

Placental Location as a Predictor of Maternal and Fetal Health Outcomes: An Observational Study

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ABSTRACT

Background: The human placenta plays a vital role as an organ that facilitates metabolic exchange, hormone regulation, and various key physiological interactions between the mother and the growing fetus. It also forms the physical link between the fetus and the uterine wall, essential for fetal development. Consequently, any irregularities in placental implantation may impair blood flow to the placenta, potentially leading to harmful effects on both maternal and fetal health.

Our study aims: To determine relation between placental location and maternal fetal outcome.

Methods : A prospective cohort study at Benghazi medical center include 300 pregnant women coming for any medical services after 32 weeks of gestation and followed till time of delivery , demographic and medical data were collected , ultrasound to detect placental location and its relation to maternal and foetal outcome.

Results: Age of the studied cases ranged from 20 to 42 years with mean 29.6 years, 95.6% of the studied group have central placenta, 3.33 % have lateral placenta and only 1% have placenta Previa, Highly significant relation between placental location and age of pregnant (p value <0.001) ,100% with placenta previa have blood group A+ve , 30%of lateral placenta have A-ve, A+ve and 20% with blood group B+ve and O+ve,100.0% of cases with placental Previa , main mode of delivery was Preterm cesarean section, while in cases with lateral placenta 70.0% of cases with preterm vaginal delivery, also 67.9% of cases with central placenta have preterm vaginal delivery. Conclusion: The location of the placenta, as determined at 28 weeks of gestation, can be utilized to assess pregnancies and classify them into high-risk categories for potential maternal complications and fetal outcomes.

Keywords: Placental location, antenatal outcome, pregnancy outcome

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INTRODUCTION

The placenta is essential for enabling the exchange of nutrients, hormones, and other vital functions between the mother and fetus. Furthermore, it serves as a window into the intrauterine environment, offering clues that may help pinpoint factors associated with adverse pregnancy outcomes ⁽¹⁾. Studies conducted in the USA, Europe, and Saudi Arabia have shown an association between placental location, blood flow, and pregnancy outcomes ^(1,2,3,4). Placental abnormalities are widely acknowledged as major factors contributing to maternal and perinatal morbidity and mortality ⁽⁵⁾.

Advances in medical imaging, especially ultrasound, have made it an essential tool in routine antenatal care for most pregnancies. Ultrasound is now commonly used to evaluate the fetus, placenta, umbilical cord, and amniotic fluid. Abnormalities in fetal development, amniotic fluid

levels, or Doppler assessments of blood flow in the uterine and umbilical arteries can signal potential complications or risks for adverse pregnancy outcomes. Studies indicate that uterine blood supply is unevenly distributed, suggesting that the implantation site and subsequent placental location may significantly impact placental blood flow and pregnancy outcomes ⁽⁶⁾.

Extensive research has concentrated on low placental implantation to ensure early identification of placenta previa. However, fewer studies have examined other aspects of placental positioning and their possible impact on pregnancy outcomes. Existing research suggests that placental location may be linked to adverse outcomes, including preterm birth ⁽⁷⁾ and small for gestational age (SGA) infants ⁽⁸⁾, fetal malposition, malpresentation, and the development of pre-eclampsia^(9,10). Theoretically, a lateral placental position could increase the risk of

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intrauterine growth restriction (IUGR). A case-control study in the USA found that women with fundal placental placement had a higher risk of premature rupture of membranes and related complications⁽⁷⁾. Findings on the association between IUGR and non-previa placental locations have been inconsistent^(11,12,13).

Understanding if the initial site of placental implantation observed on ultrasound can forecast antepartum complications, labor events, and neonatal outcomes is essential. Moreover, evaluating whether placental location could be used as a screening tool to predict these complications may offer important insights for enhancing pregnancy management and outcomes. Data on the influence of placental location on pregnancy outcomes in developing countries, however, remains limited. Our aim to determine relation between placental location and maternal fetal outcome.

METHODS

A prospective cohort study at Benghazi medical center, including 300 pregnant women attending for any medical services after 32 weeks of gestation, primigravida or multipara (P1,2,3) and willing to follow up but patients who refuse to participate excluded from the study, sample was comprehensive sample.

