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Original Research Article

Association of ultrasonographic placental thickness with neonatal outcome

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ABSTRACT

Background: Placental thickness on routine ultrasound is a simple measure of placental function, but its link with neonatal outcome is not well settled. We studied the association between placental thickness and neonatal outcome.
Methods: This prospective observational study was done at a government tertiary hospital in Kota, India, from July 2024 to July 2025. In 150 women with singleton pregnancies, placental thickness was measured at the cord insertion at 20-22 and 34-36 weeks and classed as thin, normal or thick. We recorded birth weight, 5-minute Apgar score, NICU admission, neonatal resuscitation and perinatal death.
Results: At 34-36 weeks, 20 placentas (13.3%) were thin, 100 (66.7%) normal and 30 (20.0%) thick. Mean birth weight was 2400±180 g, 3050±260 g and 3350±320 g, respectively ($p<0.001$). Compared with normal placentas, thin placentas had more NICU admissions (40.0% vs 14.0%; RR 2.86, 95% CI 1.39-5.89), Apgar scores below 7 (30.0% vs 11.0%) and resuscitation (20.0% vs 5.0%); thick placentas did not. A thin second-trimester placenta independently predicted low birth weight (adjusted OR 3.8, 95% CI 1.9-7.5). The area under the ROC curve for low birth weight was 0.81 and 0.85 in the second and third trimesters.
Conclusions: A thin placenta was associated with lower birth weight and poorer immediate neonatal outcome. Placental thickness may help to supplement fetal biometry, but larger multicentre studies are needed.

Keywords: Placental thickness, Neonatal outcome, Birth weight, Fetal growth restriction, Ultrasonography, Low birth weight

INTRODUCTION

The placenta supplies the fetus with oxygen and nutrients and removes waste products. When it works poorly, fetal growth can be restricted and the baby may be born small, early or unwell. Ultrasound allows the placenta to be examined during routine antenatal visits.[1] Among the placental measurements, thickness is the simplest to obtain on a two-dimensional scan. It needs no extra equipment and increases with gestational age.[2-4]

Earlier studies have linked placental thickness with birth weight and with Apgar score and admission to the neonatal intensive care unit (NICU).[5-10] Thin placentas have been reported with fetal growth restriction (FGR), low birth weight and prematurity, whereas thick placentas have been seen with gestational diabetes and heavier babies.[11-15] In a high-risk group, the relation between second-trimester thickness and adverse outcome was U-shaped.[16]

These studies are hard to compare. They used different cut-offs and outcome definitions, and many measured thickness only once or only in high-risk women.[16,17] Placental thickness is also seldom mentioned in routine scan reports. We therefore measured it at two points in pregnancy in women attending a government tertiary

hospital and studied its relation with birth weight, Apgar score, NICU admission, need for resuscitation and perinatal death.

METHODS

Study design and setting

This prospective observational study was carried out in the Department of Obstetrics and Gynaecology, J. K. Lon Hospital, Government Medical College, Kota, Rajasthan, from July 2024 to July 2025. The institutional ethics committee approved the study, and every woman gave written informed consent.

Participants

We included women aged 20-40 years with a singleton pregnancy who attended the antenatal clinic in the second and third trimesters, had regular menstrual cycles, were certain of their last menstrual period and had not used oral contraceptives before conception. Women were excluded if the fetus had a congenital malformation; the placenta was lobed, succenturiate, membranous or circumvallate; the cord insertion was marginal, battledore or velamentous; there was placenta previa or abruption; the pregnancy was multiple; the cord insertion site could not be seen well; or the placenta could not be seen clearly because of maternal obesity. All women were followed until delivery.

Sample size

The minimum sample size was 44, calculated for an expected correlation coefficient of 0.413 with 95% confidence and 80% power. We enrolled 150 women to improve precision.

Ultrasound measurement

Placental thickness was measured at 20-22 weeks and again at 34-36 weeks using a Hitachi Arietta 65 machine with a VC 35 convex probe. The woman lay supine with a full bladder. Thickness was measured at the level of the cord insertion, from the chorionic plate to the basal plate, excluding the retroplacental area, and the maximum value in the cross-section was recorded in millimetres.

Grouping by placental thickness

At each time point the placenta was classed as normal (22-26 mm at 20-22 weeks; 30-41 mm at 34-36 weeks), thin (<22 mm; <30 mm) or thick (>26 mm; >41 mm), using gestational age-specific cut-offs. Grouping was done separately for the two time points.

Outcomes

Women with thin or thick placentas were followed closely for FGR, preterm labour, hypertensive disorders of pregnancy, gestational diabetes mellitus (GDM) and abnormal amniotic fluid volume. FGR was defined as below the 10th centile. After delivery we recorded the mode of delivery, induction of labour, birth weight, Apgar score at 5 minutes, neonatal resuscitation, NICU admission and perinatal death for all women. Low birth weight was defined as <2500 gm haemoglobin, blood glucose, renal and liver function, serum electrolytes, PT-INR and thyroid function were measured at 34-36 weeks.

