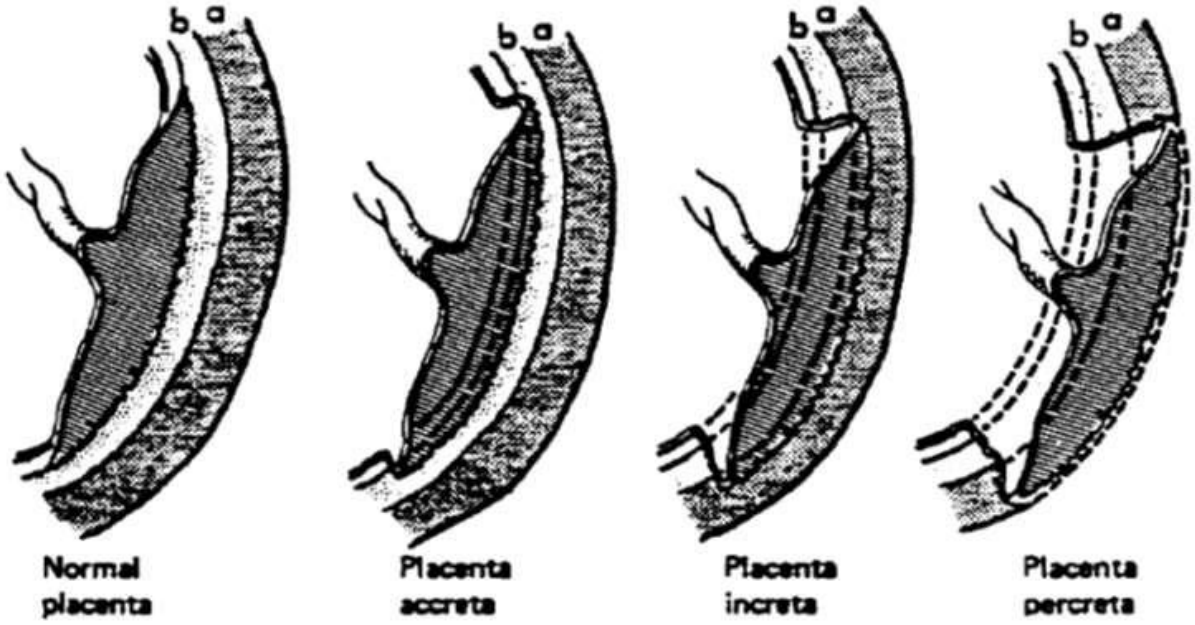

Fig: 2.13 abnormal placental attachments. (Devin 2005).

The most important predisposing risk factor for placenta accreta is previous uterine surgery resulting in focal damage to the endometrium and uterine scarring, most notably C-S delivery. Other significant risk factors include advanced maternal age,increasing parity, previous endometritis or history of Asherman's syndrome, and submucousmyomas.Patients are either asymptomatic or may present with antepartum bleeding. In one published series, 5 of 11 patients (45%) had elevated maternal serum alpha-fetoprotein. Placenta accreta is usually discovered at the time of delivery and may be associated with lack of normal progress during labor (Devin D 2005).

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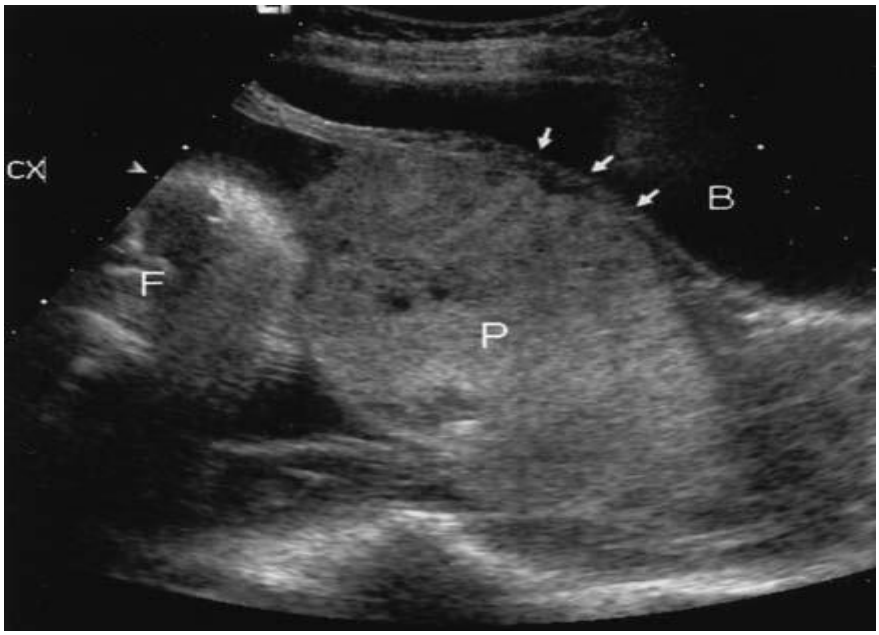

Fig:2-14 Placenta increta. Longitudinal image of a gravid patient with a history of two previous cesarean sections demonstrates a complete previa and the loss of the normal hypoechoic boundary (*arrows*) between the placenta (*P*) and the urinary bladder (*B*) (Penny 2011)

2.3.6: Placenta Previa:

Placenta previa describes a placenta that partially or completely covers the internal os. Three degrees of placenta previa are generally described :

Complete or Total Previa: The internal os is completely covered by the placenta. Complete placenta previa may be either symmetric or asymmetric. A symmetric placenta previa is indicated when the central portion of the placenta is over the os and equal portions of the placenta appears to be attached to the anterior and posterior walls of the lower uterine segment. With asymmetric, complete placenta previa, the placenta is predominantly anterior or posterior in relation to the internal os.(Devin D 2005).

