

## Two Dimensional Ultrasonographic Study of Placental Maturity and Its Correlation with Gestational Age and Maternal Parameters

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### ABSTRACT

**Background:** Placenta being a fetal organ shares the same stress and strain, to which the fetus is exposed. Thus any disease process affecting the mother and fetus also has a great impact on placenta. The purpose of the present study was to determine the changes and growth of placenta with advancing age of fetus in our population in third trimester of pregnancy. The correlation of placental maturity with maternal factors (maternal age and parity) was also determined.

**Methods:** This was an ultrasonographic study, conducted on 100 women (belonging to third trimester of pregnancy) 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. Maturity grade of placenta was determined.

**Results:** The frequencies of grade 0, grade I, grade II and grade III placental maturity were 1%, 6%, 46% and 47% respectively.

**Conclusion:** The p-value was highly significant; therefore, there was significant difference in maturity grade of placenta among different gestational groups.

**Key Words:** Placenta, Placental maturity, Ultrasonography of placenta, Placental Abnormalities

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### INTRODUCTION

The placenta serves as the major link between a mother and her unborn baby, the fetus. Owing to the delicate and important nature of the placenta, it is sometimes referred to as the "mirror of the perinatal period, which has not been sufficiently polished".<sup>1,2</sup> Placenta being a fetal organ shares the same stress and strain, to which the fetus is exposed. Thus any disease process affecting the mother and fetus also has a great impact on placenta. Normally the placental morphology varies considerably during its short life span. Alterations in placenta as part of "Ageing" phenomenon are probably a part of maturation process and go hand in hand with continued growth of placenta. The well being of the fetus is affected by many factors but a healthy placenta is the single most important factor in producing a healthy baby.<sup>3,4</sup> Fetal outcome is directly related to the maturation of placenta. With the advent of medical sciences and in conjunction with efforts to practice medicine based on scientific evidence, pathological conditions associated with all other systems were intensely studied. However, the

placenta is one of the least understood and most understudied organ in the human body. Mostly due to lack of available knowledge about the ultrasonographic features of normal placenta and its development this organ once again has been left behind.

Abnormalities of the placenta and the umbilical cord are the most culpable causes of most abnormal fetal outcome and even death with only a few being attributed to other causes such as behavior and diseases affecting the mother.<sup>5</sup> Sadly however, since the placenta and the umbilical cord are delivered with the baby, obstetricians have very little appreciation of placental development in the uterus. The need to be able to diagnose some of these abnormalities made the evolution of ultrasonography very useful in obstetrics and has found application in placental studies.<sup>6</sup> Sonography remains the imaging modality of choice for evaluation of the placenta. It is an important part of obstetrical evaluation of pregnancy.

Prior to the general use of ultrasound in prenatal surveillance, placental hormonal levels were used to assess placental function.<sup>7</sup> In the early days of ultrasound, Grannum et al (1979). Developed a method of placental grading in an attempt to evaluate placental fetal maturation.<sup>8</sup>

All placenta start as grade 0. The mean gestational age at which the placenta matures to a grade 1 is 31.11wks; grade 2, 36.36wks and grade 3, 38.04 wks.<sup>9</sup>

Wins berg (1973) described a distinct ultrasonographic appearance of the placenta occurring after 36 wks gestation, appearance of rounded transonic areas correspond to the placental tissue and a villous space between the interlobular septa show as white echoes due to their calcium content.<sup>10</sup>

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.<sup>11</sup> So, the purpose of this study was to collect the recent information about the normal and variant maturation of this organ by ultrasonography.

## MATERIAL AND METHODS

The present prospective study was conducted on 100 pregnant women attending antenatal clinics in the Department of Obstetrics and Gynaecology in collaboration with Department of Anatomy in King George's Medical University, Lucknow. 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. An exclusion criterion of the subjects is shown in Table 1.

Ultrasound examinations were performed in the Department of Obstetrics and Gynaecology with model LOGIQTM  $\alpha$  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:** 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.<sup>12</sup> Adnexa were looked for the presence of any mass. Fetus was also seen for the presence of any major congenital anomaly. Following fetal parameters were taken to rule out intrauterine growth retardation- 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.<sup>13</sup> The placenta was identified as a

hyper echoic area separated from fetus by a hypo echoic area of amniotic fluid.

**Grade of maturity of placenta (G):** The placentae were graded according to the criteria described by Grannum et al (1979).<sup>8</sup> According to the ultrasonographic appearance of the chorionic plate, placental substance and the basal layer, the placentae were graded as grade – 0, grade – I, grade – II and grade – III. **Grade – 0** placentae were identified on the basis of appearance of smooth line of chorionic plate with no indentations, homogenous placental substance and the basal layer without high level echoes.

