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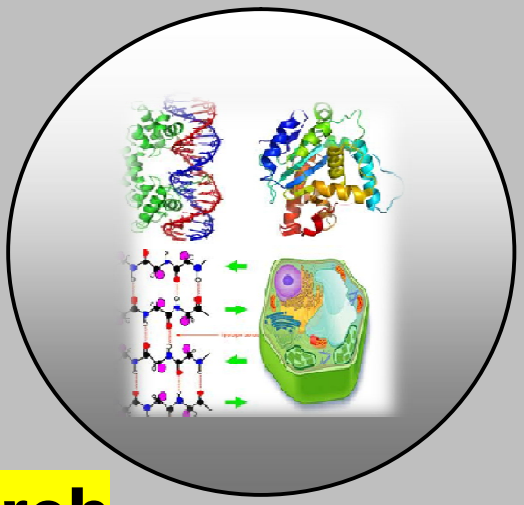

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RESEARCH PAPER

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Two Dimensional Ultrasonographic Volume Measurement of Third Trimester Placenta in Indian Females

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ABSTRACT

Determination of placental size is a part of the overall assessment of intrauterine environment. Placental growth can be estimated by either measuring the thickness or estimating its volume. The purpose of the present study was to determine the normal range of placental volume in our population in third trimester of pregnancy. This study was conducted on 100 women coming to antenatal clinic of Obstetrics and Gynaecology at Queen Mary's Hospital, King George's Medical University, Lucknow.

Cases having any obstetrical, gynaecological, medical or surgical illnesses were excluded. Placental volume was determined by measuring the width, thickness and height of the placenta and putting the values in the formula, Volume (V) = (π *T/6)* [4H (W-T) + W (W-4T) + $4T^2$] (AzPurua et al. 2009)[1]. Mean Placental volume in third trimester was observed as 493.27±282.4cm^3 which increased till 34 weeks, thereafter decreased and volume was found to be more dependent on width and height of placenta rather than its thickness.

Key Words: Placenta, Placental Volume, Ultrasonography of placenta, Placental and Abnormalities.

INTRODUCTION

A normally functioning placenta is critical for normal foetal growth and development (Kliman, 1993). Sonographic evaluation of placenta is the safest imaging technique and remains the imaging modality of choice for its evaluation. It is an important part of obstetrical evaluation of pregnancy. Advances in prenatal surveillance have focused mainly on the foetus, with little attention paid to the placenta (Galan et al. 2002, Resnik, 2002, Brodsky et al. 2004). A significant fraction of stillbirths are secondary to very small placentae. Prenatal assessment of placental volumes using ultrasound imaging can decrease the number of unexpected foetal demises (Jauniaux et al. 1994). Determination of placental size is a part of the overall assessment of intrauterine environment. Placental growth can be estimated by either measuring the thickness or estimating its volume (Geirsson et al. 1985). Placental size is expressed in terms of thickness in the midportion of the organ.

Although multiple well-written texts are available on the pathology of the placenta, few sources specifically focus on the normal development and anatomy of this complex organ (Pinar, 2006)[11]. So, the purpose of this study was to collect the recent information about the normal conditions and variations regarding the volume of this organ by ultrasonography in selected population.

MATERIAL AND METHODS

The present prospective study was conducted from August 2011 to August 2012 on 100 pregnant women attending antenatal clinics in the Department of Obstetrics and Gynaecology in collaboration with Department of Anatomy. Clearance of institutional ethical committee was obtained before starting the work. Women with uncomplicated, singleton pregnancy of more than 26 weeks, who gave their written informed consent, were taken as subjects and the gestational age was confirmed by previous ultrasonography reports of first trimester. Exclusion criteria followed has been shown in Table I.

Ultrasound examinations were performed in the department of Obstetrics and Gynaecology with model LOGIQ^{TM} α 200 ultrasound machine and in the Department of Anatomy with the help of L&T Medical, Sonata (version 3.1) machine, with a curvilinear 3.5 – MHz transducer.

Detailed history was taken to rule out medical and surgical illnesses which could affect our study. Thorough general physical and obstetrical examinations were done.