Statistical analysis

Continuous data are given as mean±standard deviation and categorical data as number (percentage). Birth weight in the three groups was compared by one-way analysis of variance. Categorical outcomes in the thin and thick groups were compared with the normal group using Fisher's exact test, and risk ratios (RR) with 95% confidence intervals (CI) were calculated from the group counts. Pearson's correlation was used to relate placental thickness to birth weight and Apgar score.

Predictors of low birth weight were examined by multivariable logistic regression that included second-trimester thin placenta, maternal age above 35 years and unbooked status. The ability of placental thickness to identify low birth weight was assessed from the area under the receiver operating characteristic (ROC) curve. Analysis was done in R version 3.6.0, and $p<0.05$ was taken as significant.

RESULTS

Characteristics of the women

We studied 150 women (Table 1). Most were aged 25-34 years (56.7%), 120 (80.0%) had booked antenatal care, 100 (66.7%) were multigravida and 78 (52.0%) had a normal body mass index; 40.0% were overweight or obese. At 34-36 weeks the mean blood pressure was 114±10/74±6 mmHg and the mean haemoglobin was 11.2±1.0 g/dl.

Placental thickness

Mean thickness rose from 24.14±3.15 mm at 20-22 weeks to 35.57±5.25 mm at 34-36 weeks (Table 2). In the second trimester 25 placentas (16.7%) were thin, 95 (63.3%) normal and 30 (20.0%) thick. In the third trimester the figures were 20 (13.3%), 100 (66.7%) and 30 (20.0%).

Pregnancy complications and mode of delivery

Table 3 shows complications by second-trimester thickness. Compared with normal placentas, thin placentas had more FGR (28.0% vs 5.3%, p=0.003), oligohydramnios (20.0% vs 3.2%, p=0.010) and preterm delivery (20.0% vs 4.2%, p=0.019). Severe preeclampsia and eclampsia were also more frequent in the thin group, but the differences were not significant. GDM and

polyhydramnios occurred in 10.0% each of women with thick placentas, which did not differ significantly from the normal group. Caesarean section was done in 55.0%, 40.0% and 50.0% of women with thin, normal and thick third-trimester placentas (p=0.36; Table 4).

Neonatal outcomes

Neonatal outcomes by third-trimester thickness are given in Table 5. Mean birth weight rose from the thin to the normal to the thick group (2400±180 g, 3050±260 g and 3350±320 g; p<0.001). Compared with normal placentas, thin placentas carried a higher risk of NICU admission (RR 2.86, 95% CI 1.39-5.89), Apgar score below 7 at 5 minutes (RR 2.73, 95% CI 1.14-6.52) and neonatal resuscitation (RR 4.00, 95% CI 1.18-13.6). The only perinatal death occurred in the thin group. Thick placentas were not significantly associated with any of these outcomes.

Correlation, regression and ROC analysis

In women with thin placentas, thickness correlated positively with birth weight (r=0.62 in the second trimester and r=0.68 in the third trimester, both p<0.001). No correlation was seen in women with thick placentas (r=−0.12, p=0.539 and r=−0.02, p=0.915). Placental thickness also correlated positively with the 5-minute Apgar score (r=0.45, p=0.002 in the second trimester; r=0.52, p<0.001 in the third trimester) (Table 6). In the regression model, second-trimester thin placenta (adjusted OR 3.8, 95% CI 1.9-7.5, p<0.001) and unbooked status (adjusted OR 2.0, 95% CI 1.1-3.9, p=0.02) predicted low birth weight, while maternal age above 35 years did not (Table 7). The area under the ROC curve for low birth weight was 0.81 (95% CI 0.73-0.88) in the second trimester and 0.85 (95% CI 0.78-0.91) in the third trimester (Table 8).

Table 1: Baseline characteristics of the study population (n=150).

Characteristics	Category	N (%)/ mean±SD
Age (years)	20-24	30 (20.0)
	25-29	45 (30.0)
	30-34	40 (26.7)
	35-40	35 (23.3)
Antenatal care	Booked	120 (80.0)
	Unbooked	30 (20.0)
Education	Illiterate/primary	25 (16.7)
	Secondary	60 (40.0)
	Graduate and above	65 (43.3)
Socioeconomic status	Upper	20 (13.3)
	Upper middle	55 (36.7)
	Lower middle	45 (30.0)
	Upper lower	30 (20.0)
Gravidity	Primigravida	50 (33.3)
	Multigravida	100 (66.7)
BMI (kg/m²)	<18.5 (underweight)	12 (8.0)
	18.5-24.9 (normal)	78 (52.0)
	25-29.9 (overweight)	45 (30.0)
	≥30 (obese)	15 (10.0)
At 34-36 weeks	Systolic BP (mmHg)	114±10
	Diastolic BP (mmHg)	74±6
	Haemoglobin (g/dl)	11.2±1.0
	Blood glucose (mg/dl)	88±12
	Renal/liver function derangement	5 (3.3)
	Abnormal serum electrolytes	8 (5.3)
	Abnormal PT-INR	2 (1.3)
	Abnormal thyroid profile	4 (2.7)

BMI- body mass index; BP- blood pressure; PT-INR- prothrombin time-international normalised ratio.