DATA COLLECTION

Demographic and demographic data was collected from January 2023 to June 2024 by direct face to face questionnaire including age, blood group, residence, working status, education, last date of menstrual period (LMP), expected delivery date (EDD), gestational age, primigravida or multipara (P1,2,3), Obstetric History (PIH, GDH, Placental abruption, PTL), weight, height, BMI, Past medical history and past surgical history (PMH, PSH).

Ultrasound examination: to detect placental location (Anterior, posterior, lateral (Right or left), fundal, low lying and accessory lobe), Presentation of baby (cephalic, malpresentation)

Pregnant women were followed up till time of delivery to detect : by routine Antenatal care every week till delivery.

Mode of delivery

(Full term vaginal delivery, preterm vaginal delivery, FT C/S, PT C/S, Term C/S)

Placenta post -partum

Method of removal (Expelled spontaneous, manual removal under anesthesia), Weight of placenta, Any abnormality seen by naked eye

Neonatal outcome

(A live – IUFD- still birth- perinatal death), APGAR score (poor – good –excellent), any congenital anomalies (mention it), any birth trauma (yes or no), neonatal ICU admission (yes or no)

Ethical consideration:

Official permissions were obtained from Benghazi medical center administration, the study group was informed about the nature and the purpose of the study and informed written consent was taken before interview. The ethical principles outlined in the Declaration of Helsinki were adhered to, and all experiments were conducted in compliance with relevant regulations and guidelines. Participants were not subjected to any harm or unintended consequences

Statistical analysis:

The collected data were computerized and statistically analyzed using SPSS program (Statistical Package for Social Science) version **25.0**, Qualitative data were represented as frequencies and relative percentages, Chi square test was used to calculate difference between qualitative variables with fisher exact and Yates correction when needed, Quantitative data were expressed as mean $\pm$ SD (Standard deviation), median and range, Mann Whitney test was used to calculate differences between qualitative variables in not normally distributed data, The significance, P value of >0.05 indicates non-significant results, P value of <0.05 indicates significant results and P value of <0.001 indicates highly significant results.

RESULTS

Our study which includes 300 pregnant women, their ages ranged from 20 to 42 years with mean $\pm$ SD (29.6 ± 4.62) years. About 97.0 % of them were Libyan, 99% of the studied group resident in Benghazi. Regarding Occupation 58.0% of studied group were house wife, 71.7% of them were University Education.

Gestational age ranged from 19 to 41 weeks with mean $\pm$ SD (37.9 ± 1.84) weeks. Regarding Parity (28.7%, 23.3%, 20.0%, 28.0%) of the studied group with P0, P1,P2, P3 respectively, about 80.3% of the studied group with no previous miscarriage, in addition 91.0 % of the studied group with no past obstetric history, 83.6% with no past medical history, 83.3% with no past surgical history and 93.3% of the studied group with no past drug history and only 6.7 % only take medication as (Aldomet, L-thyroxin, Insulin, Tab thyroxin and Tonic) (**Table,1**).

32.0 % of the studied group were A+ve, 31.7% were O+ve and 17.7% of the studied group were B+ve, (6.0%, 2.0%, 3.0%, 2.0%, 5.7%) of the studied group were A-ve, B-ve, AB-ve, AB+ve and O-ve respectively (**Fig., 1**).

Our results declared that 95.6% of the studied group have central placenta, 3.33 % have lateral placenta and only 1% have placenta Previa, among central placenta, 58.6% with anterior location, 14.6% with fundal location (**Fig., 2.a,b**)

There was statistical significant difference between placental location and complication of pregnancy ($p < 0.001$) about 35 (12.2%) cases with complication from total 287 cases with central placental location, 7 (70.0%) cases from 10 pregnant with lateral placenta and 3 (100.0%) of pregnant women with placenta Previa, but there is insignificant difference regarding type of

complication ($p=0.22$), in addition there was statistical significant association between site of central placenta and presence of complications ($P<0.001$), the most complication present in women with posterior location (26.0%) (Table, 3a,b).

Our results revealed that 100.0% of cases with placental Previa, main mode of delivery was Preterm cesarean section, while 70.0% of cases with lateral placenta experienced full term vaginal delivery, also 67.9% of cases with central placenta have full term vaginal delivery (Table, 4).

