PLACENTAL THICKNESS-A SONOGRAPHIC PARAMETER FOR ESTIMATION OF GESTATIONAL AGE

DISSERTATION SUBMITTED IN FULFILLMENT OF THE REGULATIONS FOR THE AWARD OF

M.D.OBSTETRICS AND GYNAECOLOGY

DIVISION OF OBSTETRICS AND GYNAECOLOGY

PSG INSTITUTE OF MEDICAL SCIENCES & RESEARCH

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY

GUINDY, CHENNAI, TAMILNADU, INDIA

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GUIDE

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CERTIFICATE

This to certify that the thesis entitled **PLACENTAL THICKNESS-A SONOGRAPHIC PARAMETER FOR ESTIMATION OF GESTATIONAL AGE** is a bonafide work of Dr.B.Meenambiga done under my direct guidance and supervision in the department of Obstetrics & Gynaecology, PSG Institute of Medical Science & Research, Coimbatore in fulfillment of the regulations of Tamilnadu Dr.MGR Medical University for the award of MD degree in Obstetrics & Gynaecology

Guide HOD

Principal

DECLARATION

I hereby declare that this dissertation entitled **PLACENTAL THICKNESS-A SONOGRAPHIC PARAMETER FOR ESTIMATION OF GESTATIONAL AGE** was prepared by me under the direct guidance and supervision of Prof. Dr. T.V.Chitra MD, DGO, DNB.PSG Institute of Medical Sciences and Research, Coimbatore.

The dissertation is submitted to the Tamilnadu Dr.MGR Medical University in fulfillment of the University regulations for the award of MD degree in Obstetrics & Gynaecology. This dissertation has not been submitted for the award of any other Degree or Diploma.

Dr.B.Meenambiga

ACKNOWLEDGEMENT

No academic work is single handedly accomplished. This work is no exception words fail me in expressing my heart felt and humble gratitude to my guide **Prof. Dr.T.V.Chitra,** Unit chief, department of Obstetrics & Gynaecology, PSG Institute of Medical Sciences & Research for guidance and encouragement all along in completing my study. I acknowledge the kind and willing cooperation extended to me by **Prof. Dr.Seetha Panicker,** HOD, department of Obstetrics & Gynaecology, PSG Institute of Medical Sciences & Research.

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Above all my prayers to Lord who is with me during my tough times

CONTENTS

INTRODUCTION[1]

One of the commonest problems that an obstetrician faces frequently is estimation of fetal maturity. An accurate establishment of expected date of delivery is fundamental to the management of high risk pregnancies,

Proper assignment of expected date of delivery is necessary to obtain and appropriately interpret laboratory tests, to plan and execute therapeutic maneuvers and to determine the optional management in certain difficult situations like intrauterine growth restriction, gestational diabetes and Rh disease. The elements involved in the clinical estimation of gestational age are the characteristics and the time of occurrence of the LMP, the findings of the initial pelvic examination and the date on which the fetal heart tones are heard.

The patient's menstrual history is considered adequate for the purpose of establishing EDD, only if LMP was normal in duration, amount of flow, if prior menstrual periods came at regular intervals and if the patient did not use oral contraceptives with in 3months of a last period.

Unfortunately, approximately, 30% of patients do not fulfill these criteria, making estimation of EDD based on LMP unreliable.

In a study at Mc Gill University it was shown that LMP estimates were particularly inaccurate in patients with preterm and post term pregnancies. Clinical parameters which are widely accepted for estimation of maturity are gestational age and the weight of the fetus.

Next comes positive urine pregnancy tests for establishing EDD. The sensitivity of the available data over the counter pregnancy tests allow the diagnosis of the pregnancy at 4-5 post menstrual weeks. Thus if the patient has a positive pregnancy test after 4-5weeks of amenorrhea, the patient dates become firmly established.

CLINICAL DATING

Average duration of pregnancy is 266 days from conception and 280 days from LMP in women with 28 days cycle. The estimation of gestational age by measuring the uterine size of the pregnant women is not 100% accurate.

Naegele’s Rule

To add 7 days to the first day of LMP and count back 3 months

McDonald’s Rule

Height of fundus measured by a flexible tape and duration of pregnancy is calculated from

Ht of fundus (cms) x 2/7 = duration of pregnancy in lunar months

Ht of fundus (cms) x 8/7 = duration of pregnancy in weeks

Date of Quickening

If this can be ascertained definitely, 22weeks should be added to the date of quickening in multigravida and 20weeks in primigravida which gives probable date of confinement.

Abdominal Girth Measurement

The girth is measured at every visit from 30weeks onwards. At 30 weeks, it is 30inches and at 40weeks it is 40inches.

Symphysio Abdominal Fundal Height

Between 18 and 30weeks the uterine fundal heights in centimeters coincide with weeks of gestation. If it is more than 2-3cms from the expected height in appropriate fetal growth may be suspected. But this method will identify only 40% of SGA fetus.

X-ray Estimation of the Ossification Centre

At 37weeks ossification centre at lower end of femur is visible. At 40weeks, ossification centre of upper tibia and lower end of femur are visible.

But assessment of uterine size is made unreliable by many variables like

- Maternal obesity
- Position of uterus
- Multiple gestations
- Amount of amniotic fluid
- Observer experience
- Fetal growth disorders

Studies have shown that physicians measurement tend to under estimate the gestation age and have a preference for even numbers. In patients with unreliable menstrual history, estimation of the EDD by measuring uterine size is useful only if it concurs with the estimation by ultrasound examination.

Presently it appears the most effective way to date pregnancy is the use of ultrasound. Even in a patient with reliable clinical criteria pointing to a given EDD, should have a real time USG examination for confirmation. Several sonagraphic derived parameters can be used to date pregnancy like,

FIRST TRIMESTER[2,3]

- G S - 5weeks
- GS + Yolk Sac - 5.5weeks
- GS + Yolk Sac + Embryo - 6weeks

Estimation by measuring gestational sac and crown rump length

SECOND TRIMESTER onwards

- Biparietal diameter
- Abdominal circumference
- Head circumference
- Femur length

Age in weeks corresponding to each measurement is averaged, and the mean is the gestational age of the fetus. But out of this none is accurate in the third trimester.

Accuracy in[3,6]

- 1st trimester ±3days
- 2nd trimester ± 1 or 2 weeks
- 3rd trimester ± 2 to 3 weeks

So other USG parameters like

- Placental thickness
- Renal length
- Foot length
- Clavicle length

Were used to assess the GA.So this study was under taken to estimate the placental thickness in all gestational ages and to determine the reliability of placental thickness in estimating the gestational age

AIM OF THE STUDY

To evaluate the Placental thickness as a Sonographic parameter for estimating the Gestational age of fetus.

OBJECTIVES OF THE STUDY

1. To find out if a correlation exits between the placental thickness and maternal age and parity and menstrual age.
2. To identify the differences in ultrasonographic placental thickness with advancing gestation based on implantation site.

REVIEW OF LITERATURE

The placenta is a fetal organ with important metabolic endocrine and immunological functions. Placental formation begins in the later half of second month of pregnancy and is usually completed by 4^{th} month. It reaches its maximum growth at term.

Until recently the fetoplacental unit could only be assessed clinically and biochemically. Now sonography has provided a safe and non invasive means to evaluate fetus and placenta. Besides several fetal parameters like CRL, BPD, HC, AC, FL, PLACENTAL THICKNESS, measured either at the level of umbilical cord insertion or at mid placental position can be used as a new parameter for estimating gestational age.

THE PLACENTA

Embryogenesis[9-12]

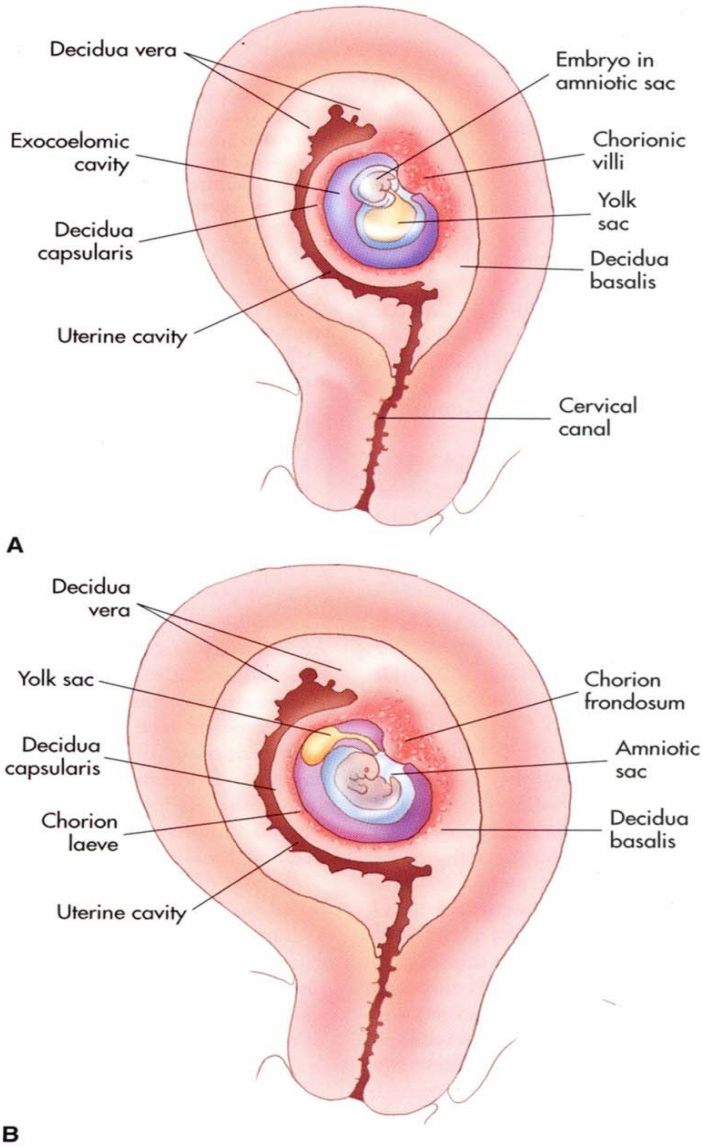


Figure 1-1 **A,** The placenta has two components: the fetal portion, developed from the chorion frondosum (chorionic plate), and a maternal portion, the decidua basalis, formed by the endometrial surface. **B,** The chorionic villi gradually atrophy and disappear (chorion laeve). The chorionic villi in the decidua basalis increase rapidly in size and complexity.