Scanning Technique: The ultrasound examination was performed through a full urinary bladder. During scanning, the pregnant woman was made to lie in the supine position with the protruding abdomen facing upwards; the probe was placed on the skin and a layer of ultrasonic gel was applied to the skin above the pubic area. To rule out oligohydramnios and polyhydramnios, amniotic fluid volume was measured by taking Amniotic Fluid Index (AFI). AFI was obtained by adding the vertical lengths of deepest fluid pockets in four uterine quadrants (Rumack et al. 1998). Adnexa were looked for the presence of any mass. Fetus was also seen for the presence of any major congenital anomaly. Fetal lie and position were identified by moving the probe all over the abdomen and following fetal parameters were taken to rule out intrauterine growth restriction- Biparietal diameter (BPD),

Abdominal circumference (AC), Head circumference (HC), Femur length (FL) and Effective Foetal Weight (EFW). Foetal weight was calculated using the Shepard formula. (Shepard et al. 1987). The placenta was identified as a hyper echoic area separated from fetus by a hypo echoic area of amniotic fluid.

The two edges of the placenta were focused in a single ultrasonographic field in transverse and longitudinal sections. The distance between two edges of placenta was taken as **width** (W) [Fig.1 (a)]. A point was taken over the maternal surface of placenta where it showed maximum convexity and a perpendicular line was drawn from this point over the previous line (line joining the two edges of the placenta) and in this way **maximum height** (H) was measured [Fig.1 (a)]. The probe was moved all over the localized placenta and the level of cord insertion was identified over the fetal surface. A straight line was drawn from the level of cord insertion up to the maternal surface of the placenta and thus **thickness** (T) was measured **[**Fig.1 (b)].

Volume of placenta (V) was calculated by using three variables i.e. width (W) , thickness (T) and height (H) put in the following concavo-convex shell formula-

Volume (V) = (π *T/6)* [4H (W-T) + W (W- 4T) + 4T^2] (AzPurua et al. 2009)[1].

The comparison among >2 groups was done by one way analysis of variance or Kruskal Wallis test for normally distributed or otherwise respectively. Data were analyzed using statistical software package, STATA 11.2 and the difference was considered to be significant if 'p' value was found to be <0.05.

RESULTS

100 pregnant females belonging to third trimester gestational period were divided into four gestational groups. The mean values of volume of the placenta were 453.61±369.8cm^3, 529.52±315.8cm^3, 505.77 ± 244.1cm^3 and 441.43± 126cm^3 for each group of gestation respectively. It was observed that the volume of placenta showed increasing trend uptil 34 wks of gestation and thereafter decreased till 42wks of gestation.

Table 1. List of maternal complications for exclusion criteria.

Medical complications	Pregnancy induced hypertension, severe anaemia (Hb<7gm%), Diabetes mellitus, Tuberculosis, any heart disease.
Obstetrical complications	Congenital anomalous fetus, oligohydramnios and polyhydramnios, rupture of membranes, Rh negative mothers, history of vaginal bleeding 1 month before the study, intrauterine growth retardation.
Gynecological complications	Presence of fibroid, any adnexal mass.

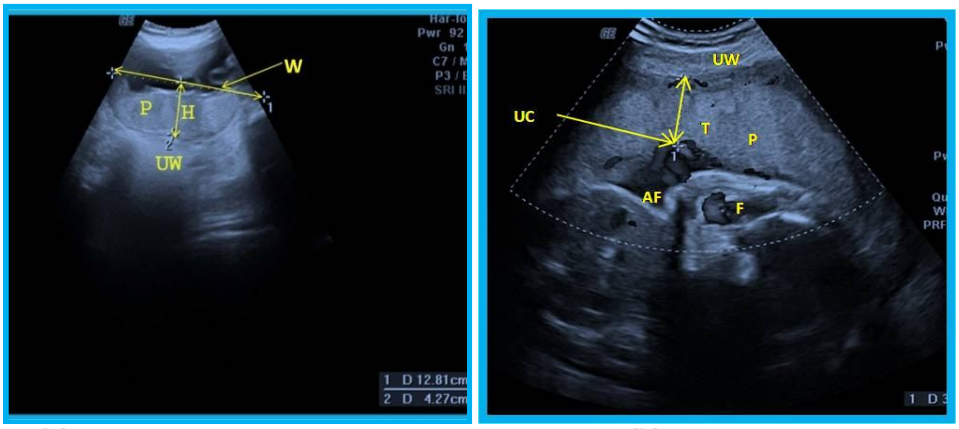
The mean value of placental volume for combined gestational groups (Third Trimester) was found to be 493.27± 282.4cm^3. The minimum and maximum volumes were 24.2cm^3 and 1797.4cm^3 respectively.

It was observed that in both conditions, no maternal or foetal complications were associated. The p –value was > 0.05, therefore, no significant difference was observed in volume of placenta among different gestational groups. (Table. 1 and 2). 493.27± 282.4**.** (Figure 1-3).

Table 2. Distribution of placental volume according to gestational age in study population.