Our results declared that, statistical significant difference between placental location and Weight of placenta ($P<0.001$) which (mean weight of central placenta (546.73 ± 90.34), lateral placenta (623.0 ± 110.7) and Placenta Previa (302.0 ± 40.3), In addition, there was statistical significant difference between placental location and birth weight ($P=0.03$) which birth weight of neonate born with central placenta was (3098.38 ± 542.4) gm, mean birth weight of neonate born with lateral placenta (3470 ± 1110.6) gm and

mean birth weight of neonate of placenta Previa was (2370 ± 340), Also, there was statistical significant difference between placental location and Gestational age ($p<0.001$) which mean of gestational age of pregnancy of central placenta (37.97 ± 1.78), lateral placenta (38.1 ± 0.87) and Placenta Previa (32.0 ± 0.2), (Table,5)

There was statistical significant difference between (central location, lateral location of placenta and placenta previa) regarding APGAR score ($p<0.001$) which 81.2 % of cases with central placenta have excellent APGAR score, 60% of cases with lateral placenta and 100.0% with placenta previa have good APGAR score. Moreover there was statistical significant difference between different location and NICU admission ($p<0.001$), 100% of neonates of mothers with placenta previa need ICU admission and 30.0% with lateral placenta need ICU admission. But on the other hand, there was statistically insignificant difference between placental location and neonatal is alive or stillbirth ($p=0.93$) and any congenital anomalies ($p=0.97$) (Table,7).

Table (1): medical history of the studied group:

Variable		(n=300)	
Gestational age: (Weeks)	Mean $\pm$ Sd Range	37.9 $\pm$ 1.84 (29-41)	
Variable		No	%
Parity:	P0	86	28.7
	P1	70	23.3
	P2	60	20.0
	P3	84	28.0
Previous miscarriage	Zero	241	80.3
	One	24	8.0
	Two	32	10.7
	Four	3	1.0
Obstetric history	No	273	91.0
	GDM	9	3.0
	PIH	6	2.0
	PIH and placental abruption	3	1.0
	PTL	9	3.0
Past medical history	No	259	83.6
	Hypothyroidism	20	6.7
	UTI	9	3.0
	Asthma	6	2.0
	Hypertension	3	1.0
	Antiphospholipid	3	1.0
Past surgical history	No	250	83.3
	yes	50	6.7
Drug History	No	280	93.3
	Aldomet	6	2.0
	L-thyroxin	5	1.7
	Insulin	3	1.0
	Tab thyroxin	3	1.0
	Tonic	3	1.0

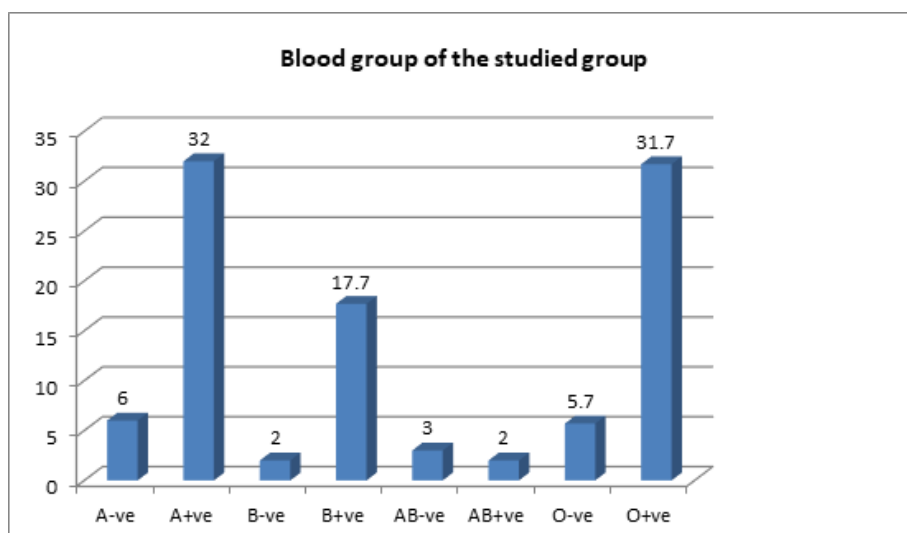


Fig. (1): Bar graph shows distribution of the studied group according to Blood group.

