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Research Article

Placental Location and its Maternal and Perinatal Outcome

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Abstract

Background: The human placenta is a complex organ and plays a key role during pregnancy. Normal placentation and placental development are critical for a successful pregnancy. The localisation of the placenta determined by ultrasound in the second trimester has been hypothesised to have an impact on the pregnancy and hence it can be used as a tool to assess the adverse pregnancy outcomes.

Objectives: To assess the relationship between placental location and maternal and perinatal outcomes.

Methods: This is a prospective study conducted at ESIC-MC and PGIMSR Hospital, Bengaluru from January 2020 to June 2021. 350 primigravida attending the antenatal clinic were included in the study. Placental locations was determined by Ultrasound during 18-28 weeks period of gestation. Patients were followed upto term gestation. The maternal and perinatal outcomes was observed.

Results: Among the 350 patients enrolled in the study; the placenta was located laterally in 106 women (30.3%), anteriorly in 96 (27.4%), posteriorly in 96 (27.4%) and fundal in 52 (14.9%) women. 54 (42%) of the study participants with gestational hypertension had laterally located placenta which was statistically significant (p = 0.001). Fundal and lateral placenta had a significant association with malpresentations (p = 0.005). 6 out of 7 pregnant women with abruption had lateral placenta (p = 0.013).

Conclusion: Localisation of placenta by ultrasound in second trimester is an important determinant of pregnancy outcomes. Different placental locations are associated with a number of adverse pregnancy and neonatal outcomes like Preeclampsia, IUGR, preterm labour occur more in lateral placenta. Hence second trimester ultrasound can be used as one of the non invasive predictor of adverse pregnancy and neonatal outcomes.

Keywords: *Placental Location; Maternal Outcome; Neonatal Outcome; Lateral Placenta; Ultrasound; Preeclampsia*

Background

The human placenta is a complex organ and plays a key role during pregnancy. Normal placentation and placental development are critical for a successful pregnancy. The localisation of the placenta determined by ultrasound in the second trimester has been hypothesised to have an impact on the pregnancy and hence it can be used as a tool to assess the adverse pregnancy outcomes.

Methodology

Study design

It is a hospital based prospective study.

Source of data

Antenatal women undergoing antenatal care and delivery at ESIC_MC and PGIMSR Hospital, Bangalore, from January 2020 - June 2021 after obtaining the institutional ethical committee clearance.

Duration of the study: Eighteen months (January 2020 to June 2021).

Inclusion criteria:

1. Primigravida.
2. With singleton pregnancy.
3. Age group 18 to 35 years.
4. Willing for follow up and delivery at ESIC-MC and PGIMSR hospital.

Exclusion criteria:

1. Multigravida.
2. Multiple pregnancy.
3. Chronic cases of hypertension, diabetes, thyrotoxicosis, chronic renal disease.
4. Placenta previa.
5. With previous history of uterine surgeries/procedure- Myomectomy, dilatation and curettage.

Method of collection of data

Sample size: 350 pregnant women.

This clinical study will be conducted at ESIC- MC and PGIMSR Hospital, Bangalore from January 2020 to June 2021.

All the Primigravidae, attending the antenatal clinic after obtaining an informed consent are assessed and will be followed upto term gestation for maternal and neonatal outcome.

A detailed history and the patient information is taken, then a complete clinical examination is done, Routine antenatal investigations are done.

The placental location is determined by a 18 - 28 weeks ultra sonogram and categorised into central (Anterior and posterior) placenta, lateral (right or left), fundal or low lying.

Gestational age confirmed from last menstrual period and ultrasound scan.

Maternal outcomes: Will be measured in terms of:

A. Development of maternal morbidities
    1. Gestational hypertension/preeclampsia
    2. Gestational diabetes mellitus

3. Post-partum haemorrhage
4. Ante-partum haemorrhage
5. Intra uterine growth restriction
6. Premature rupture of membranes
7. Preterm labor
8. Oligohydramnios.

B. Mode of delivery

1. Vaginal delivery - Full Term (FTVD)/Preterm (PTVD)
2. Instrumental delivery
3. Caesarean delivery- Elective/Emergency.

Perinatal outcomes: Will be measured in terms of:

1. Birth weight,
2. APGAR score at 1 and 5 minutes,
3. NICU admissions.

The patient details will be collected using the proforma (Annexure 2).