**Grade – I** placentae were identified on the basis of subtle indentations in the chorionic plate, presence of echogenic densities in the placental substance and no echogenic densities in the basal layer.

The placentae were classified as **grade – II** on the basis of presence of echoes in the basal layer parallel to the base, numerous and confluent echoes in the placental substance and markedly indented vertical echoes from chorionic plate continuing in the placental substance but not reaching basal plate.

The placentae were classified as **grade – III** when the indentations reach the basal plate dividing the placenta into compartments. Basal layer echoes became more prominent and cast acoustic shadows. Irregular echoes appeared in the substance of the placenta close to the chorionic plate.

Descriptive statistics were described as mean  $\pm$  SD along with median, if indicated for quantitative variables. For qualitative variables, the data were described as proportion with their 95% CI for inferential statistics. The significance of the association between two categorical variables was tested by  $\chi^2$  statistic. 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  $<0.05$ .

## OBSERVATIONS AND RESULTS

100 pregnant females belonging to third trimester gestational period were enrolled and divided into four gestational groups.

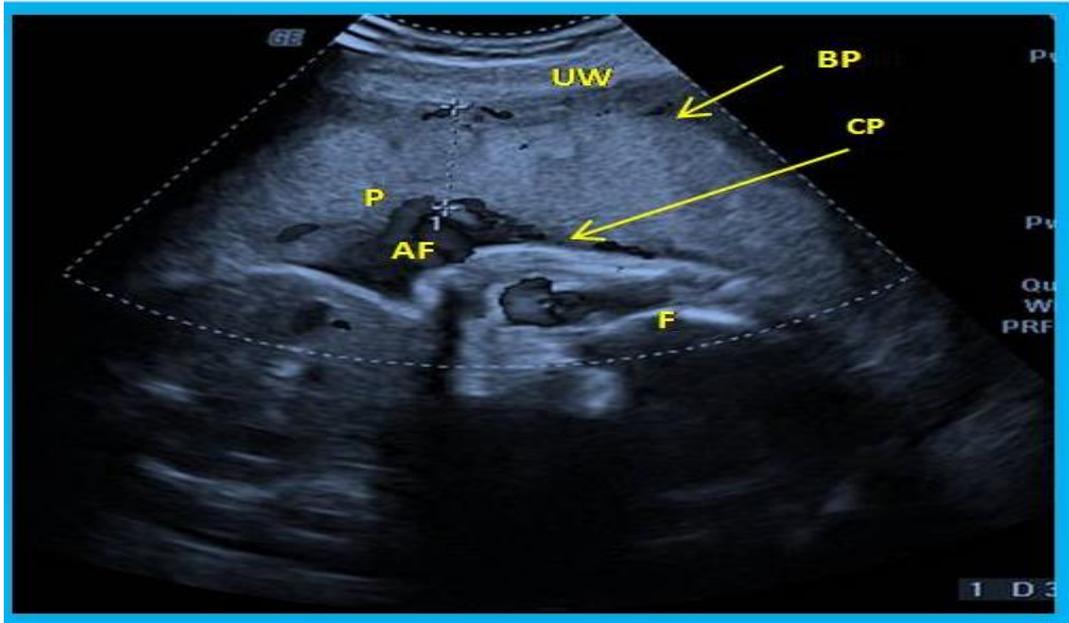
Only 1 case (100%) of grade 0 placenta was observed between 26 -30 wks of gestation. None case of grade 0 was present in rest of the groups of gestations. Five cases (83.33%) of grade I placenta were present between 26- 30wks and only 1 case (16.67%) was observed between 30<sup>+</sup> -34wks. Thirteen, nineteen and fourteen cases of grade II were present in 26 -30wks, 30<sup>+</sup> -34wks and 34<sup>+</sup> -38wks gestation respectively. Similarly, 2, 6, 27 and 12 cases were observed in each corresponding group of gestation. Table I also showed that 1% cases were grade 0, 6% cases were grade I, 46% cases were grade II and 47% cases were grade III [Fig.1 (a), (b)]

and (c)]. The p-value was highly significant; therefore, there was significant difference in maturity grade of placenta among different gestational groups. (Table 2)