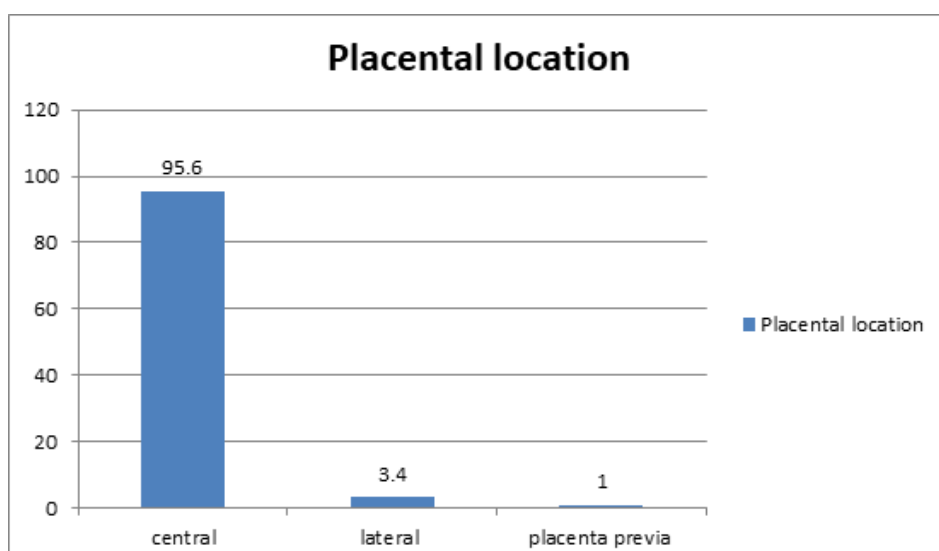


Fig. (2.a): Bar graph shows distribution of the studied cases regarding Placental Position.

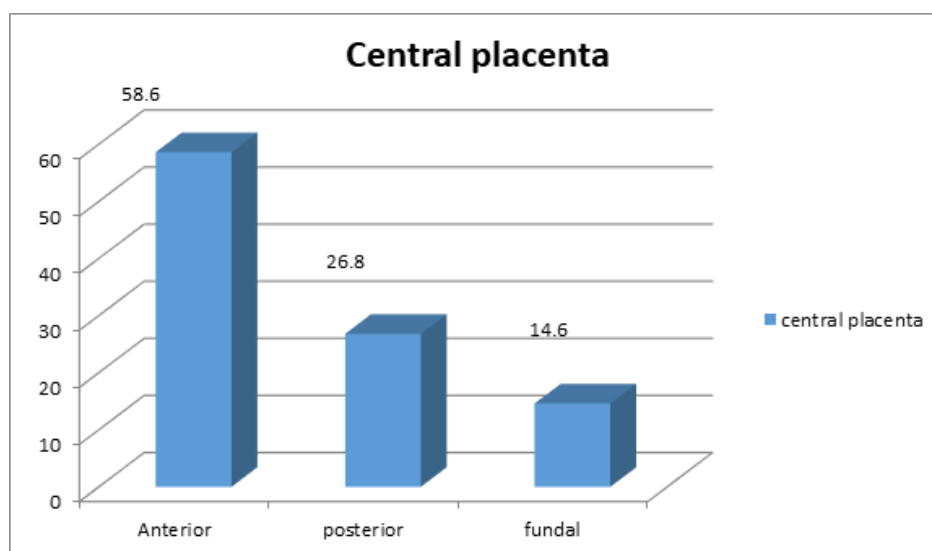


Fig. (2.b): Bar graph shows distribution of the studied cases according to central location of placenta.

Table (3.a): relation between placental location and pregnancy outcome.