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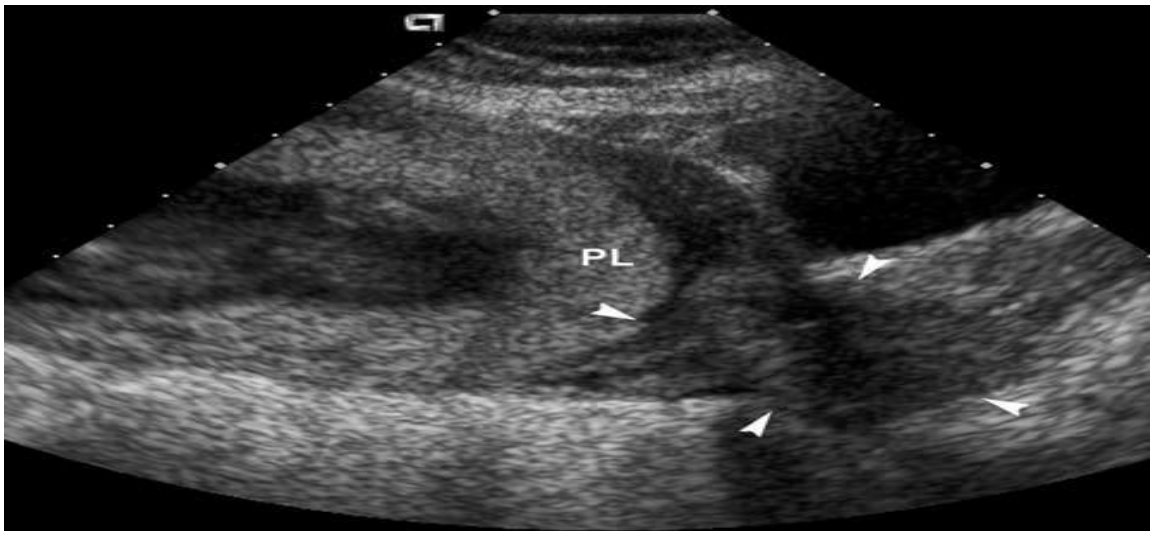

Fig 2-15:Complete placenta previa. Sagittal midline transabdominal view of the cervix (*arrowheads*) demonstrates the placenta (*PL*) completely covering the internal os. (Penny 2011)

2.3.6.2: Marginal Previa:

The internal os is only partially covered by placenta.

A) Midline TAS image with a partially distended bladder shows a posterior placenta that is overlying the area of the internal os. B) Midline EVS image shows the placenta covering the os by a distance of 0 mm. Follow up at 32 weeks showed complete resolution (Devin D 2005).

2.3.6.3:Low-Lying Placenta;

The placenta is close to the edge of the internal os but does not extend over it. Lowlying placentas generally convert to higher positions by 34 weeks gestation. The incidence of placenta previa at the time of delivery is reported to be about 1%. Three factors which increase the relative risk of placenta previa are advanced maternal age, parity, and smoking. Multiparous women are twice as likely to have placenta previa as women delivering for the first time. A possible reason for this association is endometrial scarring which occurs with increasing age or repeated pregnancies. The scarring is thought to cause inadequate placental blood supply, for which the placenta compensates by becoming thinner and occupying a greater

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surface area of the endometrium. A consequence of greater placental surface area attachment is an increased chance for encroachment over the internal os. The majority of patients with placenta previa present with painless vaginal bleeding near the end of the second trimester or early in the third trimester (antepartum hemorrhaging or APH) howeverplacenta previa may remain asymptomatic until the onset of labour. (Devin 2005).

The clinical course and management of placenta previa depends on several factors including the onset and severity of APH, the maturity of the fetus, and the degree of placenta previa.

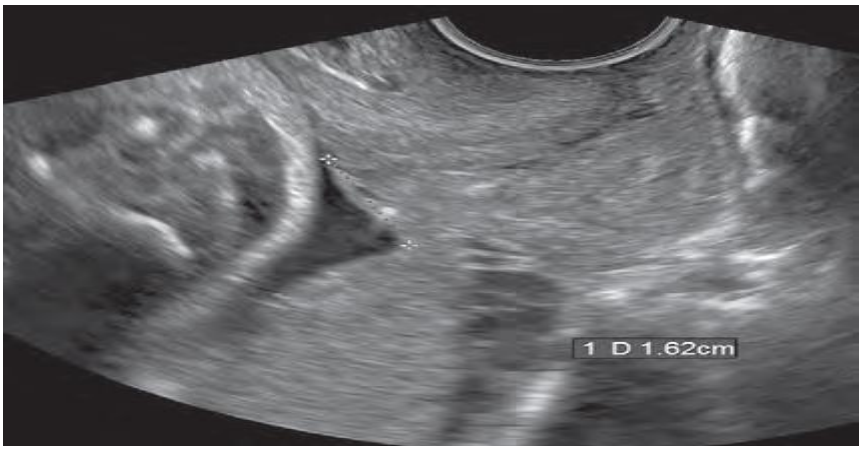

Fig: 2.16 low-lying posterior placenta The tip of the placenta is 1.6 cm from the internal os (Rumak-2011)

2-3-7: Placental Abruption

Placental abruption is acute separation of the placenta from the uterus prior to delivery of the fetus .The symptoms include, pain ,uterine tenderness and abdominal pain and it is usually accompanied with vaginal bleeding such. bleeding ,if excessive may cause maternal hypovolemia and shock , while severe forms of abruption result in diminish fetoplacental transfer and consequently may cause fetal death in uterus [Kurjak and Chervenak 2006].

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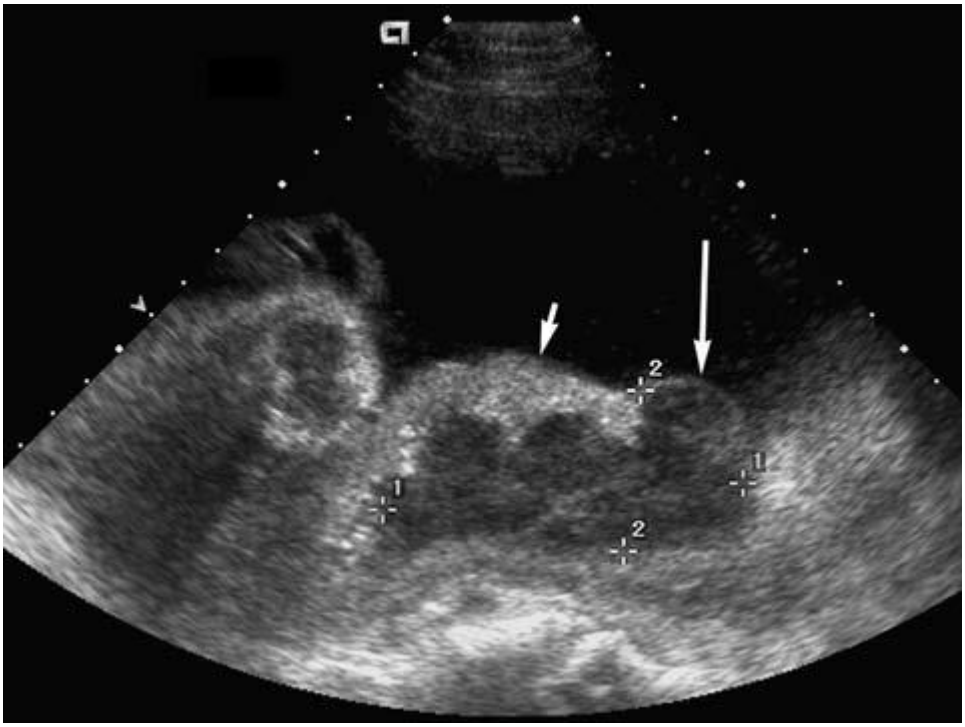