The placenta has 2 components

- Maternal portion- **the deciduas basalis** formed by endometrial surface
- And the fetal portion which develops from **chorion frondosum**

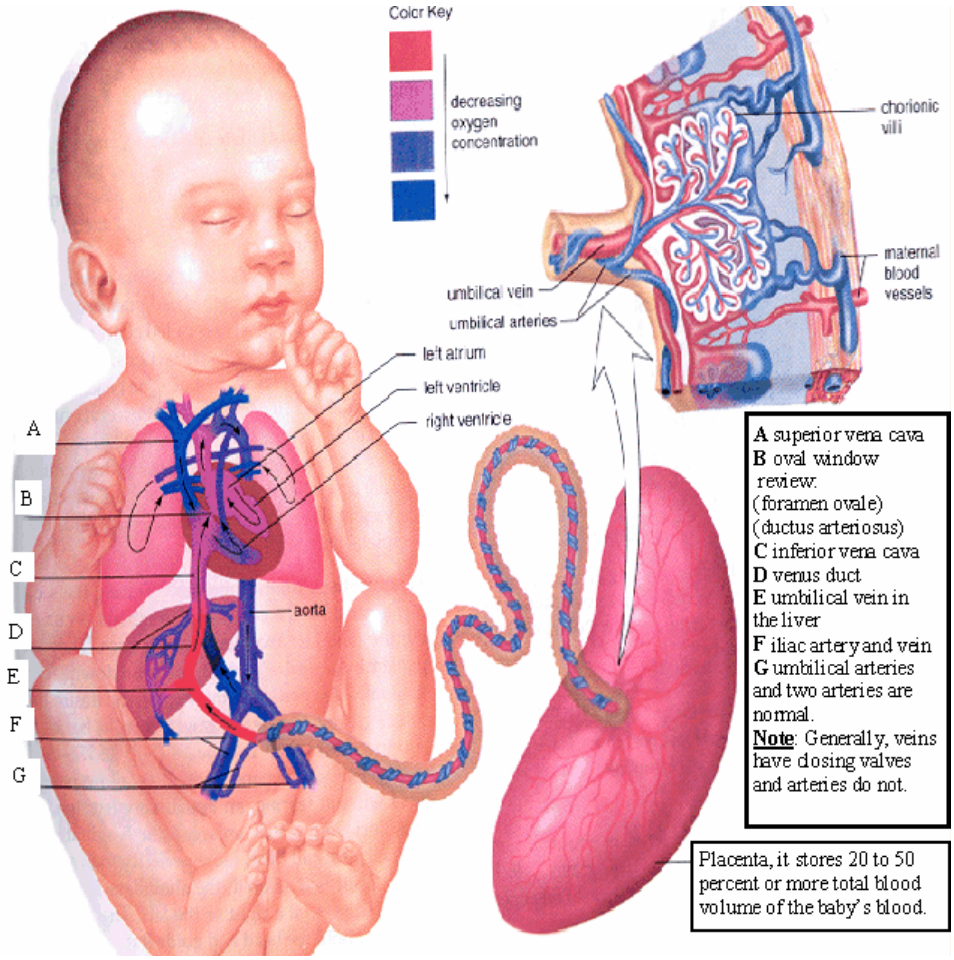
The fetal chorion is the fusion of the trophoblast and extra embryonic mesenchyme.There are 2 types of trophoblastic cells: the syncytiotrophoblast and the cytotrophoblast.

The major functioning unit of placenta is the chorionic villus. Within the chorionicvillous are the intervillous spaces. The maternal blood enters the intervillous spaces. As the embryo and the membranes grow, the decidua capsularis is stretched. the chorionic villi on the associated part of the chorionic sac gradually atrophy and disappear**(chorion leave).**The chorionic villi related to the decidua basalis increase rapidly in size and complexity

(chorion frondosum)

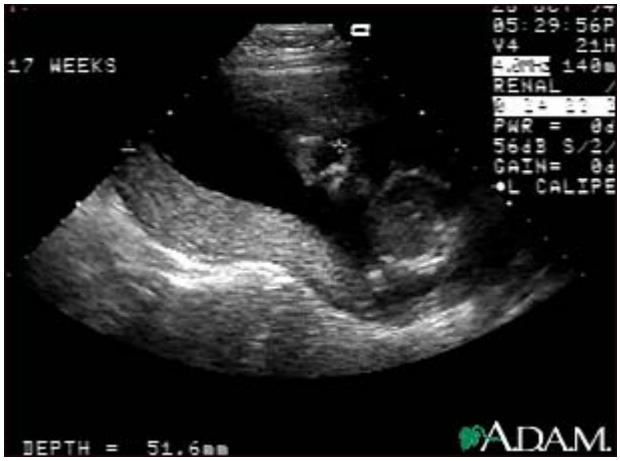
The maternal surface of the placenta which lies contiguous with the deciduas basalis is termed the **basal plate**. The fetal surface which is contiguous with the surrounding chorion is termed the **chorionic plate**.

Functions of the Placenta[13]

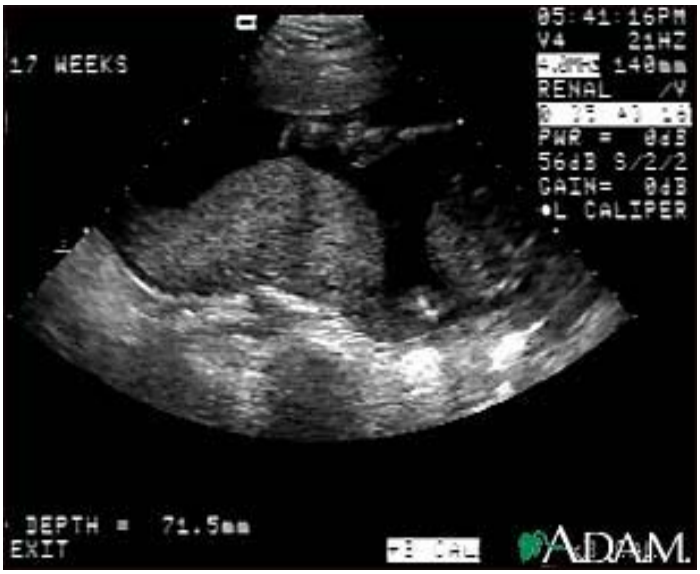


- Respiration-the placenta acts as fetal lung
- Nutrition
- Excretion
- Protection from microorganisms
- Storage
- Hormone production-estrogen, progesterone, HCG

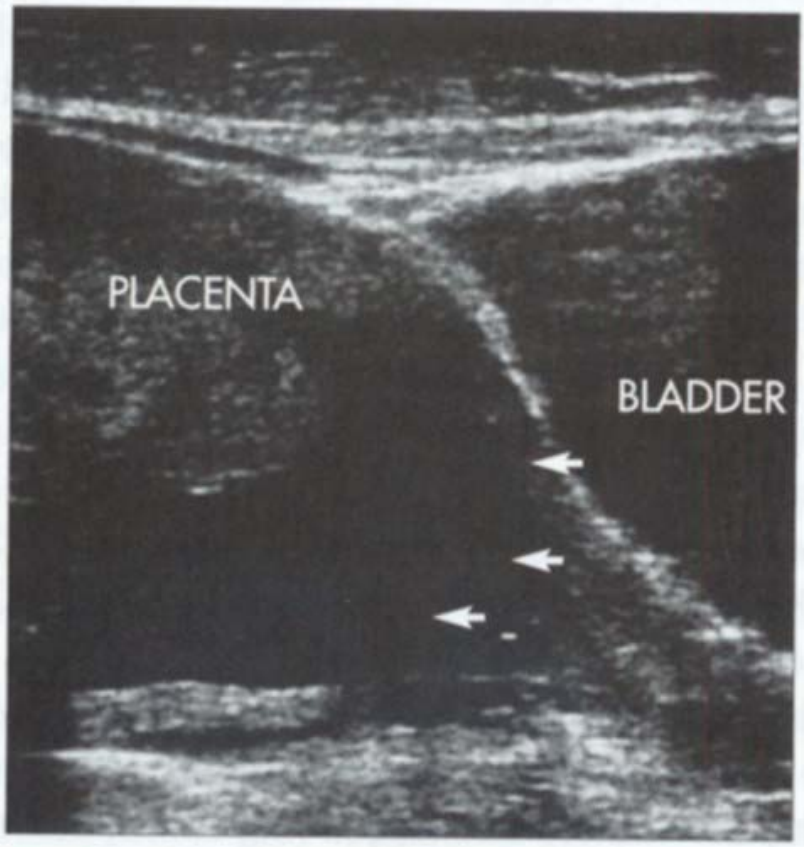
Sonographic evaluation of normal placenta[4-6, 8]



NORMAL PLACENTA



False Enlargement of placenta due to uterine contraction



Ultrasound clearly shows the internal os of the cervix *(arrows)*. The placenta is implanted away from the os.

The fetal surface of the placenta is represented by the echogenic chorionic plate the maternal portion (basal plate) lays at the junction of myometrium and the substance of placenta. The endometrial veins run behind the basal plate and more apparent when the placenta is located in the fundus or posteriorly with in the uterine cavity.

Placenta is identified in sonography as early as eight weeks of pregnancy. Placenta assumes a relatively homogeneous pebble grey appearance[27] between 8 & 20 weeks of pregnancy. The thickness of placenta corresponds to the gestational age in weeks. After 20weeks gestation the intra placental sonolucencies (venous lakes) and placental calcification may begin to appear. A heterogeneous placenta is seen in patients with elevated maternal serum alpha fetoprotein or with history of first trimester bleeding.[35]

The sonographer must maintain a perpendicular measurement of the placental surface in relation to the myometrial wall when evaluating the thickness of the placenta.[25,26]

The following points are noted while imaging the placenta

- **Placental position** – Anterior/posterior/Lateral/Low lying
- **Maturity of the placenta**[17] – grade 0/1/2/3
- **Placental abruption**
- **Placental abnormalities** – Placenta Accreta, Increta, Percreta

  Succenturate placenta, placental infarcts

Placental tumors

- **Placental thickness**-Normal-2-4cm.
    - Thick placenta seen in Hydrops, Rh incompatability, GDM, CMV infection, abruption.
    - Small placenta seen in PIH, IUGR, IDDM.

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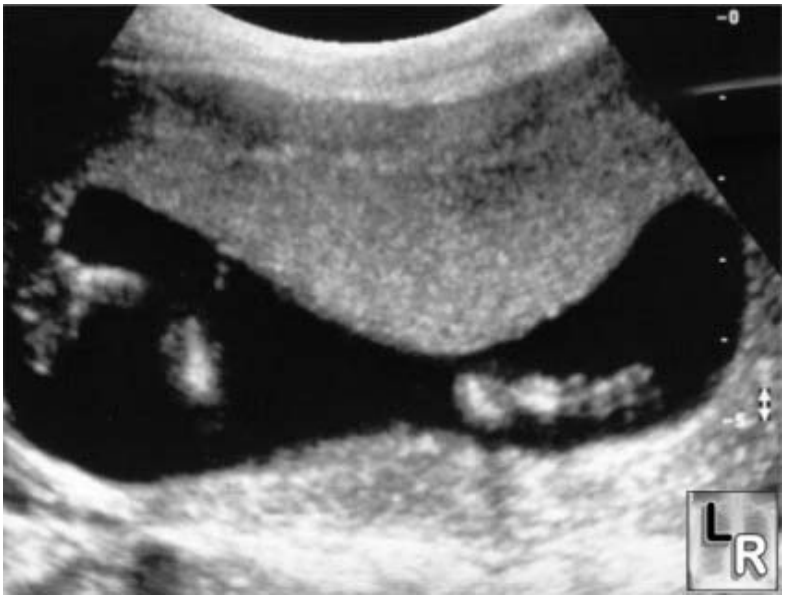
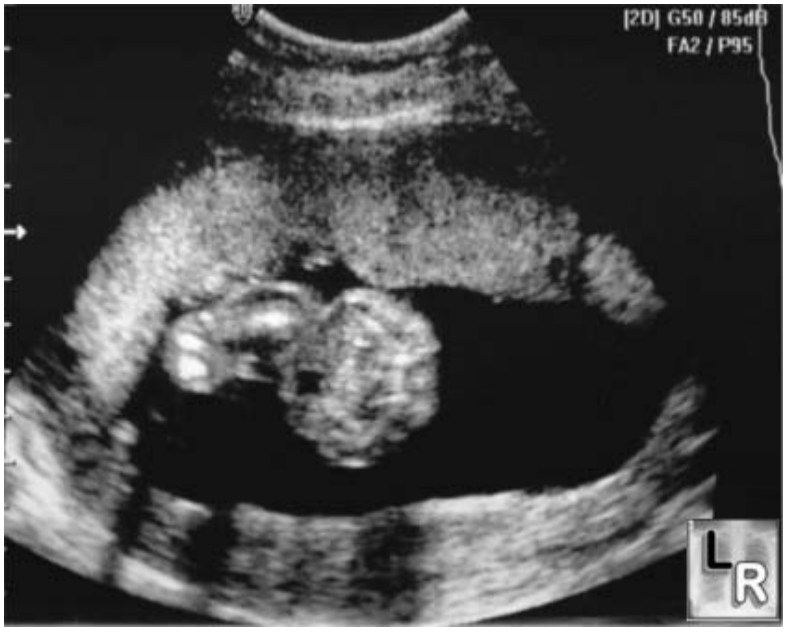