Variable		Central (N=287)		Lateral (N=10)		Placenta Previa (n=3)		Test	P value
		N	%	N	%	N	%		
<i>Complication in this pregnancy</i>	<i>No Present</i>	252	87.8	3	30.0	0	0	42.49	<0.001*
		35	12.2	7	70.0	3	100.0		
<i>Type of complications</i>	<i>PROM</i> <i>PPROM</i>	23	65.7	3	30.0	1	33.3	2.96	0.22
		12	34.3	0	0	2	66.7		

*statistical significant difference - Test of significant (Chi square)

PROM: premature rupture of membrane - PPRM: Preterm premature rupture of membrane

Table (3.b): relation between central placental location and pregnancy complications

Variable		Anterior (N=168)		Posterior (N=77)		Fundal (n=42)		Test	P value
		N	%	N	%	N	%		
<i>Complication in this pregnancy</i>	<i>No Present</i>	156	92.9	57	74.0	39	92.9	18.65	<0.001*
		12	7.1	20	26.0	3	7.1		

Table (4): Relation between Placental location and mode of delivery.

Variable		Central (N=287)		Lateral (N=10)		Placenta Previa (n=3)		Test	P value
		N	%	N	%	N	%		
<i>Mode of Delivery</i>	<i>FTCS</i>	80	27.9	3	30.0	0	0	98.35	<0.001*
	<i>PTCS</i>	6	2.1	0	0	3	100.0		
	<i>FTVD</i>	195	67.9	7	70.0	0	0		
	<i>PTVD</i>	6	2.1	0	0	0	0		

*statistical significant difference - Test of significant (Chi square)

-FTCS: full term cesarean section

-PTCS: preterm cesarean section

-FTVD: Full term vaginal delivery

-PTVD: preterm vaginal delivery

Table (5): Relation between placental location and neonatal outcome.

Variable		Central (N=287)	Lateral (N=10)	Placenta Previa (n=3)	Test of significance	P value
<i>Weight of Placenta (gm)</i>	<i>Mean ±SD</i>	546.73±90.34	623.0±110.7	302.0±40.3	6.75	<0.001*
	<i>Range</i>	(320-820)	(470-720)	(250-540)		
<i>Birth weight (gm)</i>	<i>Mean ±SD</i>	3098.38±542.4	3470±1110.6	2370±340	2.37	0.03*
	<i>Range</i>	(1200-4450)	(2100-4800)	(2200-3200)		
<i>Gestational age (weeks)</i>	<i>Mean ±SD</i>	37.97±1.78	38.1±0.87	32.0±0.2	17.24	<0.001*
	<i>Range</i>	(29-41)	(37-39)	(31-33)		

*statistical significant difference - Test of significant (one way ANOVA)

Table (6): Post hoc of relation between placental and neonatal outcome.

Variable		Central	Lateral	Placenta Previa
<i>Weight of</i>	<i>Central</i>	---	0.009*	<0.001*
	<i>Lateral</i>			<0.001*

<i>Placenta (gm)</i>	<i>placentaprevia</i>			
<i>Birth weight (gm)</i>	<i>Central</i>		0.042*	0.02*
	<i>Lateral</i>			0.003*
	<i>placentaprevia</i>			
<i>Gestational age (weeks)</i>	<i>Central</i>		0.82	<0.001*
	<i>Lateral</i>			<0.001*
	<i>Placenta previa</i>			

Table (7): Difference between placental location and other factors related to neonatal outcome

Variable		Central (N=287)		Lateral (N=10)		Placenta Previa (n=3)		Test	P value
		N	%	N	%	N	%		
<i>Neonatal outcome</i>	<i>Alive</i>	284	99.0	10.0	100.0	3	100.0	0.13	0.93
		3	1.0	0	0	0	0		
<i>APGAR score</i>	<i>Excellent</i>	233	81.2	4	40.0	0	0	26.74	<0.001*
	<i>Good</i>	45	15.7	6	60.0	3	100.0		
	<i>Poor</i>	9	3.1	0	0	0	0		
<i>Any congenital anomaly</i>	<i>No</i>	286	99.7	10	100.0	3	100.0	0.4	0.97
		1	0.3	0	0.0	0	0.0		
<i>NICU admission</i>	<i>No</i>	259	90.2	7	70.0	0	0.0	27.6	<0.001*
		28	9.8	3	30.0	3	100.0		

*statistical significant difference - Test of significant (Chi square)

NICU: Neonatal Intensive Care Unit

DISCUSSION

Pregnancies with placentas attached to one side of the uterus are more likely to exhibit abnormal uterine artery blood flow, suggesting that placental location may influence fetal growth ⁽¹⁴⁾. Given the placenta's role in supplying the fetus with blood, nutrients, and oxygen, its positioning within the uterus can notably heighten the risk of intrauterine growth restriction (IUGR) ⁽¹⁴⁾.