Fig:2-17 Placental abruption with retroplacental hematoma. There is a hypoechoic hematoma (*long arrow* and *calipers*) lifting the edge of the placenta (*shor*
(Penny-2011)

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2-4: **Role of Ultrasound**

Ultrasound is the preferred imaging modality for the diagnosis and monitoring of pelvic organs. Pelvic ultrasound can help to identify and evaluate a variety of urinary and reproductive system disorders in both sexes without even the minimal risks associated with xray exposure. Ultrasound imaging, formed by exposing part of the body to high-frequency sound waves to produce pictures of the inside of the body. Because ultrasound images are captured in real-time, they can show the structure and movement of the body's internal organs, as well as blood flowing through blood vessels. (Stewart C, Benjamin R – 1991).

Ultrasound scanners consist of a console containing a computer and electronics, a video display screen and a transducer that is used to scan the body and blood vessels. The transducer is a small hand-held device that resembles a microphone, attached to the scanner by a cord. The transducer sends out high frequency sound waves into the body and then listens for the returning echoes from the tissues in the body. The principles are similar to sonar used by boats and submarines. (Stewart C, Benjamin R – 1991)

In an ultrasound examination, a transducer both sends the sound waves and records the echoing waves. When the transducer is pressed against the skin, it directs small pulses of inaudible, high-frequency sound waves into the body. As the sound waves bounce off of internal organs, fluids and tissues, the sensitive microphone in the transducer records tiny changes in the sound's pitch and direction. These signature waves are instantly measured and displayed by a computer, which in turn creates a real-time picture on the monitor. One or more frames of the moving pictures are typically captured as still images. (Stewart C, Benjamin R – 1991).

Doppler ultrasound, a special application of ultrasound, measures the direction and speed of blood cells as they move through vessels. The movement of blood cells causes a change in pitch of the reflected sound waves (called the Doppler Effect).

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A computer collects and processes the sounds and creates graphs or color pictures that represent the flow of blood through the blood vessels.

Medical imaging uses frequencies that are much higher than 20 kHz; the range normally used is from 3 to 15 MHz. These frequencies do not occur in nature and it is only within the last 50 years that the technology has existed to both generate and detect this type of ultrasound wave in a practical way. (Barness E, Spicer D – 2004).

Placental Appearance

The placenta in the first and second trimesters is slightly more echogenic than the surrounding myometrium. The attachment site, or base of the placenta, should be clearly delineated from the underlying myometrium. The edges of the placenta usually have a small sinus, the marginal sinus of the placenta where intervillous blood drains into the maternal venous circulation. This structure should not be confused with placental separation. As the placenta matures, areas of echogenicity within the placenta are visualized. In cases of placental infarction, there may be hypoechoic lesions with echogenic borders. Placental lakes (venous lakes) occur in up to 5% of pregnancies5-9. They represent areas of intervillous spaces devoid of placental villous trees. They can be seen as hypoechoic structures in the placenta. Moving blood flow can be seen in these areas. They may have irregular shapes or a narrow, cleft like appearance and may change in appearance over time. (Rumak-2011)

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2-5: Previous Study

Hammad (2008) investigated the placental thickness in the third trimester, he showed linear relationship between Placental thickness in mm and gestational age in weeks .He found that Placental thickness increase with the fetal age. His conclusion the measurement of placental thickness is an important parameter for estimating gestationl age in normal singleton pregnancies along with other parameters.

Elamin (2012) study the relationship between placental thickness and fetal age in Sudanese women She found that the placental thickness increase with gestational age. She also found that the significant positive correlation between placental thickness and LMP, biparietal diameter (BPD),(AC) and (FL). Her study show linear regresstion between placental thickness and last (LMP),(BPD) ,(AC) and(FL).

Younis (2015) explain the relationship between the placental thickness in the(second and third trimester)and fetal weight by measurement the abdomen circumference (AC)and biparietal diameter (BPD),and the placental thickness and studies the correlation between them. He found there is positive significant correlation between placental thickness and fetal age .Also he found there is positive significant correlation between placental thickness and biparietal diameter (BPD) and abdomen circumference(AC) respectively .Also he found that the fetal weight increase with increase placental thickness .

Alhassan (2017) found that there was linear relationship between placenta thickness

and GA per week, placenta thickness and fetal weight respectively this mean that the placenta thickness more linearly associated with fetal weight than with gestational age. There is strong significant correlation between placenta thickness and estimation of fetal weight , FL,BPD ,HC,GA..

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Chapter Three

Materials and Method

3.1. study design:

This isdescriptive cros sectional study.

3.2. Area of the study:

The study will be conducted in khartoum state, in the ultrasound departments of Om osher health center

3.3. D uration of the study:

The study done from september 2019 to september 2020

3.4. Population of the study:

pregnant sudanese women in third trimester came to the ultrasound department for regular checkup in the area of the syudy , during the spacific duration of the study.

3.5 Sample size:

Sampling of study will be conducted in 100 pregnant women, selection of participation through simple random sampling, and then the data will be collected from the participants.

3.7. Inclusion criteria:

Singleton gestation, Viable fetus, Gestational age from 25 weeks and above, Normal amount of amniotic fluid.

3.8. Exclusion criteria:

Diabets mellitas, Multiple pregnancy, Hypertension of any etiology and Anomalous fetus.