Grade 0

Late 1st trimester – early 2nd trimester

Uniform moderate echogenicity

Smooth Chorionic plate without indentation

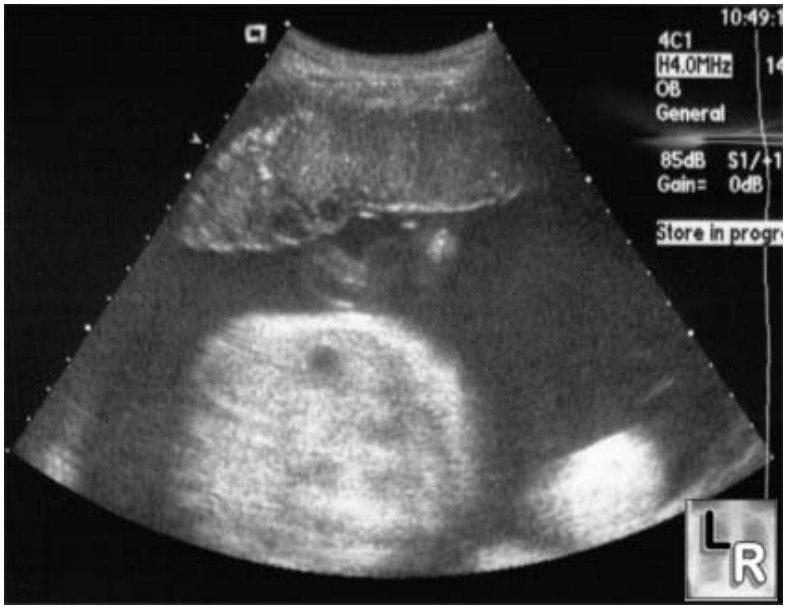


Grade 1

Mid 2nd trimester – Early 3rd trimester (18 to 29 weeks)

Subtle indentation of chorionic plate

Small diffused calcification seen

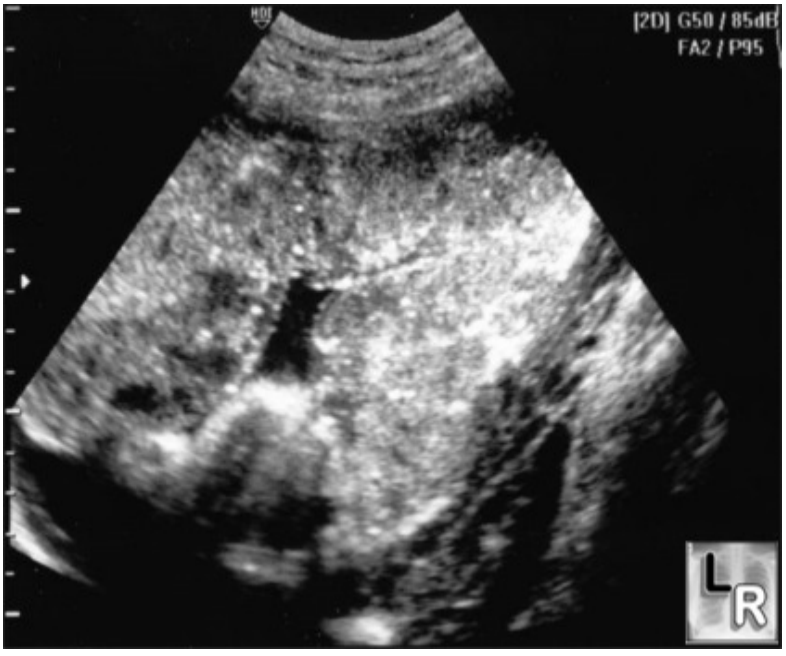


Grade 2

Late 3rd trimester (> 30 weeks)

Larger indentation along chorionic plate

Larger calcification in a dot dash pattern seen along the basilar plate



Grade 3

39 weeks to post dates.

Complete indentation of chorionic plate creating cotyledons.

More irregular calcification with significant shadowing.

May signify placental dysmaturity. Associated with smoking, hypertension, DM, SLE.

BIOEFFECTS OF USG[18-21]

The impact of Ultrasonography on the practice of obstetrics has been profound. Ultrasonic methods for the evaluating the fetus are now employed widely.

A carefully performed ultrasound examination reveals vital information about

- ✓ Fetal anatomy
- ✓ Fetal environment
- ✓ Fetal growth
- ✓ Fetal wellbeing

With no confirmed biological hazards.

Ultrasound technology has evolved from producing images of pregnancy to methods for measuring maternal and fetal circulatory function.

The acoustic condition of ultrasound used in humans are a sound wave intensity of 100mv/cm ^{2} and frequency of 3-5MHz and an exposure time less

than 30mins.under this low instrumental output conditions and shorter exposure period, no side effects are seen, hence ultrasound appears safe enough to be used.

Major biological effects of ultra sound are believed to be thermal and cavitation.One can minimize the thermal effects by not staying in one spot especially over fetal bone for long periods of time.Cavitation is dependent on presence of gas preexisting within the tissue.

Under experimental conditions of the intensity of more than 100mv/cm^2 and continuous exposure the following bioeffects may be seen

- ✓ macro nodular degeneration invitro
- ✓ Cellular effects such as cell membrane changes increased protein and DNA synthesis.
- ✓ genetic damage (mutations)
- ✓ Sister chromatid exchange (SCE) probably due to DNA repair after cell damage

Safety of Doppler for the Obstetric patient[2]

The Doppler ultrasound is use to asses the physiology and pathophysiology of fetal and maternal circulation. In most cases, pulsed wave Doppler is used in the fetus rather than continuous wave Doppler. The fetal sonagraphy with Doppler should be performed only when there is a valid medical reason and the lowest possible exposure setting should be used to obtain the necessary diagnostic information. The US FDA guideline state that the spatial peak temporal average intensity (SPTA) must be <94 mW/cm^2. The commercial equipments available in market use intensity of 1 -46 $mW/cm^{2.}$

The American of ultrasound in medicine approved the following statements on clinical study in 1997**(AIUM)**[18]

"**No confirmed biological effects on patients or instrumental operators caused by exposure at intensities typical of present diagnostic instruments have ever been reported. The current data indicates that the benefits of the patients, of the prudent use of diagnostic ultrasound out weigh the risk of any that may be present."**

CONVENIENCE OF AN ULTRASOUND[8]

Ultrasound in an antenatal woman has become one of the important investigations that are routinely done now a day. There are three stages during a normal pregnancy when ultrasound will be most useful and provide the most information.

These stages are

1. At 10 – 14 weeks after the first day of the women's LMP
2. At 18-22weeks after the first day of the woman's LMP.
3. At 32-36weeks after the first day of the woman's LMP.

Most informative times for a first and second scan

1 2 3 4 5 6 7 8

9 **10** **11** **12** **13** **14** 15 16

17 **18** **19** **20** **21** **22** 23 24 weeks

Most informative times for a third scan

25 26 27 28 29 30 31

32 **33** **34** **35** **36** 37 38

39 40

What is important in 10 – 14 weeks[2] scan?

1. To confirm intrauterine pregnancy and cardiac activity
2. to estimate gestational age
3. to rule out ectopic pregnancy and vesicular mole
4. to diagnose and evaluate multiple pregnancy
5. to evaluate uterine anomaly and pelvic mass
6. to measure nuchal translucency

What is important in 18 – 22weeks scan?

This is the best time

1. To diagnose fetal anomalies
2. To locate placenta
3. To recognize myomas or other associated pelvic mass that may interfere with pregnancy or delivery.

What is important in32 – 36weeks scan?

This is the best time to

1. Recognize intrauterine growth restriction
2. Fetal anomaly missed at first scan
3. Confirm presentation and position of fetus
4. Locate placenta accurately
5. Assess the amount of amniotic fluid

So along with this the placental thickness can be measured and maturity of fetus can be assessed.

Role of Ultrasound in Gestational age[2-6]

It is recognized that assessment of dates from LMP is fraught with errors in 20% to 40% of the gravida.Some reasons for this uncertainty are irregular cycle and other menstrual irregularities, ovulation and implantation bleeding, pregnancy following contraceptives and menstrual dates fall within wide margin of about 3weeks in 90% of population.

The pelvic examination is also unreliable for accurate dating errors in the judgement confirming fetal maturity have contributed to the development of ARDS, with resultant perinatal morbidity and mortality.

Apart from the iatrogenic prematurity objective knowledge of the data is essential in the management of all pregnancy in particular with regard to the method of MTP, management of high risk pregnancy, elective or planned induction of labour, elective LSCS

FIRST TRIMESTER DATING

Gestational sac measurement

From 5^{th} to 11^{th} week of pregnancy, mean diameter and the volume of gestational sac is measured. The sac is first visualized in uterus in the 5^{th} menstrual week and its diameter increases at the rate of 7 to 11 mm/week to reach 5 – 6cm by 10^{th} week.

G.sac volume = 0.55 x 33 x D_1 x D_2 x D_3

Mean sac diameter (mm) + 30 = gestational age in days

Where D_1, D_2, D_3 are the transverse, anteroposterior and longitudinal diameters of the sac. This measurement has been superseded by measurement of Crown Rump Length

Fetal Crown Rump Length

This is a very important technique in first trimester. Rule of thumb is adding 6.5cm to CRL, measured in cms.After 8weeks, it is very valuable predictive measurement, but it's not much of value before 8 or after 12 weeks.

Biparietal Diameter

After 12weeks BPD is an excellent measurement of GA. It is subjected to relatively little error.

The most commonly accepted plane is cross- section parallel to the cantho – meatal line and slightly above it which includes the falx, the thalamus and most important, the cavum septum pellucidum.

Between 21-30weeks predictive accuracy is within $\pm$ 11 days. After 31weeks the predictive accuracy decreases and to an extent of 15 days at 95% confidence range. Hence BPD measurement at any duration of pregnancy is at least as good as the most reliable menstrual dates.