Kofinas ⁽¹²⁾ suggested an anatomical basis for reduced blood flow to a placenta located on one side of the uterus. Placentas positioned centrally are likely to receive balanced blood flow from both uterine arteries due to their midline location. However, when the placenta is unilaterally positioned, it may depend primarily on one uterine artery, which could lead to diminished blood flow if any circulatory insufficiency occurs, thereby increasing the risk of growth restriction in such pregnancies. ⁽¹²⁾.

In our cross-sectional study of 300 pregnant women attending Benghazi Medical Center, participants ranged in age from 20 to 42 years, with a mean age of 29.6 ± 4.62 years. Of these women, 291 (97%) were Libyan, 6 (2%) were Sudanese, and 3 (1%) were Palestinian. Nearly all participants (297, or 99%) resided in Benghazi. Regarding education, 215 (71.7%) had a university education, 61

(20.3%) completed secondary education, and 24 (8.0%) had primary education. In terms of occupation, 58.0% were housewives, 24.3% were employees, 12.7% were teachers, 3.0% were nurses, and 1.0% each were doctors and dentists. Blood type distribution showed that 32.0% were A+, 31.7% were O+, and 17.7% were B+. Additionally, 6.0%, 2.0%, 3.0%, 2.0%, and 5.7% were A-, B-, AB-, AB+, and O-, respectively.

Our findings revealed that among 300 pregnant women, 287 (95.6%) had a centrally located placenta, 10 (3.4%) had a lateral placenta, and 3 (1.0%) presented with placenta previa. These results align with those reported by **Petal et al.**, who observed that, among 200 women, 166 (82.8%) had central placentation, 32 (16.2%) had lateral placentation, and 2 (1.0%) had placenta previa. Additionally, studies by **Jaiswal et al.**, ⁽¹⁵⁾ **Singh et al.**, ⁽¹⁶⁾ and **Adekanmi et al.** ⁽¹⁷⁾ found the prevalence of anterior placentas to be 48.0%, posterior placentas 39.3%, fundal placentas 6.7%, and lateral placentas 6.0%. Another study identified a frequency of 28% for anterior placentas, 26% for posterior placentas, and 46% for fundal placentas ⁽³⁾.

Our results detected that there was statistical significant relation between placental location and complication of pregnancy, where 35 (12.2) women with complications

from total 287 pregnant women with central placental location, 7 (70.0%) women from 10 pregnant of lateral placenta and 3 (100.0) pregnant women with placenta Previa and main cause was premature rupture of membrane, Our findings in consistent with **zia ,2013**⁽³⁾ who showed a significant association between posterior placental location and complication of pregnancy (preterm labour). Also our finding is consistent with another report ⁽¹⁸⁾.

Conversely, other studies ^(19, 20) have shown a positive, significant association between fundal placental implantation and increased risk of severe preeclampsia (PE) and premature rupture of membranes (PROM). These findings align with research by **Hadley et al.** ⁽²¹⁾, which indicated that a fundal placenta location significantly raises the risk of PROM. The authors hypothesized that a fundal placenta positions the membrane's weakest point over the cervical os, thereby increasing the likelihood of membrane rupture and related complications. In contrast, our study found a significant association between a posterior placental location and preterm labor, possibly due to anatomical factors that may limit the posterior placenta's functional efficiency ⁽²¹⁾. Due to an uneven blood supply within the uterus ⁽²²⁾, the posterior uterine wall tends to be longer and somewhat thicker during pregnancy ⁽⁸⁾. These structural differences may influence blood flow, particularly as the uterus expands with pregnancy. In a case-control study, **Janewarland et al.** ⁽²²⁾ found that a posterior placental location significantly increases the likelihood of stillbirth. Although the exact cause remains unclear, they proposed three potential explanations: a structural issue with the posterior uterine wall, intrauterine factors associated with a posterior placenta, or the pregnant woman's sleeping position may be contributing factors.