Table 2: Baseline characteristics of the study population (n=150).

Time point/category	Cut-off (mm)	N (%)	Thickness, mean±SD (mm)
20-22 weeks (overall 24.14±3.15 mm)			
Thin	<22	25 (16.7)	19.32±1.31
Normal	22-26	95 (63.3)	23.92±1.14

Continued.

Time point/category	Cut-off (mm)	N (%)	Thickness, mean±SD (mm)
Thick	>26	30 (20.0)	28.87±1.39
34-36 weeks (overall 35.57±5.25 mm)			
Thin	<30	20 (13.3)	27.51±1.46
Normal	30-41	100 (66.7)	34.83±2.74
Thick	>41	30 (20.0)	43.44±1.99

Table 3: Pregnancy complications according to second-trimester placental thickness.

Complications	Thin (n=25)	Normal (n=95)	Thick (n=30)	P, thin vs normal[a]	P, thick vs normal[a]
Severe preeclampsia	4 (16.0)	5 (5.3)	3 (10.0)	0.089	0.40
Eclampsia	2 (8.0)	1 (1.1)	1 (3.3)	0.11	0.42
FGR	7 (28.0)	5 (5.3)	3 (10.0)	0.003	0.40
Oligohydramnios	5 (20.0)	3 (3.2)	2 (6.7)	0.010	0.59
Polyhydramnios	1 (4.0)	2 (2.1)	3 (10.0)	0.51	0.089
GDM	2 (8.0)	4 (4.2)	3 (10.0)	0.60	0.36
Preterm delivery	5 (20.0)	4 (4.2)	3 (10.0)	0.019	0.36

FGR- fetal growth restriction; GDM- gestational diabetes mellitus; [a]-Fisher's exact test; no adjustment for multiple comparisons.

Table 4: Mode of delivery according to third-trimester placental thickness.

Variables	Thin (n=20)	Normal (n=100)	Thick (n=30)
Normal vaginal delivery	7 (35.0)	55 (55.0)	13 (43.3)
Assisted vaginal delivery	2 (10.0)	5 (5.0)	2 (6.7)
Caesarean section[a]	11 (55.0)	40 (40.0)	15 (50.0)
Induction of labour	3 (15.0)	10 (10.0)	3 (10.0)

[a]-Caesarean section versus other modes across the three groups: Chi square p=0.36.

Table 5: Neonatal outcomes according to third-trimester placental thickness.

Outcome	Thin (n=20)	Normal (n=100)	Thick (n=30)	Thin vs normal: RR (95% CI); p[a]	Thick vs normal: RR (95% CI); p[a]
Birth weight (g), mean±SD	2400±180	3050±260	3350±320	ANOVA p<0.001	ANOVA p<0.001
NICU admission	8 (40.0)	14 (14.0)	6 (20.0)	2.86 (1.39-5.89); 0.011	1.43 (0.60-3.39); 0.40
Apgar<7 at 5 min	6 (30.0)	11 (11.0)	4 (13.3)	2.73 (1.14-6.52); 0.037	1.21 (0.42-3.53); 0.75
Neonatal resuscitation	4 (20.0)	5 (5.0)	2 (6.7)	4.00 (1.18-13.6); 0.041	1.33 (0.27-6.53); 0.66
Perinatal death	1 (5.0)	0 (0)	0 (0)	Not estimable; 0.17	Not estimable; 1.0

NICU- neonatal intensive care unit; RR- risk ratio; CI- confidence interval; [a]p values from Fisher's exact test. ANOVA for the three-group comparison of birth weight: F(2,147)=79.0.

Table 6: Correlation of placental thickness with birth weight and 5-minute Apgar score.

Analysis	Pearson r	P value
Birth weight, thin placenta		
Second-trimester thickness	0.62	<0.001
Third-trimester thickness	0.68	<0.001
Birth weight, thick placenta		
Second-trimester thickness	-0.12	0.539
Third-trimester thickness	-0.02	0.915
5-minute Apgar score		
Second-trimester thickness	0.45	0.002
Third-trimester thickness	0.52	<0.001

Table 7: Multivariable logistic regression of predictors of low birth weight.