3.9. The study variables:

The study of population will be assessed against the following variables are:

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Maternal age, fetal age, Gravidity, Placenta thickness, Fetal weight, Femer length, Biprital diameter and abdominal circumferance

3.10. Data collection and Instrumentation:

An ultrasound machine (Mindray-6600 with probe 3.5 MHz ,ultrasound imaging system with a B mode capabilities is used .The transducer is a phased-array 3.5 MHZ and ultrasound gel is applied to the transducer to prevent any attenuation or artifact, and thermal paper printer was used. The data collection sheet is used to collect the data and to number the patient.

3.11. The method of data analysis used in the study:

The data will be analyzed by using SPSS(statistical package for social science).

3.12. Data presentation:

Data presented by tables and figures.

3.13. Ethical considerations:

No part of this study relies on data which normaly be collected from routine scaning. All patients will informed, that the result of examination will form part of research project. No patient identification or individual patient detail will bublished, and all specific information relating to patient's identities will be protected in the same way.

3.13.ultrasound technique:

Patients will be scanned without previous preparation only short orientation and aware of the nature of the study and had to willingly, provide informed consent before entering the study. A scanner with a carrier frequency of 3.5 MHZ and color Doppler, transabdominal (TA) curve linear transducer will be used. The angle of insonation will be kept at 55 degree in all cases. Patients are imaged in the supine position with head of bed elevated 30 degree, and a coupling medium (e.g., gel) is

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applied to the transducer to reduce the interference that may be introduced by air between the transducer and the skin.

TAS: Performed by placing the transducer in contact with the skin just above the symphysis pubis, scans are perform in the sagittal and transverse planes from anterior approach. Sonographic measurement to get the placental thickness is measured trans abdominaly by placing the ultasound transducer perpendiculary to the plane of the placenta, in the area of the cord insertion, using the elliptical calipers of the scanner,measuirng from the outer to outer borders of the placenta. Other fetal anthropometric parameters which include bi-parietal diameter and femur length will be measured. The landmark for measuring the BPD, FL and AC include the followi:BPD: Is the it is measure in aplane in which the thalami and cavum septum pellucidum should be identified as land marks,measurement are made from the outerside of near skull to the innerside of the distal skull echoes. FL:femur length is obtained by taking measurement along an axis that shows both the round ,echopenic,cartilaginous femoral head and femoral condyles using elliptical calipers.AC is measured in transverse section through the upper abdomen which should demonstrate the following fetal landmark: fetal stomach, umblical vein, portal sinus and the calipers should be in th skin surface. (www.sciencedirect.com).

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Chapter Four
Results

Table (4.1)Descriptive statistics for study variables:

	N	Minimum	Maximum	Mean	Std. Deviation
Maternal age (years)	100	15	43	29.20	6.275
Gestation age (weeks)	100	25	41	32.38	4.216
Placenta thickness (mm)	100	24.8	50.9	32.116	5.2632
FL (mm)	100	45	77	61.93	7.757
AC (mm)	100	22.5	37.7	30.676	3.8779
BPD (mm)	100	34	95	79.37	9.508
Fetal Weight (g)	100	490	4127	1994.13	962.350

Table (4.2) Model coefficients forplacenta thickness to gestational age:

	B	Std. Error	t	Sig.
(Constant)	10.658	1.411	7.556	0.000
Placenta thickness (mm)	0.676	0.043	15.603	0.000

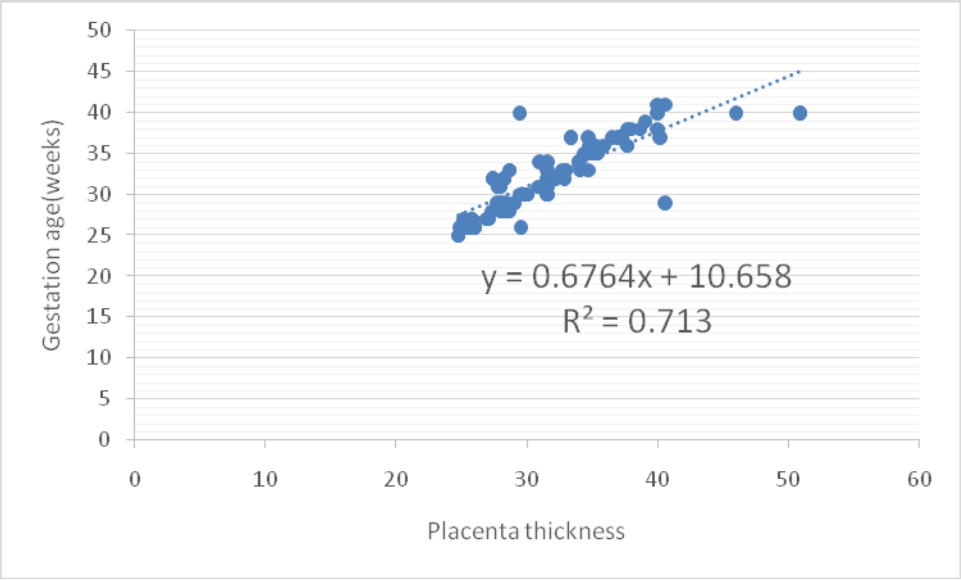

Figure (4.1) the linear relationships between gestational age and placenta thickness

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Table (4.3) Model coefficients for placenta thickness to FL:

	B	Std. Error	t	Sig.
(Constant)	22.761	2.720	8.369	0.000
Placenta thickness (mm)	1.220	.084	14.593	0.000