Duration of the study: Eighteen months (January 2020 to June 2021).

Study design: Prospective study.

Sample size

The sample size for the present study has been calculated by considering the proportion of anticipated frequency of lateralized placenta as 15% and nearly 5% complication rate of PIH in lateral placentation, from the past published literature studied by Seckin KD., *et al*. [12] 2012.

The minimum sample size at 95% confidence interval has been calculated to 307 cases with 4% absolute precision, power at 80% and absolute marginal error as 0.05. Therefore, we will enroll 350 cases in our study. The following formula has been used to calculate sample size:

$n = [DEFF*Np\ (1-p)]/[d^2 / Z^2_{1-\alpha/2}* (N-1) + p* (1-p)]$.

The sample size was calculated using www.openepi.com.

Statistical analysis

All characteristics were summarised descriptively. For continuous variables, the summary statistics of mean ± standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries and diagrammatic presentation. Chi-square (χ^2) test was used for association between two categorical variables.

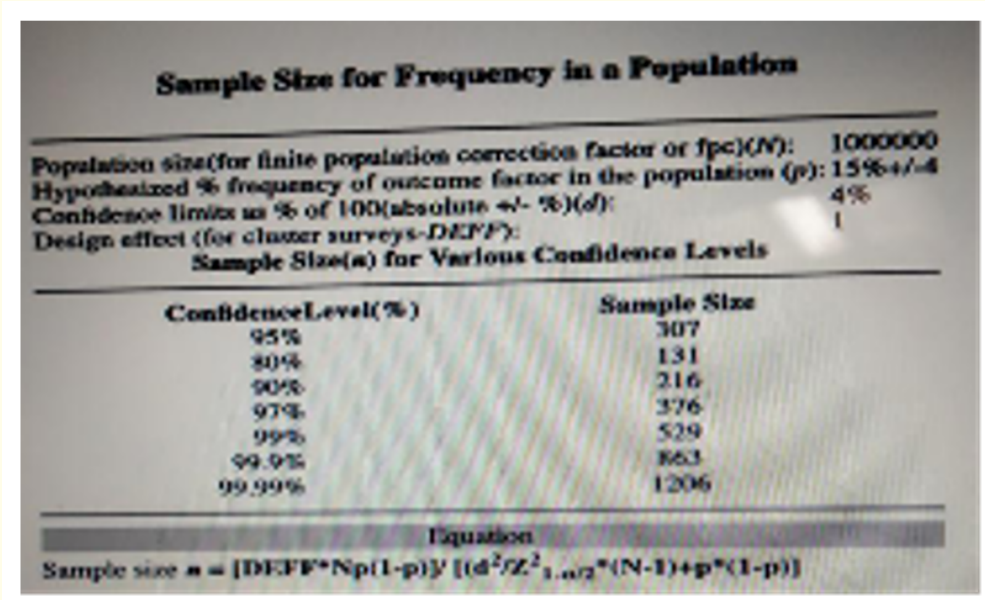

Figure 1: *Sample size for frequency in a population.*

The formula for the chi-square statistic used in the chi square test is:

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

The subscript "c" are the degrees of freedom. "O" is observed value and E is expected value.

If the p-value was < 0.05, then the results were considered to be statistically significant otherwise it was considered as not statistically significant. Data were analysed using SPSS software v.23 (IBM Statistics, Chicago, USA) and Microsoft office 2007.

Results

During the study period 350 pregnant females were enrolled. The maternal and fetal outcome data subdivided into placental location are presented in the form of tables and figures.

Placental location	Number	Percent
Anterior	96	27.4
Fundal	52	14.9
Lateral	106	30.3
Posterior	96	27.4
Total	350	100

Table 1: *Distribution of placental location.*

GHTN	Anterior		Fundal		Lateral		Posterior		p value
	N	%	N	%	N	%	N	%	
Yes	36	37.5%	15	28.8%	54	50.9%	24	25.0%	0.001*
No	60	62.5%	37	71.2%	52	49.1%	72	75.0%	
Total	96	100.0%	52	100.0%	106	100.0%	96	100.0%	

Table 2: *Distribution of GHTN among study subjects based on placental location.*