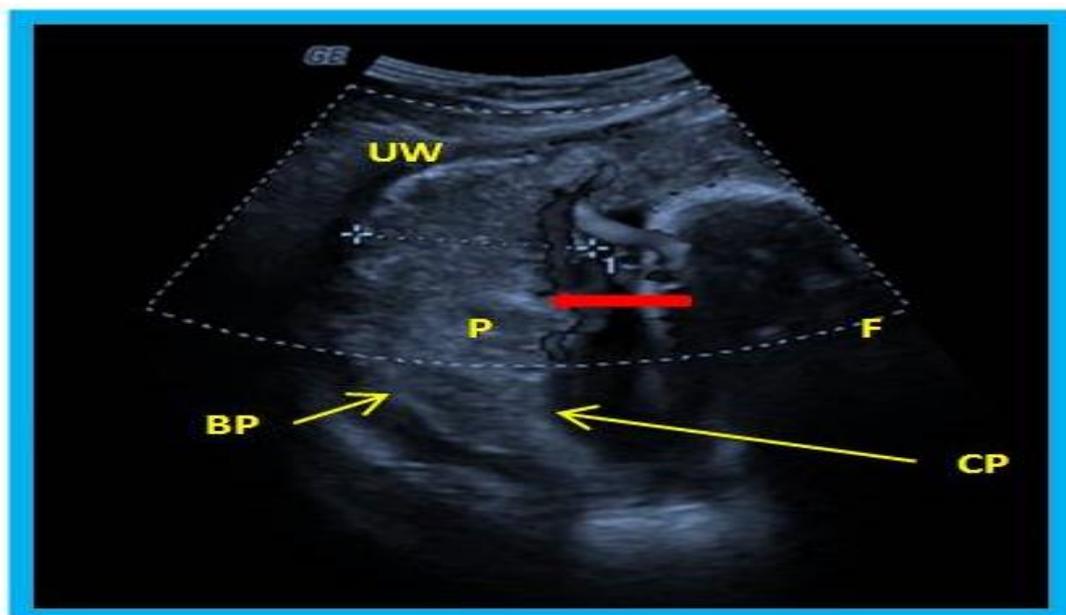
First maternal age group i.e.18-20yrs had 2, 11 and 6 cases of grade I, grade II and grade III placenta respectively. No case of grade 0 was noted in this age group. In second maternal age group i.e. 21-30yrs; 1, 4, 34 and 33 cases of grade 0, grade I, grade II and grade III were present respectively. Maternal age group of 31-40yrs contained 1 case of

grade II and 8 cases of grade III placentae respectively. No case of grade I and grade 0 was observed in this maternal age group. (Table 3)

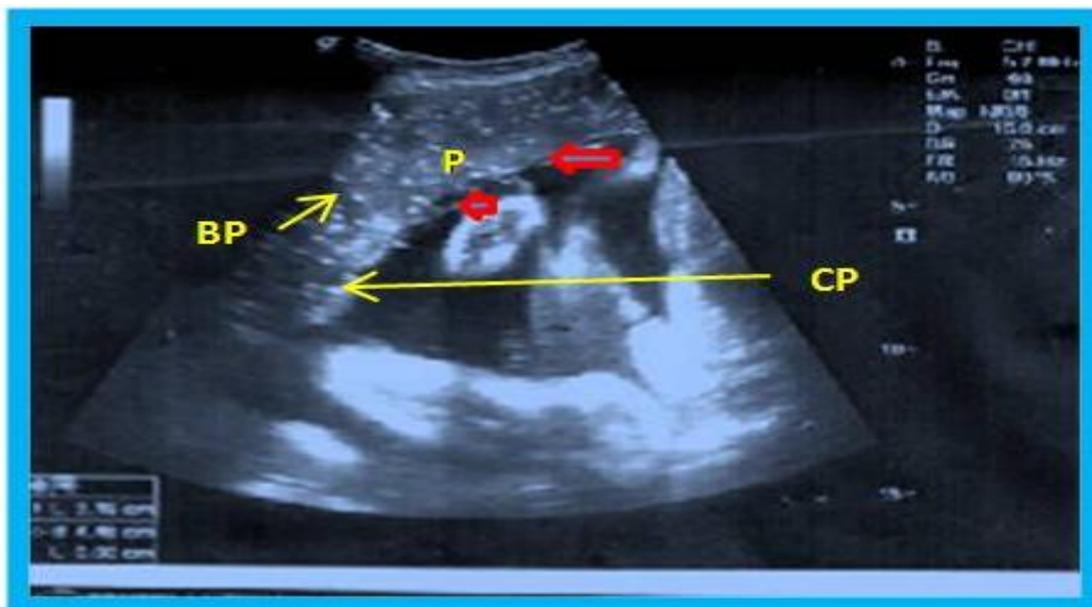
Females belonging to primigravida group had 0,2,28 and 22 cases of grade 0, grade I, grade II and grade III maturity of placenta respectively. Multigravida subjects contained 1,4,18 and 25 cases of grade 0, grade I, grade II and grade III placentae respectively. (Table 4)



**A. Grade-I Placenta**



**B. Grade -II Placenta**



**C. Grade- III Placenta**

Arrow marks (red color) indicating Indentation in Chorionic Plate (CP).  
BP-Basal Plate, AF-Amniotic Fluid, F-Fetus, UW-Uterine Wall, P- Placenta

**Table 1: List of maternal complications to exclude the subjects from study population**

Medical complications	Pregnancy induced hypertension, severe anaemia (Hb<7 gm%), 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.