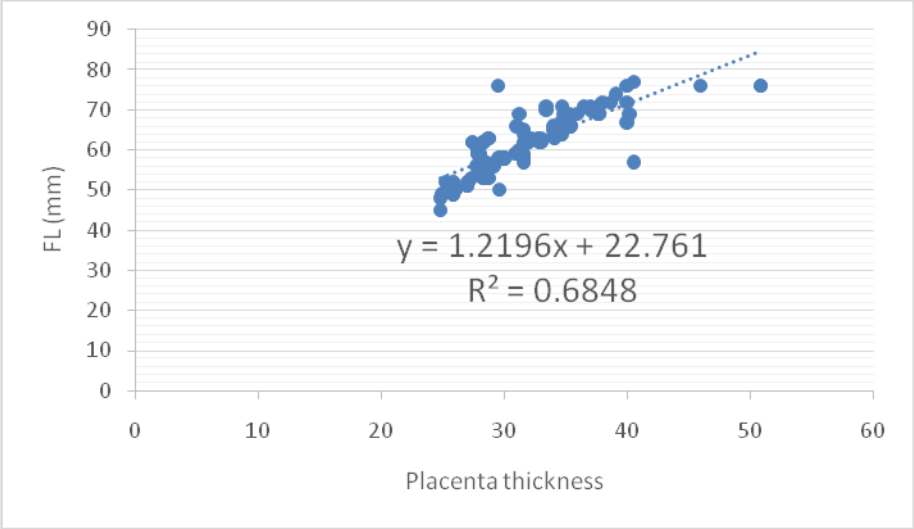

Figure (4.2) the linear relationships between FL and placenta thickness

Table (4.4) Model coefficients for placenta thickness to AC:

	B	Std. Error	t	Sig.
(Constant)	13.340	1.648	8.093	0.000
Placenta thickness (mm)	.540	.051	10.656	0.000

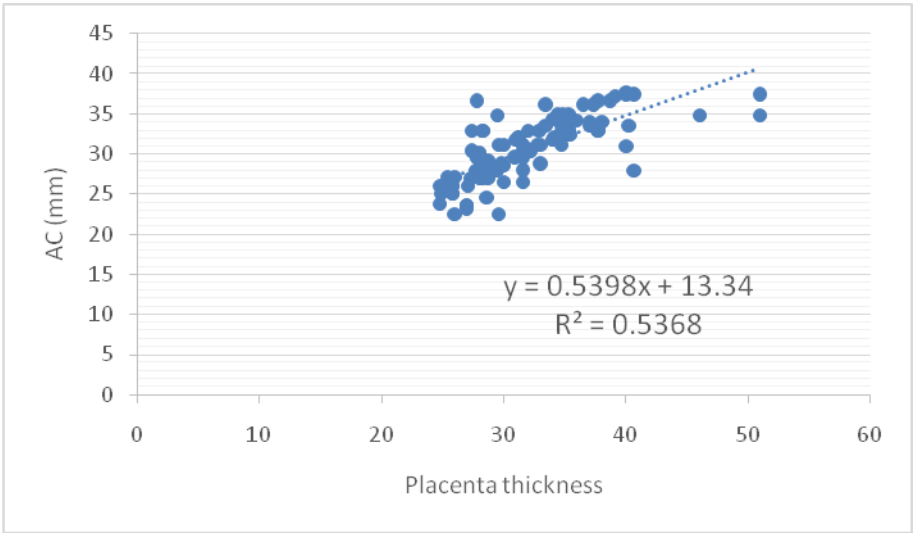

Figure (4.3) the linear relationships between AC and placenta thickness

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Table (4.5) Model coefficients for placenta thickness to BPD:

	B	Std. Error	t	Sig.
(Constant)	37.982	4.161	9.128	0.000
Placenta thickness (mm)	1.289	.128	10.078	0.000

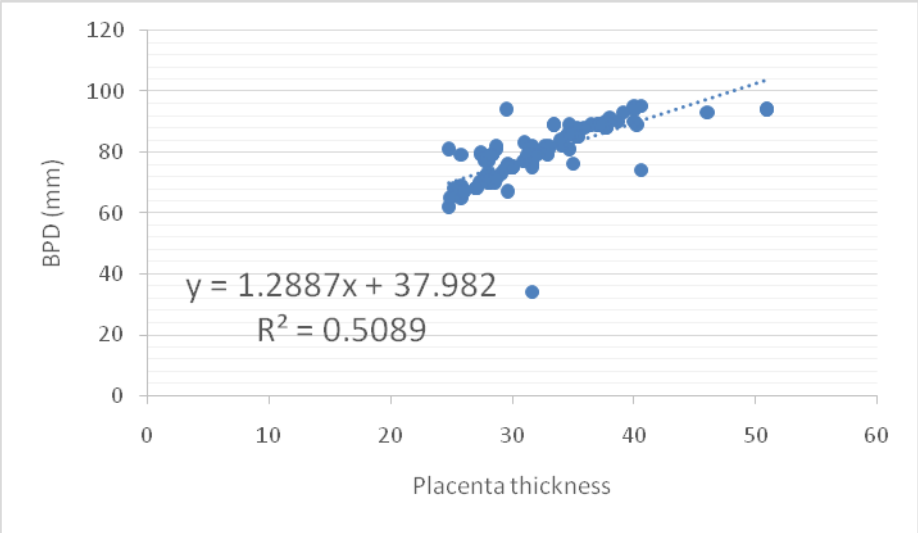

Figure (4.4) the linear relationships between BPD and placenta thickness

Table (4.6) Model coefficients for placenta thickness to fetal age:

	B	Std. Error	t	Sig.
(Constant)	-2634.910	369.802	-7.125	0.000
Placenta thickness (mm)	144.135	11.364	12.683	0.000

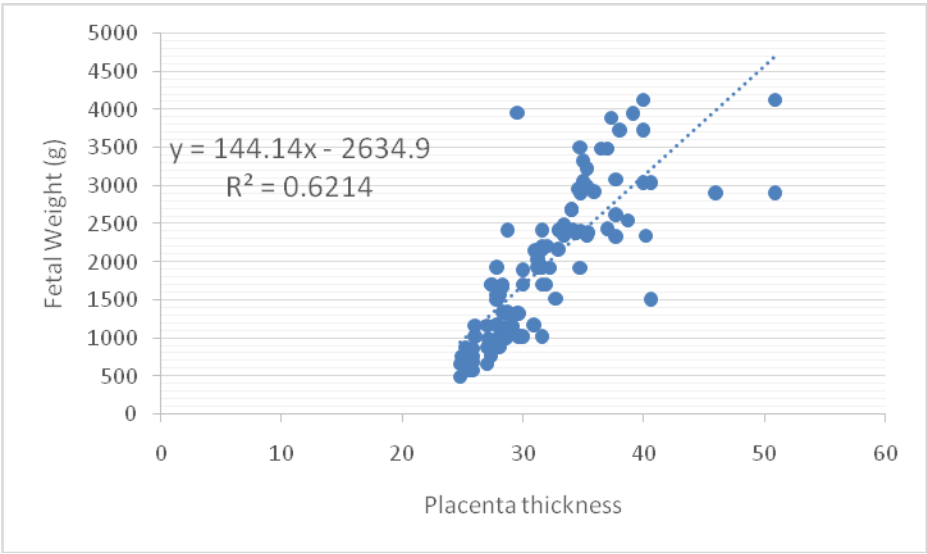

Figure (4.5) the linear relationships between fetal weight and placenta thickness