Preeclampsia	Anterior		Fundal		Lateral		Posterior		p value
	N	%	N	%	N	%	N	%	
Yes	0	0.0%	1	1.9%	19	17.9%	5	5.2%	<0.001*
No	96	100.0%	51	98.1%	87	82.1%	91	94.8%	
Total	96	100.0%	52	100.0	106	100.0%	96	100.0%	

Table 3: *Distribution of preeclampsia among study subjects based on placental location.*

OLIGO	Anterior		Fundal		Lateral		Posterior		p value
	N	%	N	%	N	%	N	%	
Yes	28	29.2%	15	28.8%	41	38.7%	20	20.8%	0.052
No	68	70.8%	37	71.2%	65	61.3%	76	79.2%	
Total	96	100.0%	52	100.0%	106	100.0%	96	100.0%	

Table 4: *Distribution of oligohydramnios among study subjects based on placental location.*

MOD	N	%
Vaginal Delivery	202	57.7
LSCS	148	42.3
Total	350	100.0

Table 5: *Distribution of mode of delivery among study subjects.*

BW	Anterior		Fundal		Lateral		Posterior		p value
	N	%	N	%	N	%	N	%	
<2.5Kg	12	12.5%	9	17.3%	23	21.7%	14	14.6%	0.326
≥2.5Kg	84	87.5%	43	82.7%	83	78.3%	82	85.4%	
Total	96	100.0%	52	100.0%	106	100.0%	96	100.0%	

Table 6: *Distribution of neonatal birth weight based placental location.*

Discussion

Placenta is a "flat, slab-like", choriodecidual structure developed during pregnancy and is the organ of exchange between the fetus and the mother for serving as a physiological exchange.

The blood supply of the uterus is not uniformly distributed [2].

Centrally located placenta receives equitable distribution of blood flow from both the uterine arteries whereas in laterally located placenta, the uterine artery closer to the side of placenta has a low resistance and a good blood flow, which causes disparity in blood distribution. The other uterine artery supplying the placenta located laterally receives less contribution from the collateral circulation. The degree of collateral contribution may not be the same in all women, and deficient contribution might lead to the development of preeclampsia, IUGR, or both [3].

This is a prospective observational study conducted in ESIC MC and PGIMSR, Rajajinagar, in the department of Obstetrics and Gynaecology. In this study placental location determined by the Ultrasound between 18 - 28 weeks and its association with adverse maternal and fetal outcomes has been evaluated. During the study period 350 pregnant individuals were enrolled in the study.

Majority of the pregnant women in our study group were from the age group 21 - 25 years i.e. 162 (46.3%), comparable to the study done by Aggarwal P., *et al*. [3] in which 207 (43.6%) women were aged between 21 - 25 years, and Singh N., *et al*. [6] where 233 (39.5%) women belonged to 20 - 25 years age group.

In our study the mean gestational age at which ultrasound scan was considered for placental localisation was 20.6 ± 2.1 weeks of gestation. We considered an 18 - 28 weeks ultrasound scan for placental localisation, comparable to study done by Faizi S., *et al*. [13] where as in a study done by Singh N., *et al*. [6] they considered a 18 - 24 weeks scan for localisation by Ultrasound.

Mean gestational age at delivery in our study was 38.6 ± 1.6 weeks ranging from 30.1 to 40.6 weeks of gestational age.

313 (89.4%) women delivered at > 37 weeks, comparable to the study by Zia S [2], Seckin., *et al*. [12] and Devarajan., *et al*. [16].

In our study, lateral placenta was the most common placental location in 30% cases, followed by anterior in 27%, posterior in 27% and fundal in 14%. Comparable to the study done by Singh N., *et al*. [6] in which lateral placenta accounted for the majority 38% (226/592).

Gestational hypertension

	Anterior	Lateral	Posterior	Fundal
Present study	36 (37.5)	54 (51)	24 (25)	15 (29)
Singh N., *et al*.	16 (13)	78 (63)	12 (9.5)	18 (14.5)
Faizi., *et al*.	58 (21.2)	17 (27.9)	26 (15.4)	16 (16.3)
Dhingra S., *et al*.	8 (13)	2 (12)	8 (22)	0

Table 7: *Comparison of GHTN with other studies based on placental location.*

In centrally located placenta, the uteroplacental blood flow needs are met by the equal distribution from both uterine arteries, whereas in laterally located placenta majority of cases uteroplacental blood flow is met with primarily by one of the uterine arteries. This degree of collateral circulation may vary and if there is deficient contribution may facilitate development of preeclampsia.