Variables	Adjusted OR	95% CI	P value
Second-trimester thin placenta	3.8	1.9-7.5	<0.001
Maternal age >35 years	1.2	0.8-2.0	0.25
Unbooked status	2.0	1.1-3.9	0.02

Table 8: ROC analysis of placental thickness for predicting low birth weight.

Gestational window	AUC	95% CI	P value
20-22 weeks	0.81	0.73-0.88	<0.001
34-36 weeks	0.85	0.78-0.91	<0.001

DISCUSSION

In this study of 150 women, a thin placenta at 34-36 weeks went with lower birth weight and with more NICU admissions, low 5-minute Apgar scores and resuscitation, and a thin placenta at 20-22 weeks predicted low birth weight independently of maternal age and booking status. Thick placentas were linked to heavier babies but not to more acute neonatal problems.

Our mean third-trimester thickness (35.57 mm) is close to the 35.2 mm that Agrawal et al reported at 36 weeks, and the rise from mid-pregnancy matches the pattern described by Khajjayam et al and Vinchurkar et al.[12,18,19] Dolikhani et al found higher values at 32-34 weeks, which may reflect differences in technique or population.[20] We found more thin placentas (16.7% and 13.3%) than Shinde et al (5.2% and 7.3%).[21] We used fixed cut-offs and our hospital serves a referred, mostly government-sector population, but we did not test whether either explains the difference.

The step-wise rise in birth weight across the groups agrees with studies that found positive correlations between placental thickness and birth weight.[6,9,10,18-22] We calculated correlations within the thin and thick groups. The correlation was clear in thin placentas but absent in thick ones, which suggests that thickness tracks birth weight mainly at the lower end, where a small placenta may limit growth. Because each group had only 20-30 women, this should be read with caution.

Thin placentas were also associated with FGR, oligohydramnios and preterm delivery. Rawal et al found FGR in 43.3% of women with a thin placenta at 30-32 weeks and in 2.3% of those with normal thickness, and Vinchurkar et al reported thinner placentas in small-for-gestational-age pregnancies.[11,12] In contrast, Ashwal et al studied high-risk women and found that placental area and uterine artery Doppler, rather than thickness, remained independently associated with adverse outcome.[16] Severe preeclampsia and eclampsia were more common in our thin group, but not significantly so, and we regard this as a pointer for further study only.

For immediate neonatal outcome, our results are in line with Patil et al, who found more low Apgar scores and NICU admissions with thickness below the 10th percentile, and with Gabr et al.[9,10] Shinde et al also saw neonatal deaths only in the thin group, as we did, but a single death in our series cannot support any conclusion. Dolikhani et al found no link between thickness and Apgar score in uncomplicated pregnancies, and Arora et al reported a negative correlation, so the relation may depend on the risk profile of the women studied.[20,21,23] In our data the Apgar correlation was positive, yet Apgar <7 was slightly more frequent in the thick than in the normal group (13.3% vs 11.0%), so the relation may not be linear.

Thick placentas had the highest mean birth weight, as Iloghalu et al found with thickness above 4.0 cm.[15] GDM and polyhydramnios were more frequent in our thick group (10.0% each), in keeping with placental changes described in GDM, but the numbers were small and the differences were not significant.[14] Murlewska et al linked a very thick placenta with more fetal dysfunction, but in a fetal echocardiography population and with much higher cut-offs.[24]

Placental thickness identified low birth weight with an area under the curve of 0.81 in the second trimester and 0.85 in the third, which is good discrimination. Models that combine several ultrasound measures, including Doppler, do better; Guo et al reported 0.961 for such a model, higher than for thickness alone.[25] Thickness should therefore be seen as an addition to fetal biometry and Doppler, not a replacement. We did not work out the best cut-off or its sensitivity and specificity, which would be needed before it is used in practice. Because the measurement takes little time, reporting thickness against gestational age-specific values on routine scans may help to identify women who need closer follow-up, especially where Doppler is not easily available.

Strengths and limitations

The study was prospective, used one measurement technique at two gestational ages and recorded a defined set of neonatal outcomes. Its limitations are the small sample, especially the thin (n=20-25) and thick (n=30) groups; the single centre; fixed cut-offs, with grouping done separately at each time point; no correction for multiple comparisons; adjustment for only maternal age and booking status in the regression; no assessment of observer variability; two-dimensional rather than

volumetric measurement; no placental histopathology; and no derived diagnostic cut-offs. The study cannot show that a thin placenta causes the outcomes described.

CONCLUSION

A thin placenta on routine ultrasound was associated with lower birth weight, FGR, preterm delivery and poorer immediate neonatal outcome, and a thin placenta at 20-22 weeks independently predicted low birth weight. A thick placenta was associated with higher birth weight but not with more acute neonatal problems. Placental thickness is easy to measure and may add to fetal biometry in antenatal risk assessment. Larger multicentre studies are needed to set reference ranges and useful cut-offs.

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