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Table (4.7) Model coefficients for gestation age to fetal weight:

	B	Std. Error	t	Sig.
(Constant)	-4778.093-	301.640	-15.840-	0.000
Gestation age (weeks)	209.148	9.238	22.639	0.000

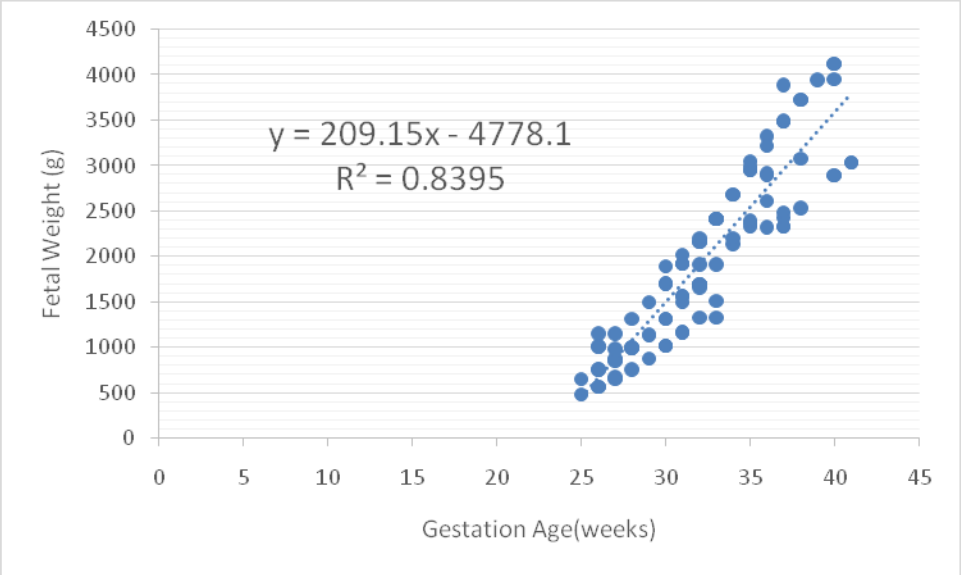

Figure (4.6) the linear relationships between fetal weight and gestational age

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Chapter Five

Discussion, Conclusion and Recommendations

5.1 Discussion:

A sample of (100) pregnant of third trimester, aged from 15 to 43with mean(29.20±6.275) years, while their gestational age was 25-41 with mean (32.38±4.216) weeks,(table 4.1).

Which found that the placenta thickness was measured (24.8-50.9mm) with mean 32.116±5.26mm, (45-77mm) with mean 61.93±7.76mm of FL,(22.5-37.7mm) with mean 30.68±3.88mm of AC, (34-95mm) with mean 79.37±9.51mm of BPD, while the fetal weight was measured (490-4127g) with mean 1994.13±962.35g.

The study found that gestational age is significantly increases with placenta thickness(R^2 = 0.713), (figure 4.1),since (P-values < 0.05) (table 4.2) which indicate a statistically significant relationship between gestational age and placenta thickness, that gestational age increases as placenta thickness increases. This result was seem to close to studies done by Hammad (2008): showed linear relationship between Placental thickness in mm and gestational age in weeks, which the Placental thickness increase with the fetal age and Elamin (2012): found that the placental thickness increase with gestational age, that the significant positive correlation between placental thickness and gestational age.

The study found that FL is significantly increases with placenta thickness (R^2 = 0.685), (figure 4.2),since (P-values < 0.05) (table 4.3) which indicate a statistically significant relationship between FLand placenta thickness, that FL increases as placenta thickness increases. This result was seem close to the studies done by Elamin (2012): found that the placental thickness increase with gestational age, that the significant positive correlation between placental thickness and FL, and Alhassan (2017): there is strong significant correlation between placenta thickness and FL.

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The study found that AC is significantly increases with placenta thickness (R^2 = 0.537), (figure 4.3),since (P-values < 0.05) (table 4.4) which indicate a statistically significant relationship between AC and placenta thickness, that AC increases as placenta thickness increases. This result was seem to close to studies done by Elamin (2012): found that the placental thickness increase with AC, that the significant positive correlation between placental thickness and AC, and Younis (2015): found there is positive significant correlation between placental thickness and abdomen circumference(AC).

The study found that BPD is significantly increases with placenta thickness (R^2 = 0.509), (figure 4.4),since (P-values < 0.05) (table 4.5) which indicate a statistically significant relationship between BPD and placenta thickness, that BPD increases as placenta thickness increases. This result was seem to close to studies done by Elamin (2012): found that the placental thickness increase with gestational age, that the significant positive correlation between placental thickness and BPD, Younis (2015): found there is positive significant correlation between placental thickness and bi parietal diameter (BPD), and Alhassan (2017): there is strong significant correlation between placenta thickness and BPD.

The study found that fetal weight is significantly increases with placenta thickness (R^2 = 0.621), (figure 4.5),since (P-values < 0.05) (table 4.6) which indicate a statistically significant relationship between fetal weight and placenta thickness, that fetal weight increases as placenta thickness increases. This result was seem to close to study done by Younis (2015): found that the fetal weight increase with increase placental thickness.

The study found that fetal weight is significantly increases with gestational age(R^2 = 0.84), (figure 4.5),since (P-values < 0.05) (table 4.6) which indicate a statistically significant relationship between fetal weight and gestational age, that fetal weight increases as gestational age increases. This result was seem close to the study done

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by Alhassan (2017): the study found that there was relation between GA per weeks and fetal weight per Kg (R^2 =0.896).

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5.2 Conclusion

The mean placental thickness among Sudanese pregnant of third trimester is 932.116±5.26mm, FL is 61.93±7.76mm, and AC is 30.68±3.88mm, BPD 79.37±9.51mm of BPD, while the mean fetal weight is 1994.13±962.35g.