In our study, 129 cases of gestational hypertension and 25 cases of preeclampsia were observed. There is a significant association of development of gestational hypertension and preeclampsia with lateral location of placenta ($p < 0.001$). Of the 106 cases with laterally located placenta, 54 women developed GHTN and 19 women developed preeclampsia.

Of the overall 129/350 women who developed gestational hypertension, majority 54/129 (42%) had a lateral placenta. And of the 25 women with preeclampsia, 19 (76%) had lateral placenta.

Similar outcome were noted by the study done by Singh N., *et al*. [6], who reported that out of 124 women who developed preeclampsia, 78 (63%) had laterally located placenta.

This result is also in accordance with Kofinas., *et al*. [17], who concluded that in women with lateral placenta, the incidence of preeclampsia was 2.8 fold greater than those with centrally located placenta.

Similarly, in the study done by Aggarwal P., *et al*. [3], of the total 58 women who developed preeclampsia, 45 (17.1%) had laterally located placenta while only 13 (6.1%) women had central placenta. These findings were found to be statistically significant ($p < 0.05$).

Anuja V Bhalerao., *et al*. [18] also reported that out of the 168 women with laterally located placenta, 112 (661.6%) developed PIH as compared to 132 females with centrally located placenta where 48 (36.6%) developed PIH. So, the risk of developing PIH was five times greater for the females with laterally located placenta.

This is further supported by a study done by Faizi S., *et al*. [13], where 27.9% women with preeclampsia had lateral placenta ($P < 0.05$).

Gonser., *et al*. [31] analyzed 184 patients concluding that women with a lateral placenta had significantly increased incidence of preeclampsia (risk ratio of 3.1).

Fung., *et al*. [14] conducted a retrospective analysis where a 2.2 and a 2.0 fold higher risk was noted for the development of preeclampsia ($p < 0.001$).

Gestational diabetes mellitus

The association of GDM and placentation is thought to be due to hyperplacentosis, villous immaturity, chorangiosis, and mainly due to production of human placental lactogen and human placental growth hormone, which antagonises the insulin action.

In our study, 73 women had developed GDM, among which 32 (44%) had posterior placenta and 27 (37%) women had anterior placenta ($p < 0.001$). Zia S [2] reported a significant association between Anterior placenta and GDM ($p < 0.001$).

While in studies done by Gizzo., *et al*. [19] and Magann., *et al*. [4] statistically significant association between the occurrence of GDM and placental location was found.

Intra uterine growth restriction

IUGR is a failure to achieve the growth potential of a fetus that is promised by the genetic constitution and environmental influences endogenous to the pregnancy. The growth of the fetus depends on the interactions of genetic and epigenetic determinants functioning against an environment of maternal, fetal and placental influences. IUGR is defined as estimated fetal weight less than the 10% for gestational age, although a fetal weight < 3rd % is a better predictor of perinatal mortality.

In women with centrally located placenta both uterine arteries demonstrate similar resistance whereas, in lateral placenta the degree of collateral circulation differs among all women and deficient contribution facilitates the development of IUGR.

Nair VV., *et al*. [7] found significant association between lateral placenta and development of IUGR (p = 0.007).

Singh., *et al*. [6] conducted a prospective study on 592 patients and reported that in 53 pregnant women who were diagnosed to have IUGR, 33 (62.26%) had lateral placenta, with a significant p value of < 0.0018 and 3.006 (OR) with 95% CI (1.678 - 5.385).

These results were in accordance with the study conducted by Seadati., *et al*. [20] which showed lateral placentation had 2.7 times risk of developing IUGR. And Kalanithi., *et al*. [15] reported that IUGR pregnancies were nearly 4-fold more likely to have lateral placentation OR -3.8, with 95% CI (1.3 - 11.2).

Preterm

In our study, there is no significant association between placental location and Preterm labour (p = 0.987).

Similarly Faizi S., *et al*. [13] in their study concluded no statistically significant correlation with occurrence of Preterm labour and location of placenta (p = 0.57).