Growth of BPD per week

13 – 20wks	3-4mm
21-28wks	3mm
29-32wks	2.3mm
32-term	2mm

Invalid BPD are seen in

- ✓ IUGR
- ✓ Moving fetus
- ✓ Polyhydramnios
- ✓ Occipitoposterior presentation
- ✓ Deeply engaged head
- ✓ Breech presentation
- ✓ Hydrocephalus
- ✓ Microcephaly

Hence BPD seems relatively unreliable after 30weeks; hence pregnancy dating is to utilize HC, AC&FL. This is termed as GA by multiple growth parameters.

Head Circumference

HC= (BPD + occipto frontal diameter) x 1.62

It may be true that HC is more predictable than BPD near term, but it is less accurate prior to 26 weeks.

Abdominal circumference

Worst predictor of fetal age than BPD except during 36-42weeeks at which time it is more accurate than BPD.

Femur Length

Shaft of femur is the Easiest long born to visualize and measure. It is obtained from greater trochanter to lateral condyle. Head of femur is not included.

Average FL at term 7.4-7.7cm.

One of the most recent additions to the already existing parameter are size of fetal foot and measurement of transcerebellar diameter and renal length and placental thickness.

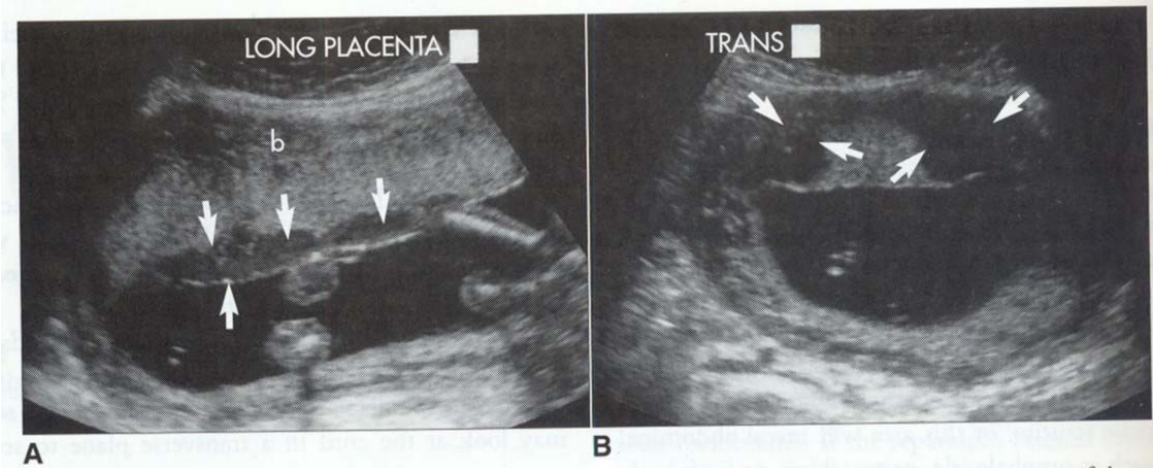
Fetal Kidney

After 17weeks, fetal kidneys are 90% imaged. After 2weeks, due to increased hyper echoic perinephric fat fetal kidneys become easily identified. The rule of thumb is menstrual age in weeks approximate kidney length in mm or twice the AP diameter in mm.

Placental Thickness[2,8,27]

Placental thickness is usually determined subjectively. It is best obtained in mid position perpendicular to the placental surface from the chorionic plate to the beginning of basilar myometrial layer. When the umbilical cord inserts into the middle of placenta, this measurement can be taken at its insertion site. The thickness is considered normal throughout the 2^{nd} and 3^{rd} trimester if between 2 and 4 cm. Care must be taken not to measure either obliquely or near uterine contraction because the placental sizes can be altered, usually creating a false impression of enlargement.

From the 22^{nd} week to 35^{th} week of gestation the placental thickness coincide almost exactly with the gestational age in weeks.



A, Longitudinal image of the placenta demonstrates the smooth homogeneous texture of the organ. Areas of echolucencies *(arrows)* are shown along the inner margin of the chorionic plate *(arrow)*. The basal surface *(b)* of the placenta is well seen along the myometrial surface of the uterus. **B,** Transverse image of the placenta as it lies along the anterior uterine wall. Echolucencies are seen representing the intervillous lakes *(arrows)*.

In addition to these

- **Ventricular size**
- **Length of Humerus**
- **Fetal Clavicle Length, Foot length**
- **Biocular distance**

Are also used as predictors of gestational age.

RELATED ARTICLES:

1. **P.Mittal et al[22] (2002)** analyzed 600 antenatal cases of all gestational ages (more than 10wks of gestation). Patients with PIH, IUGR, DM, Hydrops Fetalis, congenital malformation, twins were excluded from this study. After estimating the fetal age by CRL, BPD, FL, HC, AC, Placental Thickness was measured in each case. It was observed that the placental thickness gradually increased from 15mm at 11wks of gestational age to 37.5mm at 39wks.**From the 22nd week to 35th week of gestation the placental thickness coincide almost exactly with the gestational age in weeks.**

2. **Anupama jain et al[29] (2001)** analyzed 500 normal antenatal cases of more than 10weeks gestation. Mean values of placental thickness was calculated for different gestational ages. It was observed that the mean placental thickness increased from 15mm at 10weeks to 36mm at 39weeks of gestation. **Placental thickness matched almost equally from 27weeks to 33weeks of gestation.**

3. **Durnwald et al[34] (2004)** analyzed 167 singleton viable pregnancies. Women with suspected abruption, placentaprevia, fibroid, uterine and fetal anomalies, abnormal fluid volume were excluded. Placental thickness was measured at mid point of placental mass. Placental thickness was measured at the fundal, anterior, posterior implantation sites. The purpose of the study was to identify differences in sonagraphic placental thickness with advancing gestation and based on implantation site. It was observed that there was **step wise increase in placental thickness with increasing gestation** (15.8mm, 27.1mm, 37.6mm for 1st, 2nd, 3rd trimester respectively).**In the third trimester the placental thickness of posterior and fundal placenta was significantly greater than anterior placenta. Parity and BMI doesn't affect placental thickness.**

4. **Tongsong T et al[38] (2004)** established a nomogram for placental thickness for each week of gestational age ranged from 9 to 37weeks. By regression analysis, placental thickness (in mm) = gestational age in weeks x 1.4 – 5.6 (r = 0.82).This nomogram may be a useful aid in the early detection of placental abnormalities like hydropsfetalis. (Hb Bart's disease)

5. **Muhammad Haneef et al[40] (2005)** studied 100 cases of gestational age of more than 12weeks. Placental thickness increased from 16mm at 12weeks to 39mm at 40weeks.

6. **Ghosh UK et al[33] (1990)** analyzed 120 uncomplicated pregnancies of 32 to 40weeks of gestation. Placental diameter and thickness were measured. Placental diameter increased with advancing pregnancy where as placental thickness decreased with increasing gestational age. in75% of cases **a single ultrasound measurement of placental thickness can predict gestational age within ± 14days in the last 8weeks of pregnancy.**

7. **W.K.Hoddick et al[31] (1985)** reviewed sonograms of 200 single ton pregnancies. Placental thickness was measured and correlated with menstrual age. Placental thickness increased with advancing menstrual age. **At no stage of pregnancy was the normal placenta greater than 4cm in thickness.**

8. **Grannum et al[30] (1979)** in the ultrasonographic study of placenta have shown that there is gradual decrease in the thickness of placenta as the placenta matures.

9. **Bleker et al[32] (1977)** have shown that the surface area of the placenta increases linearly.

10. **Nyberg and Finberg[28] (G1990)** also reported that as a rule of thumb, placental thickness in mm parallels gestational age in weeks.

11. **Habib FA[41] (2002)** studied placental diameter and thickness by ultrasound at 36weeks of gestation in 70 singleton pregnancies **a warning limit of placental diameter of 18cms and placental thickness of 2cm at 36weeks of gestation were calculated to predict the low birth weight in infants.** Ultra sonagraphic placental thickness appears to be of prognostic value in identifying the subsequent occurrence of IUGR.

12. **Elchalal U et al[44] (2002)** analyzed 561 normal single ton pregnancies to establish the correlation of sonographically thick placenta with perinatal mortality and morbidity. Thick placenta was determined as placenta that was above the 90th percentile. A linear increase of placental thickness was found to correlate with gestational age through out pregnancy. **Sonographically thick placenta is associated with increased perinatal risk with increased mortality related to fetal anomalies and higher rates of both SGA and LGA infants at term.**

13. **Tongsong T et al[42] (1999)** evaluated the efficacy of placental thickness at mid pregnancy in predicting fetal Hb Bart's disease in pregnancy at risk. Placental thickness of more than 13mm was considered abnormal for 18 to 21weeks of gestation. Mean placental thickness for normal pregnancy and pregnancies with Hb Bart's fetuses were significantly different. **For couple at risk, if placental thickness is normal then the risk of having Hb Bart's fetus is markedly decreased**.

14. **Ghosh A et al[43] (1994)** measured placental thickness by ultrasound at 10 to 21weeks of gestation in 231pregnancies at risk for homozygous Alpha thalassemia. The sensitivity in detecting the affected pregnancies after 12weeks was 0.95 and by 18weeks it reached 1.**Thus the selection of pregnancies at risk by measurement of placental thickness will reduce the number of invasive diagnostic procedures.**

MATERIALS AND METHODS

The present study entitled 'PLACENTAL THICKNESS-A SONOGRAPHIC PARAMETER FOR ESTIMATION OF GESTATIONAL AGE' was conducted in the Department of Obstetrics and Gynecology, PSG Hospitals.

Selection criteria

- patients with known dates of last menstrual period
- singleton pregnancies with no fetal or congenital anomalies
- no medical or obstetrical complications

Examination Method

1. A thorough history regarding medical illness & obstetric history is taken for each patient

2. Symphysio – fundal height was measured after emptying the bladder. Fundal height by palpation and gestational age was clinically assessed.

3. Consent for doing ultrasound and their co-operation for my study was taken.

4. Routine ultrasound scanning will be done in all cases, in all trimester, transabdominally with a real time ultrasound.