Variables (Mean± S.D.)	Gestational Age (Weeks)				Range (Min – Max)
	26 – 30 (n=21)	30^{+} - 34 (n=26)	34^{+} - 38 (n=41)	38^{+} - 42 (n=12)	
Thickness (cm)	3.56±0.8	4.01±1.2	4.05±1.3	3.73±0.8	1.0 – 7.5
Height (cm)	4.80± 1.4	5.52± 1.2	5.50± 1.6	4.99± 1.0	1.1 – 9.6
Width (cm)	13.57±3.6	14.10±3.5	13.39±2.6	13.22±2.2	8.3 – 24.9
Volume (cm^3)	453.61± 369.8	529.52± 315.8	505.77± 244.1	441.43± 126	24.2 – 1797.4
Average	493.27± 282.4				24.2 -1797.4

Test used: Kruskal-Wallis. p= 0.2064
chi-squared with ties = 4.5674 with 3 d.f.



(a) **(b)**

Fig.1. Ultrasonogram showing landmarks for measuring (a) height and width of placenta. (b) – thickness of placenta. (P= Placenta, H= Height of placenta, W= Width of placenta, UW= Uterine wall, T= thickness of placenta, UC= Umbilical cord, AF= Amniotic fluid, F= Foetus).

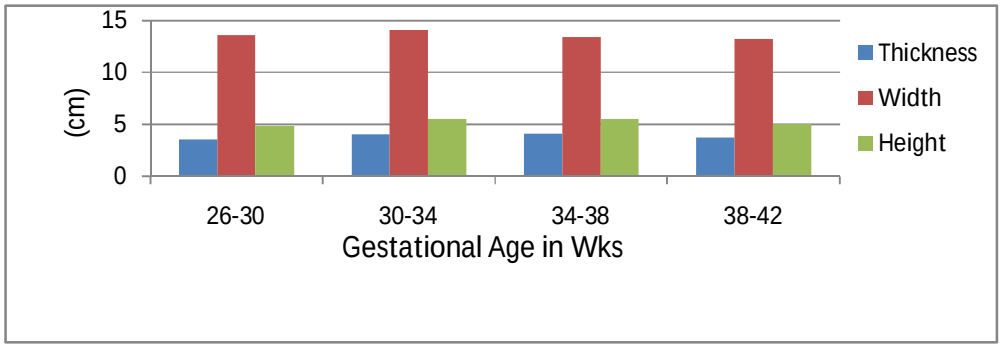


Fig.2. Bar diagram showing correlation of placental parameters (H, T, W) according to gestational age.

Fig. 3. Bar diagram showing distribution of placental volume (mean ± S.D) according to gestational age.

DISCUSSION

Placenta being a foetal organ shares the same stress and strain, to which the foetus is exposed. Thus any disease process affecting the mother and foetus also has a great impact on placenta. Placental volume and foetal measurements are useful parameters to predict birth weight. Placental volume measurement can be useful in the early diagnosis of foetal growth retardation.

In the present study, the mean placental volume between 38-42weeks of gestational period was 441.43 ± 126.5cm. The maximum placental volume was 1797.4cm^3 and minimum as 24.2cm^3. These findings were approximately nearer to the findings observed by Paula et al. 2007. They measured placental volume by 3 – D ultrasonography and found the mean placental volume as 427.7 cm^3 at 40th week. However, Fawzia and Habib, 2002, measured mean placental volume in second and third trimester of pregnancy as 923.47 ± 330.16cm^3 and Geirsson et al. 1985, measured third trimester placental volume as 801cm^3.

Hellman et al. 1970, carried out volumetric measurement of placenta at all gestations beginning from 12-44 weeks.[7] They obtained the placental volume in third trimester ranging from 64 -1140cm^3. Mansour et al. 2011, documented placental volume between 36-38weeks as 850.3±40.1cm^3, while the present study demonstrated placental volume as 505.77± 244.1cm^3 in the same time period. The probable factor for the difference may be compromised visualization of placenta in cases where the gestational age was above 36 weeks. As we know that the placental volume is directly influenced by the nutritional and environmental factors that could also lead to the discrepancy in the volume cited by different authors and the present study.

In the present study, placental volume increased till 34 weeks. In other studies mentioned above, the placental volume showed increasing trend till term. The reason behind the difference between the two findings may be the maturity and aging process of the placenta. At present we are unable to hypothesize, why such differences were observed, but these findings definitely require a study on larger sample population and also warrants Indian obstetricians and radiologists to refer data on volume specific for our environmental scenarios. As the placental volume followed similar trend with that of width and height of the placenta, it was correlated that volume was more dependent on above parameters rather than its thickness.

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