The gestational age is significantly increases with placenta thickness ($R^2 = 0.713$), FL is significantly increases with placenta thickness ($R^2 = 0.685$), AC is significantly increases with placenta thickness ($R^2 = 0.537$),BPD is significantly increases with placenta thickness ($R^2 = 0.509$), as well as fetal weight is significantly increases with placenta thickness ($R^2 = 0.621$), since fetal weight is significantly increases with gestational age ($R^2 = 0.84$).

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5.3 Recommendations

It is recommended another research that follows the fetal weight by placental thickness measuring and fetal weights the same fetus in first and second trimester and after delivery, this study is limited and it can be as a guide line for further studies, for further studies to correlate the blood supply of placenta with fetal weight using Doppler Ultrasound.

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Appendices

SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY
Collage of Graduate studies

Data Collection Sheet

Study of association of the placenta thickness and estimated fetal weight in Pregnant women During Third Trimesters in Khartoum

Patient Number(……)

Date:.....\.....\2019

1-Patient age: (……) Years.

2-gravidity.

3- Gestational Age :(…….……) weeks. BPD= (……...….mm), FL= (.....mm).

mm (…..……)AC=

4-placenta thickness (.... ….)mm

5-fetal weight(kg).

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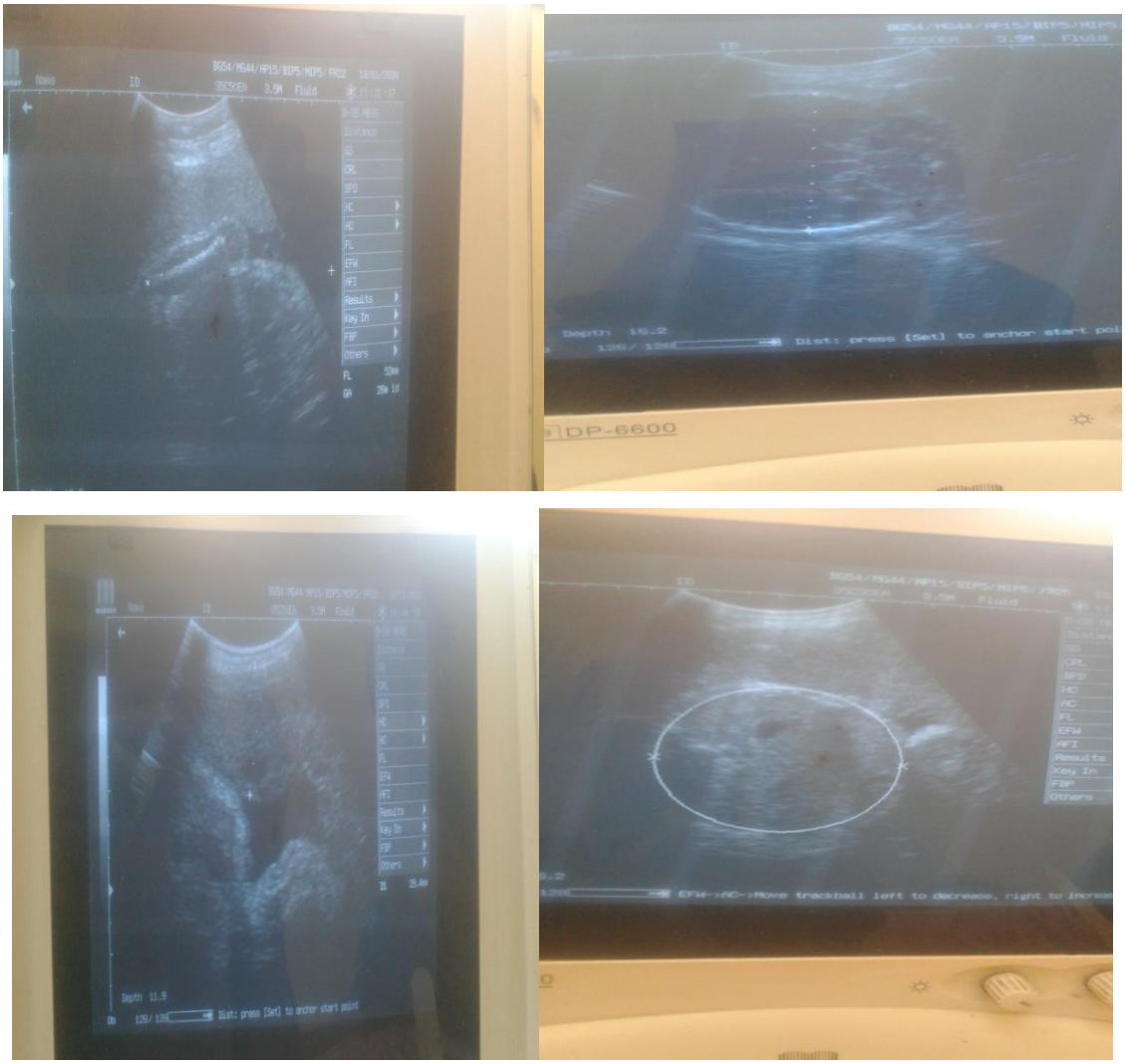

Image 1 :Transabdominal image for 36 years pregnant women placenta thickness= 273 mm, gestitational age= 28 week 5days, BPD= 71 mm, FL=54.48 mm