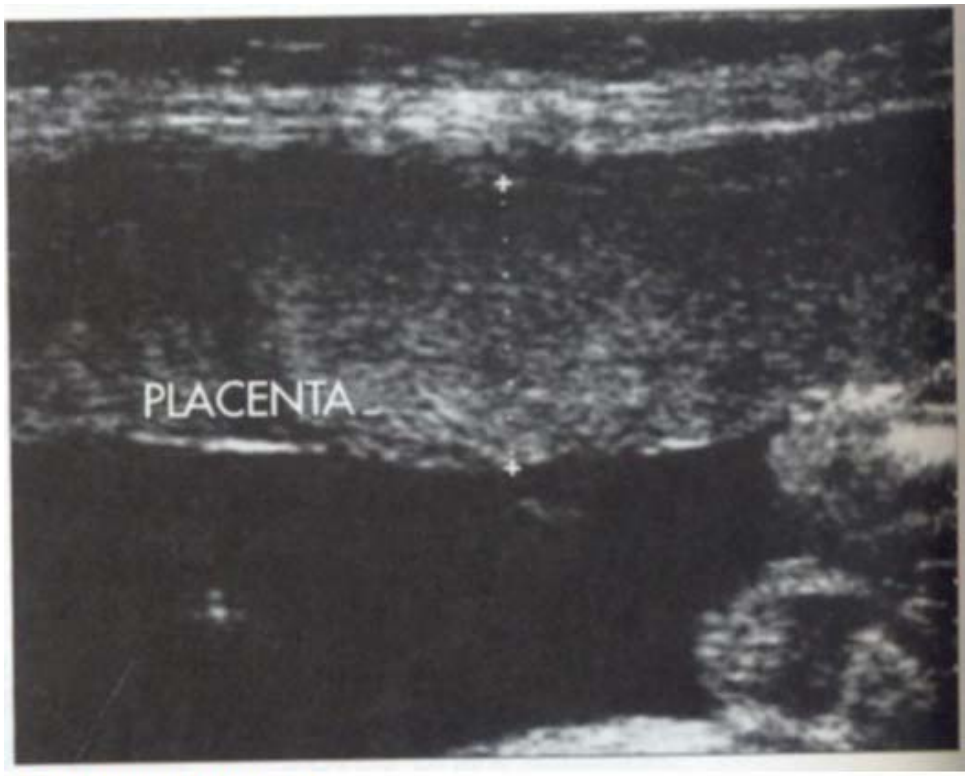
Machine used for study is Aloka real time 2D ultrasound unit with a 3.5MHz convex transducer.

Ultrasound Machine

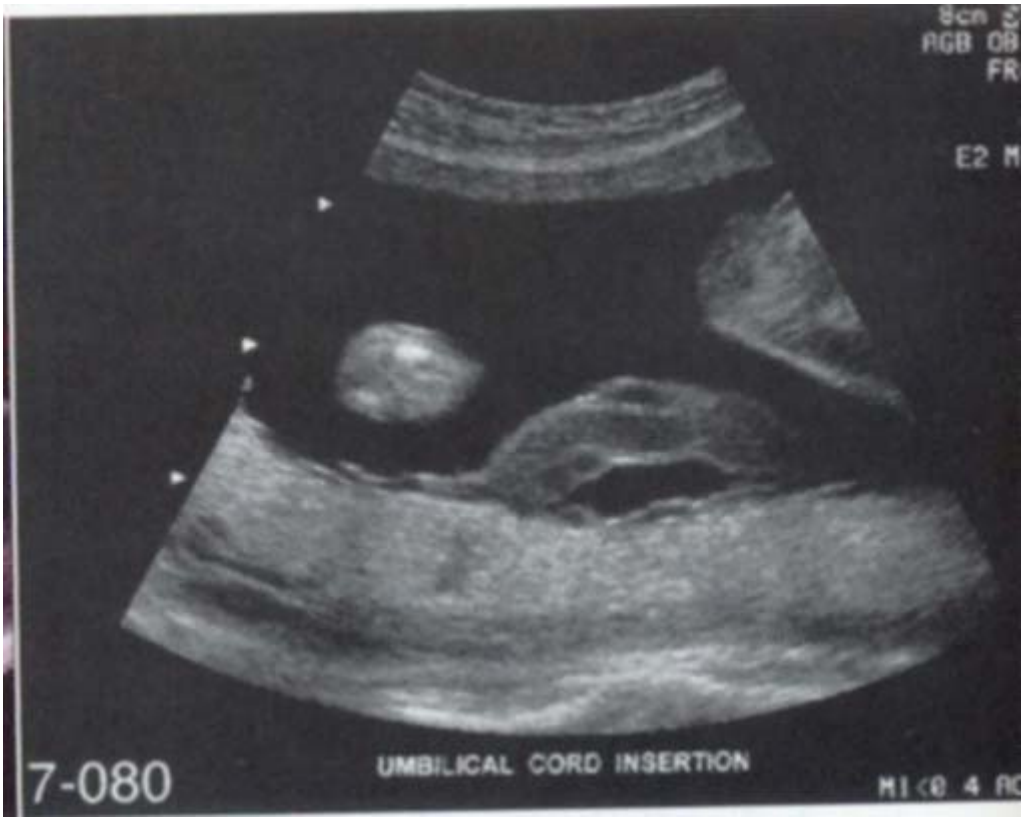
Transducer (probe) on the abdomen

The patients were scanned with optimally filled bladder in supine position. After an initial survey with ultrasound transducer in each patient, all measurements needed for fetal biometry were taken

a) CRL Upto 11 weeks
b) Femur length
c) Biparietal diameter
d) Abdominal circumference



Thickness of placenta
(Calipers must be placed perpendicular to the placental borders)



The placental thickness was measured at its midposition or at the level of cord insertion[26]. Multiple longitudinal and transverse scans are needed to demonstrate placenta completely. At 16 weeks gestation, the placenta occupies half of the inner surface of uterus. At 36 -40weeks the placenta occupies 1/4th to 1/3rd of the inner surface of the uterus. Uterine contractions can mimic the placenta so repeat the scan after 5 minutes[2,8]. The patients were followed until delivery.

RESULTS AND ANALYSIS

In our study 210 uncomplicated antenatal cases of more than 11 weeks gestation were included. Along with other fetal biometry placental thickness was measured and the labor outcomes of those women were followed.

Out of 210 women, 12 didn’t turn up for their delivery to our hospital. Hence only 198 patients who delivered in our hospital were included. The results were analysed with respect to the maternal age, parity, placental thickness, and placental location, mode of delivery, birth weight, and gestational age at birth. The mean values of placental thickness along with the respective standard deviation were calculated for different gestational age from 11 weeks to 40 weeks.

Using Pearson correlation, correlation between Placental thickness and Gestational Age and Maternal age were analysed.

Using chi square test correlation between placental thicknesses with advancing gestation and implantation site was analysed.