On the contrary, Shumaila Zia [2] concluded that preterm labour were associated with posterior placenta with a significant p value of < 0.001.

Singh., *et al*. [6] reported, out of 94 posterior placentas, 30 (31.9%) landed up into preterm labour with a p value of < 0.0001.

Torricelli., *et al*. [21] conducted a prospective study on 2354 patients and found that posterior placental location was associated with preterm labour with an outcome of 59.2% and a significant p value of < 0.001. Similar observations were made by Schulman., *et al*. [22].

Prelabor rupture of membranes

In our study, among the 79 pregnant women who had prelabor rupture of membranes, 34 had posterior placenta, 20 women had anterior placenta, 15 had fundal placenta while 10 had Laterally located placenta. There was significant association between posterior placenta and PROM (p < 0.001). This was probably because of the anatomic variation of the posterior wall of the pregnant uterus, which is longer and thicker, resulting in uneven blood supply.

In contrary to our study, Hadley., *et al*. reported that a placenta located in the fundus carries a significantly higher risk of premature rupture of the membrane. They presumed that fundal location of the placenta places the weakest point of the membrane over the cervical os and thus predisposes the women to premature rupture of membrane.

Similarly Faizi., *et al*. [13] also reported that PROM was more common in fundal placenta and this finding was statistically significant (p = 0.014). Magann., *et al*. [4] and Fung., *et al*. [14] reported that there was no statistically significant correlation between placental location and PROM (p > 0.05).

Oligohydramnios

In our study, among the 104 cases of oligohydramnios, 41 (38.7%) had laterally located placenta though this was not statistically significant (p > 0.05).

According to Seckin., *et al*. [12] the incidences of oligohydramnios 20 (15%), were higher in lateral placental group (p = 0.042).

Faizi S., *et al*. [13] in their study noted that out of 76 cases of oligohydramnios, 42 (15.3%) had anterior Placenta though this also was not statistically significant (p = 0.91).

Abruption

In our study significant association was noted between lateral location of placenta and occurrence of abruption (p = 0.013), out of 7 cases of abruption 6 cases had laterally located placenta.

In accordance to our study, Nair VV., *et al*. [7] also reported a statistically significant correlation between the lateral placental location and risk of abruption (p = 0.007), they stated that this observation may be explained in terms of unequal distribution of blood supply in lateral placentation and increased risk of development of preeclampsia and subsequent abruption as its complication. This was also supported by Faizi S., *et al*. [13] where ante partum haemorrhage was more common in lateral placenta.

Post partum haemorrhage

In our study there was no statistically significant association between occurrence of PPH and any particular placental location (p = 0.478). Similar findings were noted by Seckin., *et al*. [12]. According to Fung., *et al*. [14] severe PPH was noted in the placenta covering the os with a p value of < 0.0001. Those with a placenta covering the os earlier in pregnancy, but whose placenta did not remain so later in gestation had nearly six times (95% CI, 2.3 - 16.6) the risk of having a severe postpartum haemorrhage of more than 1000 mL compared to other placental locations [26].

Anaemia

In our study population, 40 (11.4%) pregnant women had anaemia, but we found no statistical correlation between placental location and occurrence of anaemia (p > 0.05). Similarly Seckin., *et al*. [12] also reported no significant difference in the maternal haemoglobin values between the lateral and the central placental group (p = 0.152).

Malpresentation

In our study, we had 28 women with malpresentation, i.e. breech in 22 cases and transverse lie in 6 cases. Among them the placenta was located laterally in 15 (53.57%) and Fundal in 8 (28.57%).

Association between placental location and malpresentation is statistically significant (p = 0.045).

Similarly Fung., *et al*. [14] reported that fundal or lateral implantation sites were significantly associated with an increased risk of having a non-vertex presentation at delivery probably because 'fundal' or 'lateral' placenta impedes fetal movement, thus preventing it from achieving a cephalic lie from the breech presentation by active whole body movements, such as kicking. Also Faizi S., *et al*. [13] noted malpresentation was more common in fundal placenta 8 (8.2%) with a probable explanation that with a fundal placenta, the total length of the uterine ovoid decreases thence predisposing the fetus to occupy a non longitudinal lie.