In terms of mode of delivery, our findings showed that 100% of cases with placenta previa delivered via preterm cesarean section. For cases with a lateral placenta, 70% of deliveries were full-term vaginal births, while 67.9% of those with a central placenta also had full-term vaginal deliveries. Our study revealed significant statistical differences between central, lateral, and placenta previa in relation to placental weight ($p < 0.001$), birth weight ($p = 0.03$), and gestational age ($p < 0.001$). In the study by **Adekanmi et al.** ⁽¹⁷⁾, an association was observed between ultrasound-determined placental location and outcomes such as gestational age at delivery, birth weight, and newborn maturity. Fundal placental locations were linked to deliveries occurring at the lowest gestational ages and with the lowest birth weights compared to other placental sites. Consequently, a higher proportion of premature births was noted among women with fundal placentas.

Our results indicated a statistically significant difference in APGAR scores based on placental location. Specifically, 81.2% of cases with a centrally located placenta achieved an excellent APGAR score, while 60% of cases with a lateral placenta and 100% of cases with placenta previa had a good APGAR score. Additionally, there was a

significant association between placental location and NICU admissions: 100% of neonates born to mothers with placenta previa required NICU admission, compared to 30% of those with a lateral placenta.

Alka Patil et al. ⁽²³⁾ reported that in cases of lateral placental location, the incidence of intrauterine growth restriction (IUGR) was 16%, preterm birth occurred in 31%, and intrauterine fetal demise (IUFD) was observed in 3%. These findings align with those of **Nair et al.** ⁽²⁴⁾, who noted that five cases of left-lateral placenta were associated with IUGR and abnormal Doppler readings (10.2%), while eight cases had a 16.3% risk of preterm birth. Similarly, a prospective study by **Singh et al.** ⁽¹⁶⁾ involving 592 patients concluded that lateral placental location was associated with a 62.26% risk of IUGR. **Seadati et al.** ⁽²⁵⁾ also demonstrated that lateral placentation increased the risk of IUGR by 2.7 times. A retrospective study by **Jackson et al.** ⁽²⁶⁾ found that lateral placenta was linked with preterm birth, while **Vaillant et al.** ⁽²⁷⁾ reported a higher risk of fetal distress, cesarean delivery, and IUGR in cases of lateral placental implantation compared to central placements. More recently, **Fung et al.** ⁽²⁸⁾ examined second-trimester placental location in relation to adverse pregnancy outcomes and found that unilateral placental implantation was associated with low APGAR scores, consistent with our findings.

The study by **Alka Patil et al.** ⁽²³⁾ also found that lateral placental location was associated with higher rates of NICU admissions. Specifically, among cases with central placentas, 24 (14.6%) required NICU admission, while 142 (85.4%) did not. For lateral placentas, 9 (29.3%) required NICU admission, while 23 (70.7%) did not. These findings align with our results and are consistent with those of **Nair et al.** ⁽²⁴⁾, who observed that 16.4% of central placentas and 26% of lateral placentas required NICU admission, whereas 83.6% of central and 74% of lateral placentas did not. Additionally, **Singh et al.** ⁽¹⁶⁾ concluded that 16% of NICU admissions were attributed to infants in the high-risk group for intrauterine growth restriction (IUGR).

Kalanithi et al. ⁽⁸⁾ investigated how the position of the placenta might affect newborns' Apgar scores. They categorized placental locations as fundal, uterine body, or lower uterine segment. Their findings indicated that no newborns with placentas in the lower uterine segment had low Apgar scores (<4). Conversely, higher placental positions within the uterus were associated with an increased incidence of low Apgar scores. In contrast, **Zia's study** ⁽³⁾ found no link between placental location and low Apgar scores ⁽³⁾.

RECOMMENDATIONS

Conduct multicenter studies to evaluate how placental location impacts outcomes in varied healthcare environments. Develop universal guidelines adaptable to different settings. Develop predictive models to assess the risk of adverse outcomes based on placental location.

Create tools for early identification of high-risk pregnancies, enabling timely interventions.

CONCLUSIONS

This study provides evidence that placental location is linked to pregnancy success, suggesting it could be a crucial factor in determining pregnancy outcomes. Further research is necessary to validate this finding and to assess whether pregnancies with an anterior placenta might require closer monitoring

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