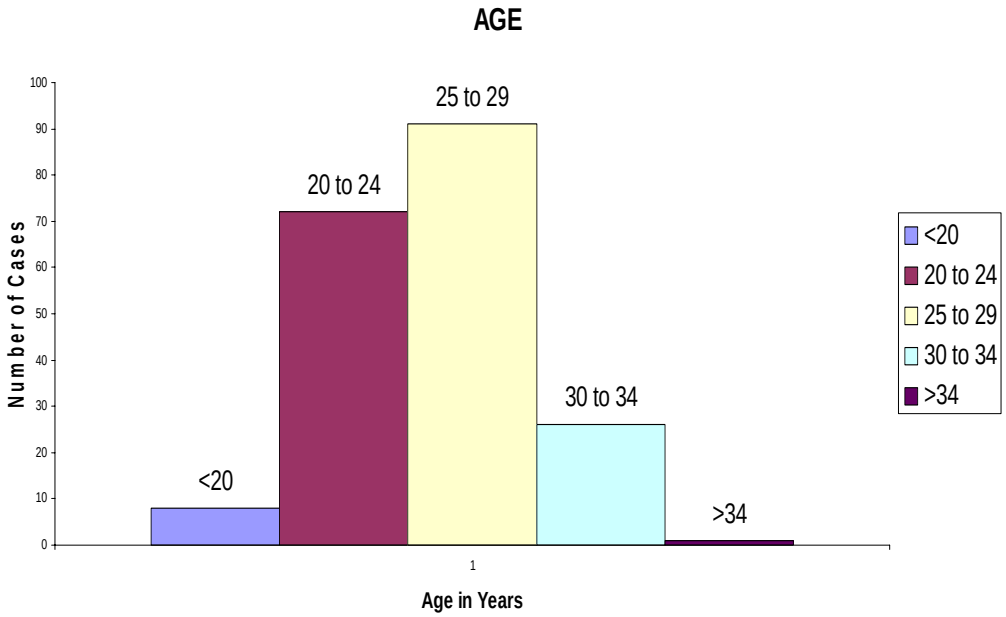


Table 1

S.NO	MATERNAL AGE	NO. OF CASES	%
1	≤ 19	8	4.04
2	20-24	71	35.86
3	25-29	93	46.97
4	30-34	25	12.62
5	≥ 35	1	0.51

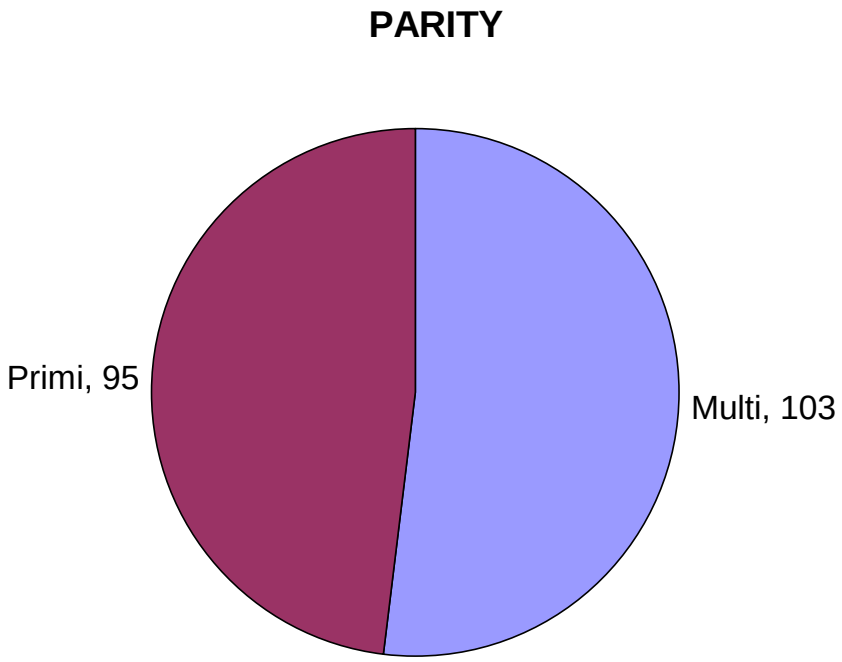


Table 2

Parity	No. of cases	%
Primi	95	47.97
Multi	103	52.03

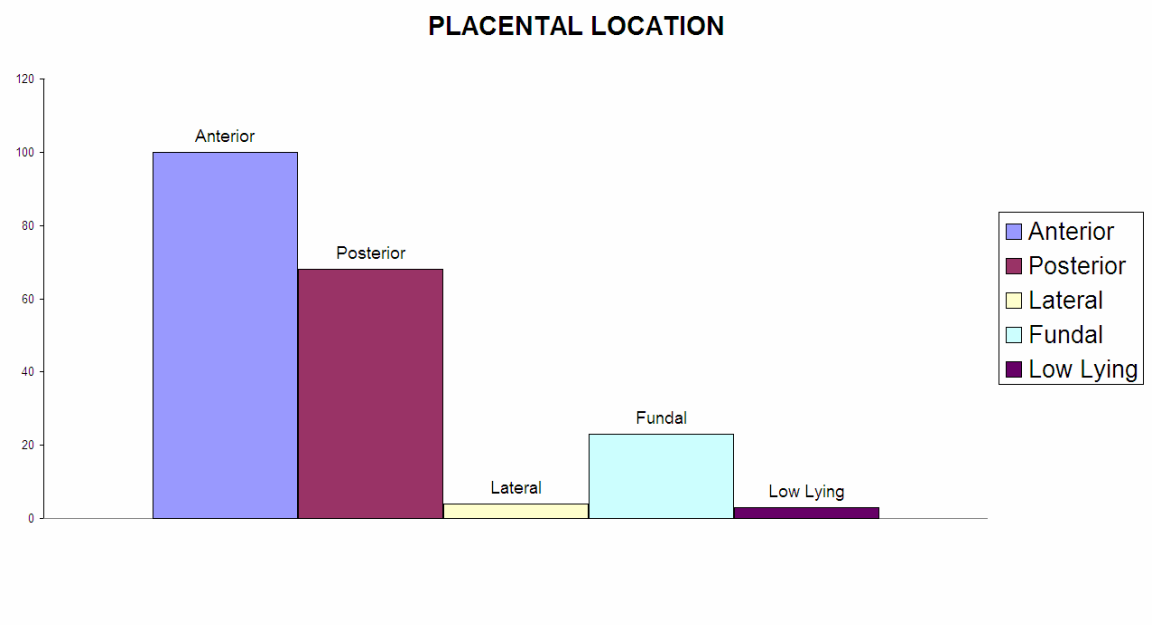


Table 3

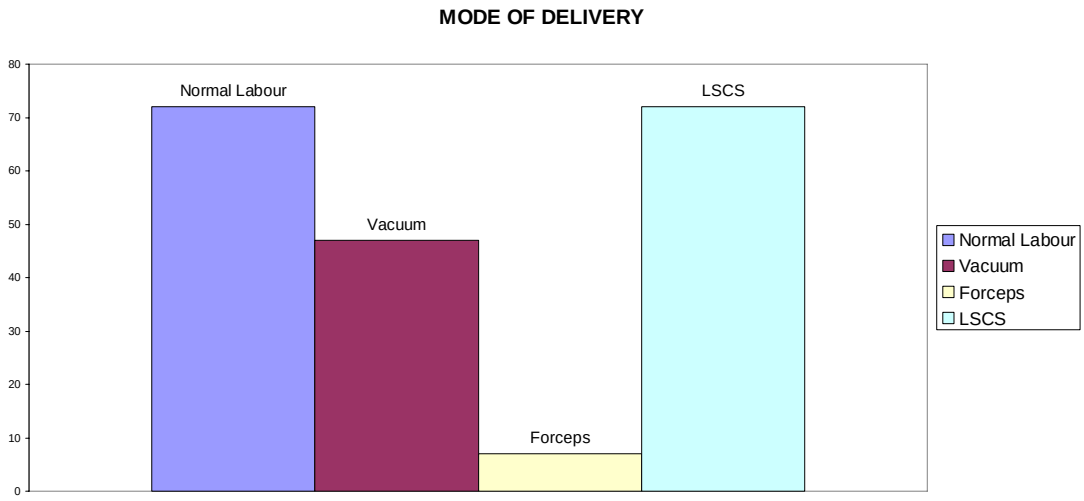
S.No.	Location	No. of Cases	%
1	Anterior	100	50.5
2	Posterior	68	34.4
3	Lateral	4	2.0
4	Fundal	23	11.6
5	Low lying	3	1.5

Table 4

Placental Location in Each Trimester

		Trimester		P value= 0.16		
Location	**I**	**Mean PT(cm)**	**II**	**Mean PT(cm)**	**III**	**Mean PT(cm)**
Anterior	-	-	49	2.06	51	3.16
Posterior	-	-	33	2.09	35	3.23
Lateral	-	-	1	2.3	3	3.5
Fundal	1	1.4	10	2.02	12	3.10
Low lying	-	-	3	2.17	-	-

Table 5



Mode of Delivery	No. of Cases	%
NORMAL	72	36.5
VACUUM	47	23.5
FORCEPS	7	3.5
LSCS	72	36.5

BIRTH WEIGHT

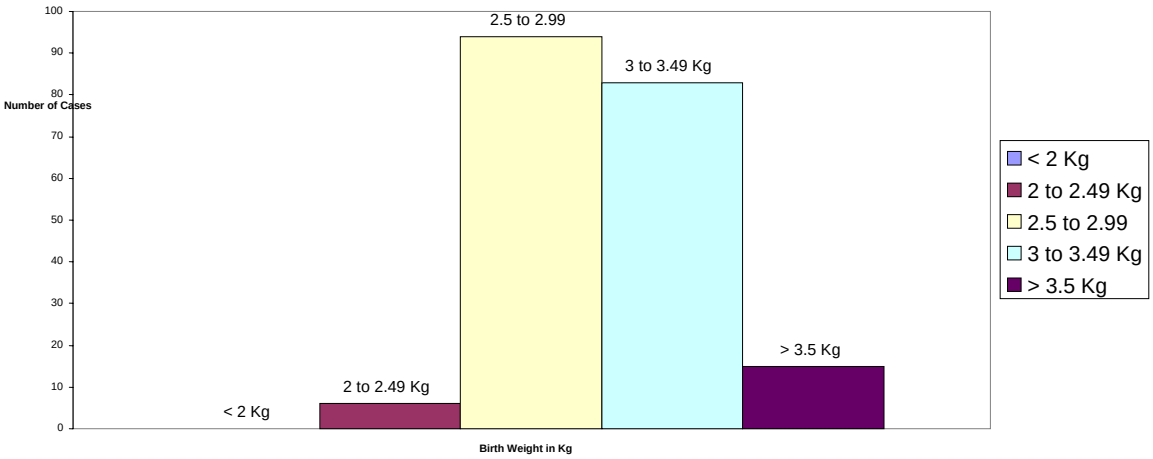


Table 6

Weight	N0. of Cases	%
<1.99	0	
2 – 2.49	6	3.1
2.5 – 2.99	94	47.4
3 – 3.49	83	41.9
>3.5	15	7.6

TABLE 7 **GESTATIONAL AGE AT BIRTH**

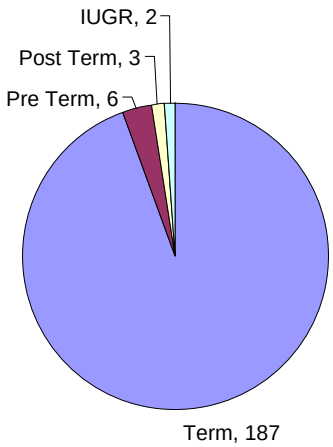
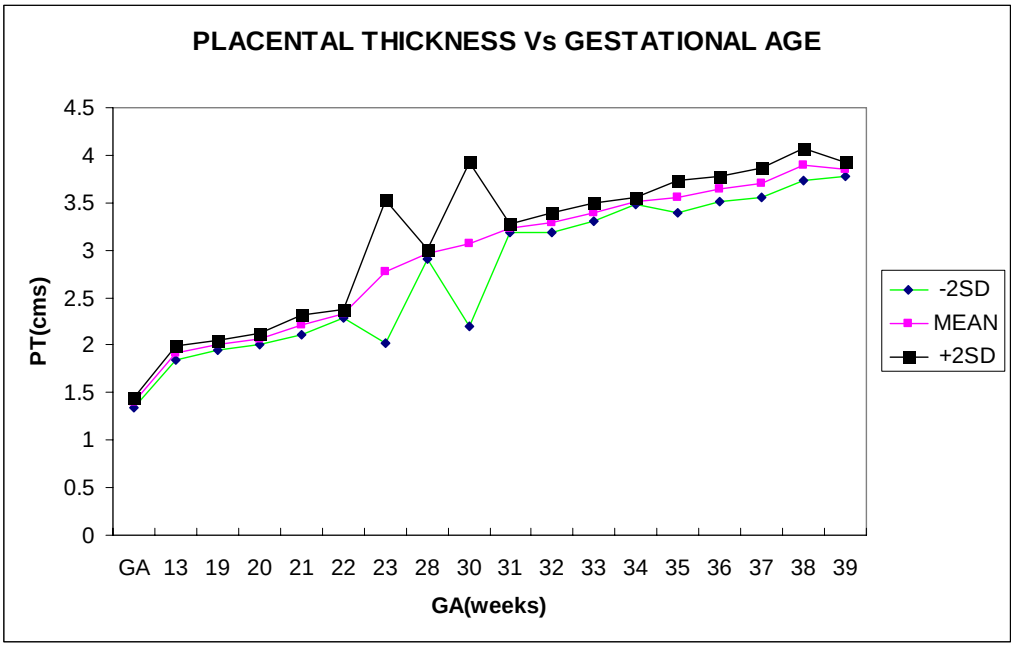


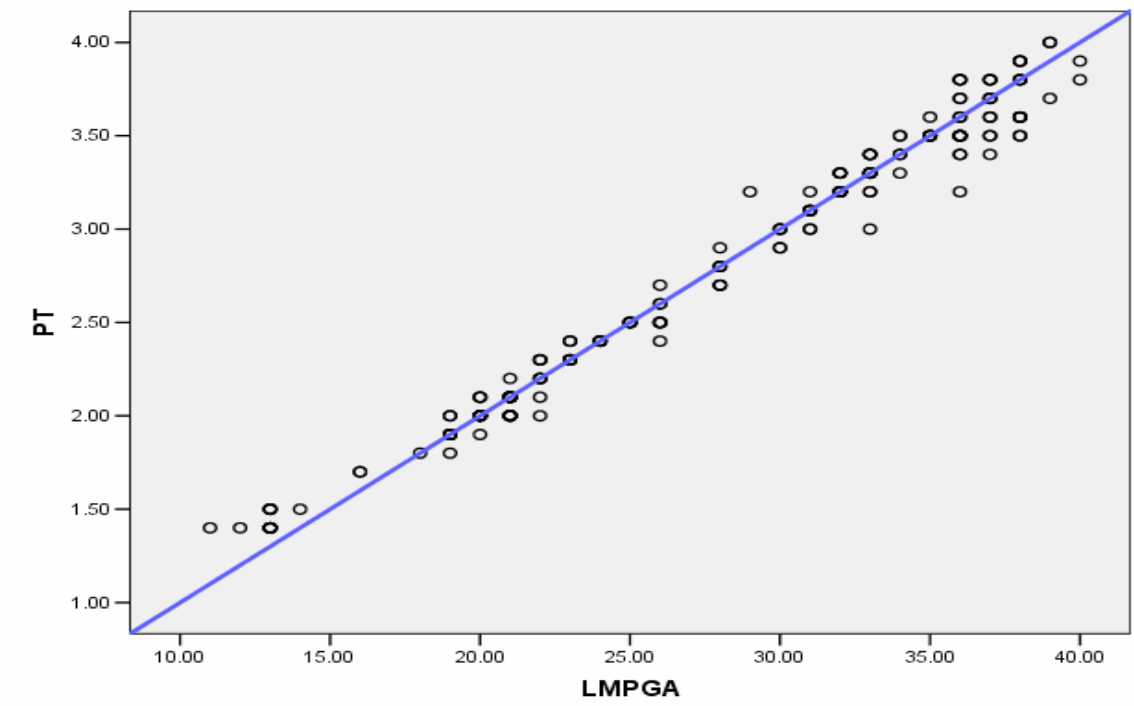
Table 8: Placental thickness Vs Gestational Age