However, the study by Magann., *et al*. [4] didn't find any statistical association between placental location and abnormal presentation (p = 0.834).

Mode of delivery

In our study, 57.7% of pregnant women delivered vaginally and 42.3% women delivered by caesarean section.

Among the women who delivered vaginally, majority 64 (31.68%) women had posteriorly located placenta, 54 (26.73%) had lateral placenta.

While among the women who underwent caesarean section, 52 (35.13%) had laterally located placenta and 47 (31.75%) had anterior placenta.

The association between placental location and mode of delivery is statistically significant ($p < 0.001$).

In contrary, Gizzo., *et al*. [19] reported that the posterior placental location had a higher rates of caesarean section compared to other placental location sites ($p < 0.01$).

According to Sekulic., *et al*. patients with cornuo-fundal placental location had a higher probability of delivery by caesarean section than by vaginal delivery.

Where as, in studies done by Seckin., *et al*. [12], Devarajan., *et al*. [16], Contro., *et al*. [27] and Duran., *et al*. they found no correlation between placental location and the mode of delivery.

Neonatal outcomes

Birth weight

In our study, 58 babies had birth weight < 2.5 kg; amongst these 23 (21.7%) women who low birth weight babies had laterally located placenta, though this was not statistically significant ($p = 0.326$). Consistent with our study, Faizi S., *et al*. [13] and Gizzo., *et al*. [19] also did not find any association of placental location and neonatal birth weight.

In contrast to our findings Fung., *et al*. [14], found that fundal 44 (10.8%) and laterally 62 (9.9%) located placenta were significantly associated with low birth weight babies ($p < 0.0001$).

Kalanithi., *et al*. [15] a found positive correlation between lateral placental implantation and low birth weight babies.

In a study by Duran., *et al*. birth weight of anteriorly located placenta was higher than posteriorly located placentas.

APGAR score

In our study 111 babies had APGAR score of ≤ 7 at 1 minute and 56 babies had APGAR score of ≤ 7 at 5 minutes. However, there was no statistically significant association between different placental locations and low APGAR scores.

In accordance with our study Faizi S., *et al*. [13], Fung., *et al*. [14] and Zia S [2] also found no correlation between low APGAR score and placental location.

NICU admission

In our study, 84 (24%) babies required admission to the neonatal intensive care unit, though there was no statistically significant association between the various placental location and need for NICU admission ($p = 0.402$). Consistent with our study, Singh., *et al*. [6], Fung., *et al*. [14] found no correlation with placental location and NICU admission.

While Nair VV., *et al*. [7], with a use significant p value of 0.05, concluded that lateral placenta had major NICU admissions 19 (26%). Also, according to Lucy., *et al*. lateral placental location led to increased chances of FGR babies thus in turn had higher need of NICU admission and care ($p < 0.01$).

Intra uterine death

In our study, one intrauterine fetal death was noted in a women with posterior placenta who had developed gestational hypertension. Though no statistical correlation was noted.

Similarly Fung., *et al*. [14] study, no significant association between various placental location and intra uterine death was noted.

While in a study done by Nair VV., *et al*. [7], thirteen cases of anterior placenta were associated with 7.3% risk of IUD/still birth with a significant p value of 0.007. However, Singh., *et al*. [6] concluded that posterior placental location had 50% risk of Still birth and a significant p value of < 0.0188. Shumaila Zia., *et al*. [2] conducted a retrospective study on 474 patients and found that anterior placental location was associated with IUD with an outcome of 1.5% and a significant p value of < 0.001. In contrast, studies conducted by Warland., *et al*. [34] and Jaisal., *et al*. [25] concluded that posterior placenta was associated with increased risk of still birth.

Conclusion

In our study, there is a significant association between laterally located placenta and adverse maternal and fetal outcome like gestational hypertension, preeclampsia, intra uterine growth restriction and IUD.

Ultrasonogram is an integral part of antenatal care and monitoring. An ultrasonogram scan is a simple, non-invasive, easy to perform and cost effective tool for placental localisation and to predict adverse pregnancy outcome.

Thus a second trimester ultrasonographic placental localisation can be used as a predictor of hypertensive disorders, gestational diabetes mellitus, so preventable measure can be implemented to achieve a more favourable outcome and reduce the maternal and perinatal morbidity and mortality.

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