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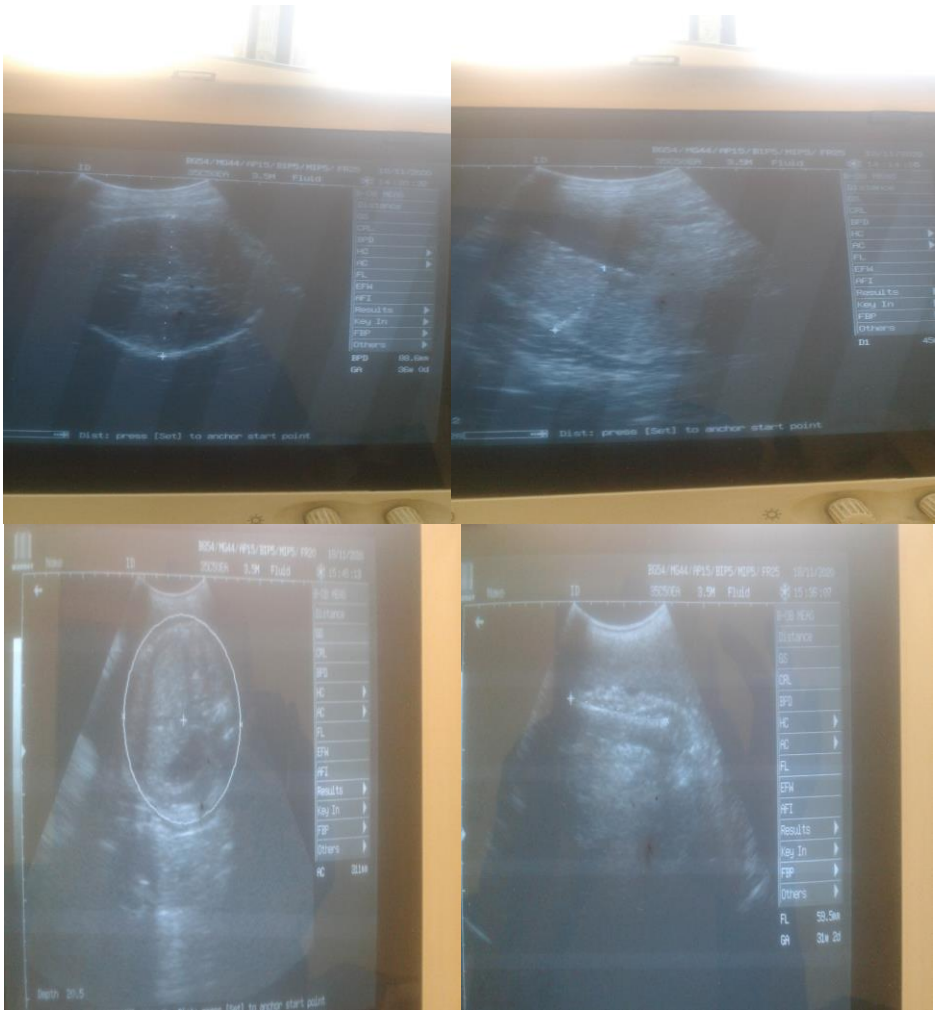

Image 2 :Transabdominal image for 25 years pregnant women placenta thickness= 273 mm, gestitational age= 36 week 5days, BPD= 90.60 mm, FL=69 mm

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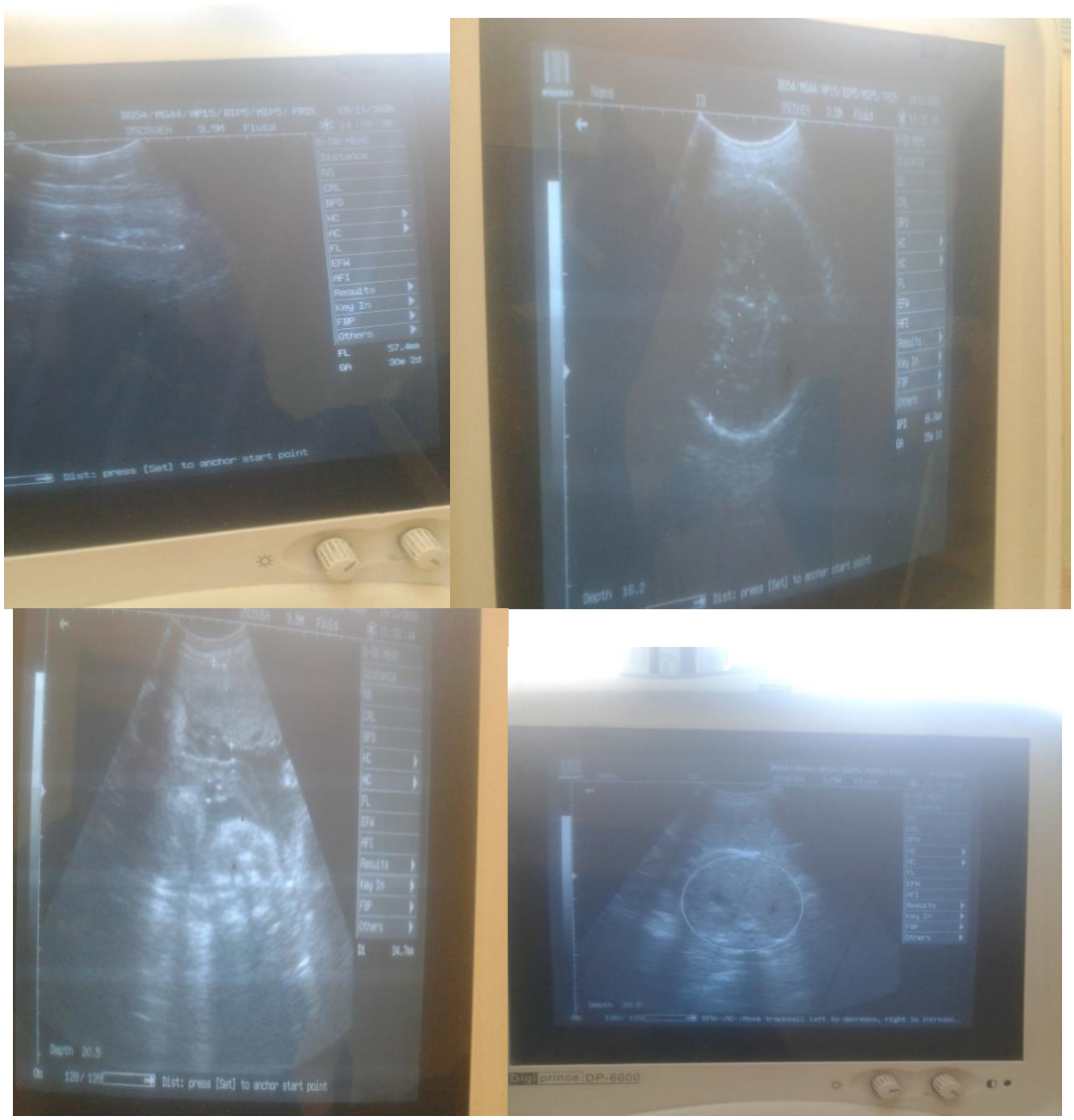

Image 3 :Trans abdominal image for 30 years pregnant women placenta thickness= 278.52 mm, gestitational age= 31 week 6 days, BPD= 78.52 mm, FL=59.32 mm

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