S. No	GA Weeks	No	Mean	SD
1	11	1	1.40	-
2	12	1	1.40	-
3	13	11	1.40	0.05
4	14	1	1.50	-
5	15	-	-	-
6	16	2	1.70	-
7	17	-	-	-
8	18	1	1.88	-
9	19	8	1.97	0.07
10	20	15	2.00	0.05
11	21	26	2.06	0.06
12	22	8	2.21	0.11
13	23	7	2.33	0.049
14	24	4	2.40	0.00
15	25	4	2.50	0.00
16	26	8	2.55	0.00
17	27	-	-	-
18	28	7	2.77	0.76
19	29	-	-	-
20	30	5	2.96	0.05
21	31	9	3.07	0.87
22	32	12	3.23	0.05
23	33	13	3.29	0.11
24	34	5	3.40	0.09
25	35	6	3.52	0.04
26	36	16	3.56	0.17
27	37	11	3.65	0.14
28	38	12	3.71	0.16
29	39	3	3.90	0.17
30	40	2	3.85	0.07

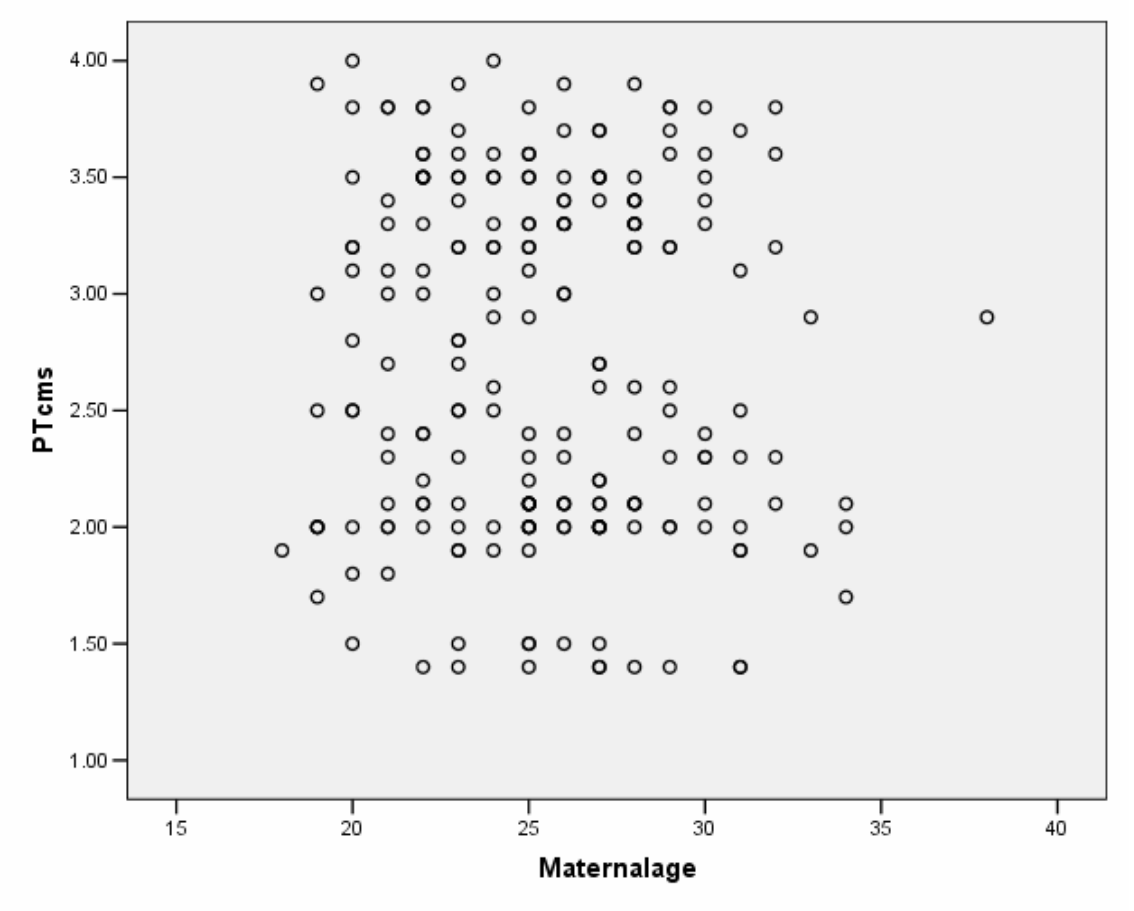
Graph 1



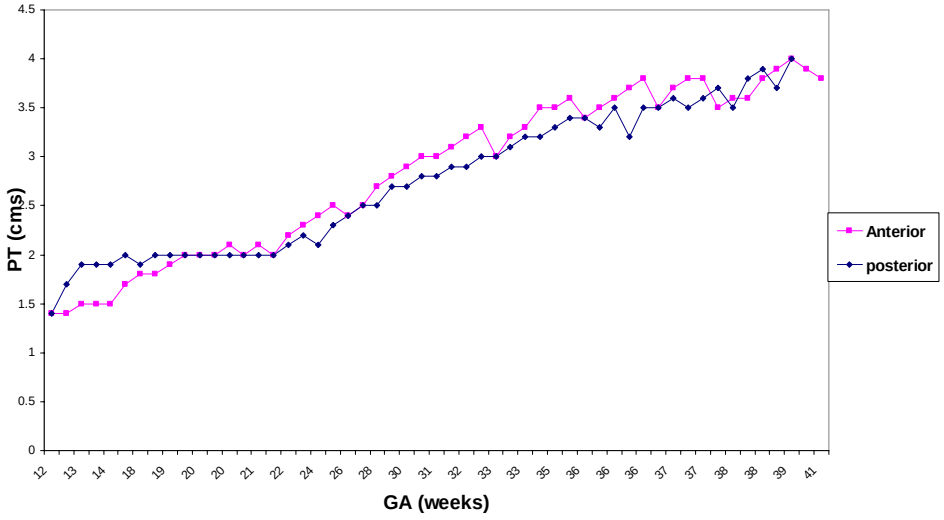
Graph 2: CORRELATION BETWEEN GESTATIONAL AGE Vs PLACENTAL THICKNESS



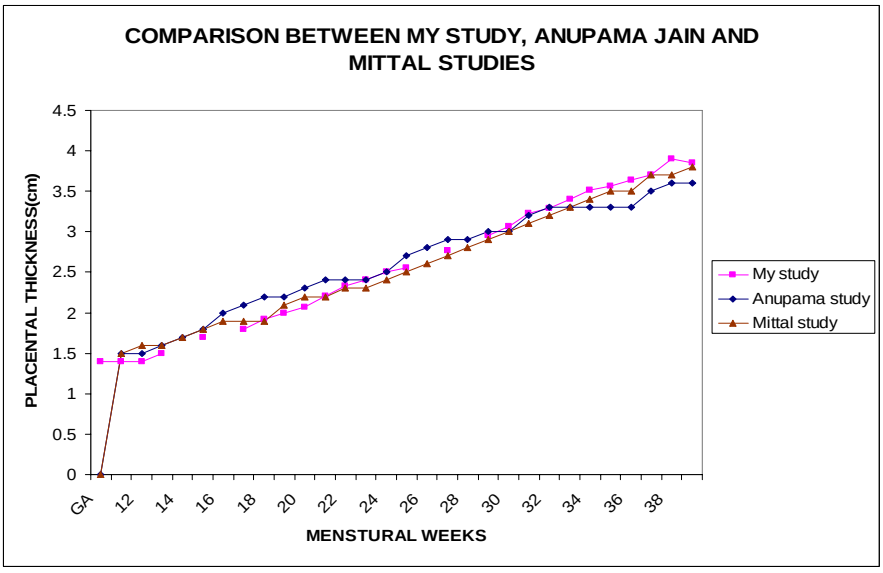
Graph 3: CORRELATION BETWEEN MATERNAL AGE Vs PLACENTAL THICKNESS



Graph 4: CORRELATION BETWEEN PLACENTAL THICKNESS AND PLACENTAL LOCATION IN EACH TRIMESTER



Graph 5



S.No	VARIABLE	TESTS OF SIGNIFIANCE	P VALUE
1	GA by LMP	Pearson Correlation(r2=0.99)	0.01
2	Maternal Age	Pearson Correlation(r2=-0.04)	0.54
3	Parity	t- test	0.40
4	Placental location	Chi square	0.16

DISCUSSION

Knowledge of GA is important to the obstetrician because it can affect clinical management in a number of important ways.

1. early pregnancy – scheduling chronic villus sampling (9 – 12wks) & Amniocentesis (16wks)
2. to anticipate normal spontaneous delivery or to plan for elective delivery with the time frame of a term pregnancy
3. In evaluating fetal growth, because the range for size of any fetal parameter changes with the advancing age.

Upto 50% of mothers who claim to know their obstetric dates with certainty or in fact more than 2 weeks in error when GA is calculated with ultrasound. A discrepancy of 2 weeks can be critical for the survival of an infant who has to be delivered early because of some antenatal complication.

The importance of an accurate determination of GA and EDD in the high risk patient cannot be overemphasized. The reliability of the EDD may be rated as excellent, good or poor by using a set of criteria.

Reliability of EDD[1]

Excellent dates

1. patients with adequate clinical information (known,normal,LMP 28 – 30 days cycles; no recent use of OCP; uterine size in agreement with dates) ultrasound examination between 16 & 24 weeks indicating that the fetal measurements are in agreement with the clinical estimation of GA.
2. Patients with the inadequate or incomplete clinical information but with two ultrasound examinations between 16 & 24 wks showing linear fetal growth and similar EDD.

Good dates

1. Patients with adequate clinical information (as mentioned above) and one confirming ultrasound examination obtained after 24 weeks of gestation.
2. Patients with inadequate or incomplete clinical information and 2 or more ultrasound examinations showing adequate growth and similar EDD.

Poor dates

Any clinical situation different from those listed above. Clinical dating is not 100% accurate .Even a patient with reliable clinical criteria should have a real time ultrasound examination for confirmation.

So as said earlier the methods commonly used involves measurement of BPD, AC, & FL. These are supposed to be more predictive of estimated date of confinement.

Fetal biometric estimates of age infer age from size and are therefore less accurate as pregnancy progresses and hence BPD,AC & FL are not accurate in determining GA in third trimester and hence this study is conducted to find how accurate is Placental thickness in estimating GA in second and third trimester.

The normal placenta increases in volume throughout gestation. It is possible to measure placental volume but the technique is cumbersome hence not used clinically. The thickness of placenta can be measured Sonographically. Measurement obtained at the mid placenta perpendicular to the plane of the placenta, results in a mean thickness in mms approximately equal to menstrual age in weeks[2,3].

Dating by ultrasound

One of the most important uses of ultrasound in Obstetrics is that of determining gestational age. The method most commonly used is measurement of CRL in 1st trimester and after 12weeks

- Biparietal diameter (BPD)
- Head circumference (HC)
- Abdominal circumference (AC)
- Femur length (FL)

The age in weeks corresponding to each measurement is averaged and the mean is the estimated gestational age of the fetus.

This method has replaced the older techniques that use the BPD alone to determine the gestational age such as the Growth Adjusted Sonographic Age (GASA) and the Mean Projected Gestational Age (MPGA).

The results obtained by averaging several measurements (BPD, HC, AC, FL) have a better correlation with the gestational age as determined by the neonatal evaluation than any of the methods used in the past.