**Table 2: Distribution of maturity of placenta according to gestational age among study population**

Gestational Age	Grade 0		Grade I		Grade II		Grade III	
	(n)	%	(n)	%	(n)	%	(n)	%
26 -30	01	100	05	83.33	13	28.26	02	4.26
30+ -34	0	0	01	16.67	19	41.30	06	12.77
34+ -38	0	0	0	0	14	30.43	27	57.45
38+ -42	0	0	0	0	0	0	12	25.53
<b>Total</b>	01	100	06	100	46	100	47	100

Pearson chi2 (12) = 51.1085 Pr = 0.000

**Table 3: Distribution of maturity grading of placenta according to maternal age**

Grading of placenta	Maternal Age (years)			Total
	18-20	21-30	31-40	
0	0	01	0	01
I	02	04	0	06
II	11	34	01	46
III	06	33	08	47
<b>Total</b>	19	72	09	100

chi-square = 8.93  
degrees of freedom = 6  
probability (p) = 0.177 ( non significant )

**Table 4: Distribution of maturity grading of placenta according to parity**

Grading of placenta	Parity		
	Primigravida	Multigravida	Total
0	0	01	01
I	02	04	06
II	28	18	46
III	22	25	47
<b>Total</b>	52	48	100

chi-square = 3.88

degrees of freedom = 3

probability = 0.275 ( non significant )

## DISCUSSION

Majority of placentae nearing the term i.e. 34-38 weeks exhibited grade III maturity. In 26 -30 weeks of gestation, maximum cases showed grade I maturity. In 30 -34 weeks of gestation, grade II maturity was most frequent.

In the present study all grades of placental maturity were observed in third trimester. We found grade 0 (1%), grade I (6%), grade II (46%) and grade III (47%) placentae. According to various text books, the distribution at term is 45% for grade I, 55% for grade II and 5-10% for grade III.<sup>14</sup>

In the present study grade 1+ and 2+ placentae were seen from 26th week to term; grade 3+ placentae from 34 weeks to term. Grannum (1979) stated that the maturational changes may not necessarily progress sequentially to a higher grade but may remain the same until term.<sup>8</sup> In abnormal pregnancies the placenta may mature more rapidly through the grades.

Hopper et al (1984) noted that if the placenta appeared to be grade 1 prior to 27 wks, grade 2 prior to 32wks and grade 3 prior to 34wks of gestation, the pregnancy would likely to be complicated with intrauterine growth retardation and pre- eclampsia.<sup>15</sup> Contrary to this, in the present study, cases of grade 2 prior to 32 wks and grade 3, prior to 34 wks were reported with no complications (IUGR and pre-eclampsia).

Shiwani and Moodley (1986), studied grading of placenta in women belonging to third trimester (> 38 weeks) and noted that grade 0, grade I, II and III placentae were present in 0%, 5%, 72% and 18% cases respectively, whereas in the present study, we observed that all the cases of similar gestational period, were belonging to grade III maturity.<sup>16</sup> In our population, this fact may be correlated with fetal lung maturity and can be a useful predictor for elective caesarean section. Dudley et al (1993) observed that the all the grade III placentae were thinner.<sup>17</sup> Similarly, we also found that thinner placentae were belonging to grade III maturity. Thereby, we may infer that placental maturity could be a probable cause for decline in placental thickness after 38 weeks.

In the present study, a statistically significant correlation existed between placental grading and gestational age of the fetus, suggesting a more dependable relationship between these two parameters. This finding is very much similar to those observed by Shiwani and Moodley (1986) and Tindall and Scott (1965).<sup>16,18</sup>

In the present study, no clear association between placental grading and maternal age or parity was observed. However, Tindall and Scott (1965) observed that 82% placentae showed calcification in primigravidae and 72% in multigravidae.<sup>18</sup> They observed that both the incidence and intensity of calcification decreases with increasing age. Fujikura (1962) stated that incidence of placental calcification seemed to decrease with advancing maternal age. There was a significant difference between the mean maternal age of the calcified group and the non-calcified group. But he observed a reverse relationship between parity and placental maturity.<sup>19</sup>

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