There are many tables available that provide an estimation of the number of weeks of gestation based on measurements for each fetal biometry. It is best to use tables generated in populations studied at sea level and containing the low (5^{th}) and high (95^{th}) percentile values for each variable at a given gestational age.

Table 9: Three tolerance intervals for BPD measurements directly from the measurements

Menstrual Age (weeks)	5%	50%	95%
12	13	20	26
13	17	22	28
14	20	26	31
15	26	32	37
16	29	35	40
17	32	38	44
18	34	40	46
19	37	43	49
20	41	46	52
21	43	49	55
22	47	53	59
23	49	55	60
24	53	59	65
25	57	63	69
26	58	64	70
27	60	66	72
28	66	72	77
29	67	73	78
30	68	74	80
31	72	78	83
32	75	81	87
33	76	82	87
34	78	84	90
35	80	86	92
36	82	88	94
37	83	89	95
38	85	91	97
39	85	91	97
40	86	93	99
41	88	93	99
42	90	96	103
43	91	97	104

Table 10: Femur length (mm)

Menstrual age (wks)	5th	50th	95th
12	04	08	13
13	06	11	16
14	09	14	18
15	12	17	21
16	15	20	24
17	18	23	27
18	21	25	30
19	24	28	33
20	26	31	36
21	29	34	38
22	32	36	41
23	35	39	44
24	37	42	46
25	40	44	49
26	42	47	51
27	45	49	54
28	47	52	56
29	50	54	59
30	52	56	61
31	54	59	63
32	56	61	65
33	58	63	67
34	60	65	69
35	62	67	71
36	64	68	73
37	65	70	74
38	67	71	76
39	68	73	77
40	70	74	79

Table 11: Abdominal circumference (cms)

Menstrual age (wks)	**-2SD (cm)**	Mean (cm)	+2SD (cm)
12	3.1	5.6	8.1
13	4.4	6.9	9.4
14	5.6	8.1	10.6
15	6.8	9.3	11.8
16	8.0	10.5	13.0
17	9.2	11.7	14.2
18	10.4	12.9	15.4
19	11.6	14.1	16.6
20	12.7	15.2	17.7
21	13.9	16.4	18.9
22	15.0	17.5	20.0
23	16.1	18.6	21.1
24	17.2	19.7	22.0
25	18.3	20.8	23.3
26	19.4	21.9	24.4
27	20.4	22.9	25.4
28	21.5	24.0	26.5
29	22.5	25.0	27.5
30	23.5	26.0	28.5
31	24.5	27.0	29.5
32	25.5	28.0	30.5
33	26.5	29.0	31.5
34	27.5	30.0	32.5
35	28.4	30.9	33.4
36	29.3	31.8	34.3
37	30.2	32.7	35.2
38	31.1	33.6	36.1
39	32.0	34.5	37.0
40	32.9	35.4	37.9

Table 12: Placental thickness (cm)

GA(Weeks)	MEAN ± SD (ANUPAMA JAIN STUDY[29])	MEAN ± SD (MITTAL STUDY[22])
11	1.5±0.29	1.5±0.05
12	1.5±0.30	1.6±0.44
13	1.7±0.29	1.6±0.09
14	1.7±0.36	1.7±0.23
15	1.8±3.2	1.8±0.40
16	2.0±0.23	1.9±0.11
17	2.1±0.29	1.9±0.33
18	2.2±0.40	1.9±0.11
19	2.2±0.28	2.1±0.16
20	2.3±0.27	2.2±0.05
21	2.4±0.38	2.2±0.37
22	2.4±0.32	2.3±0.16
23	2.4±0.32	2.3±0.41
24	2.5±0.35	2.5±0.14
25	2.7±0.35	2.5±0.15
26	2.8±0.29	2.6±0.14
27	2.8±0.18	2.7±0.19
28	2.9±0.46	2.9±0.34
29	3.0±0.40	3.0±0.23
30	3.0±0.22	3.1±0.31
31	3.2±0.31	3.1±0.31
32	3.3±0.30	3.2±0.45
33	3.3±0.25	3.3±0.26
34	3.3±0.31	3.4±0.49
35	3.3±0.29	3.5±0.45
36	3.3±0.26	3.5±0.35
37	3.5±0.32	3.7±0.56
38	3.6±0.25	3.7±0.24
39	3.6±0.23	3.8±0.45

Table 13: Comparison between my study and Anupama Jain study.

GA(Weeks)	Mean (my study)	Mean (Anupama jain study)	Mean (Mittal study)
11	1.40	1.5	1.5
12	1.40	1.5	1.6
13	1.40	1.6	1.6
14	1.50	1.7	1.7
15		1.8	1.8
16	1.70	2.0	1.9
17		2.1	1.9
18	1.88	2.2	1.9
19	1.97	2.2	2.1
20	2.00	2.3	2.2
21	2.06	2.4	2.2
22	2.21	2.4	2.3
23	2.32	2.4	2.3
24	2.40	2.5	2.4
25	2.50	2.7	2.5
26	2.55	2.8	2.6
27		2.9	2.7
28	2.77	2.9	2.8
29		3.0	2.9
30	2.96	3.0	3.0
31	3.06	3.2	3.1
32	3.23	3.3	3.2
33	3.29	3.3	3.3
34	3.40	3.3	3.4
35	3.51	3.3	3.5
36	3.56	3.3	3.5
37	3.64	3.5	3.7
38	3.70	3.6	3.7
39	3.90	3.6	3.8
40	3.85		

In our study we analysed 198 uncomplicated pregnancies of more than 10 weeks gestation till term. All of them had normal fetal outcome. Placental thickness was measured at the insertion of cord or at its midposition.

The mean values of placental thickness along with respective standard deviation were calculated for different gestational ages from 11^{th} week to 40^{th} week. It was observed that the placental thickness gradually increased from 1.4cms at 11 weeks of gestation to 3.8 cms at 40weeks of gestation.

In our study Upto 19weeks of gestation the mean placental thickness was slightly higher than the gestational age by 0.1-0.4 cms.From 20weeks to 35 weeks of gestation the placental thickness almost matched the gestational age in weeks. There after the placental thickness was lower by 0.1 to 0.2 cms.

The present study assessed the relationship between the gestational in weeks and placental thickness in cms by ultrasound. **The value of mean placental thickness increases with advancing gestational age almost matching from 20^{th} week to 35^{th} week as shown in graph 1.**

Our study results are consistent with observations made by Mittal et al[22] 2002, Anupama Jain[29] 2001 who reported the mean placental thickness increased with advancing gestation and almost matches from 22 to 35weeks as shown in graph 5.

In our study there is statistically significant correlation between placental thickness and gestational age (r2=0.99), (P<0.01) as shown in graph 2.

According to regression analysis, for every one unit (week) increase in gestational age the placental thickness increases by 5.25 units (i.e. 0.5cms).

There is no statistically significant correlation between the placental thickness and maternal age (r2= -0.044), (P<0.54)as shown in graph 3, parity (P=0.40) which is consistent with findings of Elchalal et al[44] and Durnwald et al[43] study.

In our study there is no significant difference in placental thickness with advancing gestation based on implantation site (P =0.16)as shown in graph 4 and table 4 unlike Durnwald et al study in which placental thickness of posterior and fundal placenta in 3rd trimester was greater than anterior placenta.

Habib FA[41] framed a warning limit of placental thickness of 2cms at 36weeks gestation as a predictor of LBW infants and subsequent IUGR. In our study none of the cases at 36 weeks had placental thickness of less than 2cms.Hence it is unable to show whether placental thickness can be used as a predictor of LBW, IUGR.

Elchalal et al analysed sonographically thick placenta (> 4cms or > 90th percentile) is associated with increased perinatal mortatility and morbidity like fetal anomalies, SGA, LGA infants at term. In our study none of the cases had placental thickness of more than 4cms.

Since there is statistically significant correlation between placental thickness and gestational age, placental thickness can be used as a reliable parameter in late 2nd and 3rd trimester for calculating gestational age. It is also useful in certain situations like

Occipito posterior position

- Dolicocephaly
- Brachycephaly
- Breech
- Deeply engaged head

Where BPD is less reliable.

USES OF PLACENTAL THICKNESS:

- To determine gestational age in late 2nd ,3rd trimester when exact duration of pregnancy is not known
- As a predictor for LBW[41]
- Prognostic value in identifying subsequent occurrence of IUGR[41,44].
- Placental thickness at mid pregnancy (18 -21 weeks) as a predictor of Hb Barts disease there by reducing the number of invasive diagnostic procedures[42,43].

Determination of Gestational age is very essential, so that iatrogenic prematurity can be prevented, which is very essential in the management of all pregnancies in particular with regards to methods if termination (MTP).

Elective planned induction of labor management of high risk pregnancies where in all these conditions, correct assessment of fetal age is mandatory.

So in some exceptional cases, when normality of any one of the parameters like BPD,AC or FL is in doubt, gestational age can be assigned by PLACENTAL THICKNESS.

CONCLUSION

Diagnostic ultrasound is a non – invasive, safe and useful investigative method sought by the obstetricians to clear the different dilemmas in the obstetrics. Particularly it is very much helpful in estimating the gestational age of the fetus. It’s relatively simple, easy to perform and can be repeated and has shown to be free from risk to the mother and her unborn fetus.

In our study, patients with known LMP were taken and their placental thickness measurement were recorded and the maturity of the fetus were assessed after birth.

Our study shows that the age, parity, placental location show no significant bearing in the assessment of placental thickness and its correlation to gestational age. In our study, placental thickness increases with advancing gestation almost matching from 20 to 35 weeks.

The present study has shown a significant correlation between the placental thickness and gestational age particularly in late 2^{nd} and 3^{rd} trimester.

To conclude, one can say the measurement of placental thickness is an important parameter for estimation of fetal age. It is helpful in cases where the exact duration of pregnancy is not known (between 20 and 35 weeks) where the placental thickness almost matches with gestational age. Besides in determining gestational age placental thickness can be used as a predictor of LBW, IUGR, Hb Bart's disease (Hydrops fetalis).

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ABBREVIATIONS

- LMP –Last menstrual period
- EDD – Expected date of delivery
- GA – Gestational Age
- GS – Gestational Sac
- CRL – Crown Rump Length
- BPD- Bi Parietal Diameter
- HC- Head Circumference
- AC-Abdominal Circumference
- FL-Femur Length
- PT- Placental Thickness
- SD-Standard Deviation
- SGA-Small for Gestational Age
- LGA-Large for Gestational Age
- IUGR- Intra Uterine Growth Restriction

PROFORMA

PLACENTAL THICKNESS – FOR ESTIMATION OF GESTATIONAL AGE

Name: Age:

Op/Ip No:

LMP: EDD: Gestational age (by LMP)

Menstrual History: Regular/Irregular;

Cycles-

Obstetrics History

AN/Medical disorders:

USG details:

USG done on:

No. of Fetus: Presentation:

BPD: _____ mm _____ weeks

AC: _____ mm _____ weeks

FL: _____ mm _____ weeks

Placental thickness:

Placental Location: Maturity:

Amniotic Fluid:

Fetal Spine:

Any Other:

IMPRESSION: _____LIVE FETUS_____WEEKS OF GESTATION.

Postnatal details:

Date of delivery: Mode of delivery:

Placenta weight:

Sex of baby: Birth weight:

Gestational age: Term / Pre term / Post dated.