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Midline versus non-midline placental attachment and intrapartum and postpartum outcomes in women with spontaneous vaginal delivery: a retrospective cohort study

yifeng zhang
Shandong Provincial Hospital
yongzhong gu
Shandong Provincial Hospital
mingrui xu
Shandong Provincial Hospital
chaoqun qi
Shandong Provincial Hospital
lichun fu
Shandong Provincial Hospital
xiaoya wang
108374018@qq.com
Shandong Provincial Hospital

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Abstract

Background

Placental attachment location is readily identified on late-pregnancy ultrasound, yet its influence on intrapartum and postpartum outcomes is not well defined. Whether dividing the site into a midline (anterior or posterior) and a non-midline (fundal or lateral) position adds clinical value in women who deliver vaginally remains unclear.

Methods

This retrospective cohort study included women who underwent spontaneous vaginal delivery at a tertiary hospital in Shandong Province, China, between January 2023 and June 2024. Based on the placental attachment location determined by ultrasound at ≥ 28 weeks of gestation, women were divided into a midline group (anterior or posterior wall) and a non-midline group (fundus or lateral wall). Total blood loss within 24 h postpartum, the incidence of postpartum hemorrhage (PPH), uterine cavity hematoma volume at 48 h postpartum, and the incidences of perineal trauma, retained placenta, and occiput posterior position were compared between groups. Non-normally distributed continuous variables were expressed as median (interquartile range) and compared using the Mann–Whitney U test; categorical variables were compared using the chi-square test (with continuity correction) or Fisher's exact test.

Results

A total of 882 women were included, comprising 589 (66.8%) in the midline group and 293 (33.2%) in the non-midline group. Baseline characteristics, total blood loss within 24 h ($P = 0.068$), and PPH incidence ($P = 0.404$) did not differ significantly between groups. The midline group had significantly higher incidences of perineal trauma (45.7% vs. 15.0%) and occiput posterior position (6.3% vs. 1.4%; both $P < 0.01$). In contrast, retained placenta (all five cases in the non-midline group; $P = 0.004$), additional blood loss within 24 h (70.0 ml vs. 60.0 ml; $P = 0.023$), and uterine cavity hematoma volume (16.0 ml vs. 12.8 ml; $P = 0.049$) were higher in the non-midline group. The midline group also had a longer second stage of labor (40.0 min vs. 35.0 min; $P = 0.043$).

Conclusions

Among women with spontaneous vaginal delivery, a midline placenta was linked to more perineal trauma and occiput posterior position, while a non-midline placenta was linked to retained placenta, greater additional blood loss, and more uterine cavity hematoma. Placental site can therefore inform perineal protection, fetal position assessment, and third-stage management.

Trial registration

Not applicable.

Background

Postpartum hemorrhage (PPH) remains the leading cause of maternal death worldwide, with an estimated 140,000 deaths each year [1]. In China the burden is even more concentrated: PPH accounts for roughly a quarter of all maternal deaths [2]. Identifying women at risk before delivery therefore has clear potential to lower mortality.

The implantation site of the placenta is visible on routine late-pregnancy ultrasound. Most work to date has concentrated on abnormal locations—placenta previa and the accreta spectrum—which are established independent risk factors for PPH [3–4]. Far less is known about whether a normally situated placenta, differing only in its anterior–posterior or lateral position, affects bleeding. In a cohort of 74,087 nulliparous women, Granfors et al. [5] reported a higher risk of severe PPH with a lateral placenta (aOR 1.42) but no difference between anterior and posterior positions. A 2025 meta-analysis of 40 studies by Whitcombe et al. [6] linked a low-lying placenta to higher PPH risk (OR 1.49), although that analysis dealt mainly with low-lying rather than normally located placentas.

There is also emerging evidence that a normal placental position can shape fetal presentation, labor progress, and placental separation. Torricelli et al. [7] found that an anterior placenta may delay or alter the course of labor. In 23,808 women, Schreiber et al. [8] reported that a lateral placenta was associated with a longer third stage (11.1 vs. 10.4 min) and more retained placenta (5.7% vs. 4.2%). Taken together, these observations raise the possibility that midline (anterior or posterior) and non-midline (fundal or lateral) positions carry different outcome profiles. Most of this evidence, however, comes from cohorts that included cesarean deliveries, and few studies have explicitly split the site into midline versus non-midline and compared PPH, perineal trauma, and uterine cavity hematoma in a vaginal-delivery population—especially in China, where large-sample data are lacking.

To address this gap, we divided the placental attachment site into midline (anterior, posterior) and non-midline (fundus, lateral) positions in women with spontaneous vaginal delivery and compared postpartum blood loss, PPH incidence, uterine cavity hematoma at 48 h, and the rates of perineal trauma, retained placenta, and occiput posterior position between the two groups. Our aim was to inform intrapartum and postpartum nursing practice.

Methods

Study design and participants

This retrospective cohort study enrolled women who underwent spontaneous vaginal delivery at the obstetrics department of a tertiary hospital in Shandong Province, China, between January 2023 and

June 2024. Inclusion criteria were: (1) singleton pregnancy with gestational age ≥ 37 weeks; (2) spontaneous vaginal delivery (including analgesic delivery); (3) placental attachment location clearly recorded by ultrasound examination in late pregnancy (≥ 28 weeks); and (4) complete clinical data. Exclusion criteria were: (1) abnormal placental location, including placenta previa, placenta accreta spectrum, and placental abruption; (2) severe medical or surgical comorbidities (e.g., severe preeclampsia, cardiac disease with New York Heart Association functional class ≥ II); (3) coagulation disorders during pregnancy; (4) use of anticoagulants within 24 h before delivery; and (5) multiple pregnancy. This study was approved by the hospital ethics committee.

Grouping and variable definitions

According to the placental attachment location recorded by ultrasound examination in late pregnancy (≥ 28 weeks), participants were divided into two groups: the midline group (placenta mainly attached to the anterior or posterior uterine wall) and the non-midline group (placenta mainly attached to the uterine fundus, left lateral wall, or right lateral wall).

The primary outcome was total blood loss within 24 h postpartum, defined as the sum of immediate postpartum blood loss (from placental delivery to 2 h postpartum) and additional blood loss within 24 h postpartum, compared between groups as a continuous variable in milliliters (ml). Secondary outcomes included: (1) incidence of PPH, defined as total blood loss within 24 h ≥ 500 ml according to the Guideline for Prevention and Treatment of Postpartum Hemorrhage (2022) issued by the Chinese Medical Association [2]; (2) uterine cavity hematoma volume measured by ultrasound examination at 48 h postpartum, calculated as length × width × height × 0.52, reflecting lochia drainage during uterine involution; (3) perineal trauma, defined as perineal laceration or episiotomy occurring during delivery; (4) retained placenta, defined as placental adhesion, manual removal of placenta, or retained placental membranes; and (5) occiput posterior position, defined as fetal occiput posterior presentation at delivery. Secondary analysis variables included fetal position, immediate postpartum blood loss, placental weight, placental volume, neonatal birth weight, and body mass index (BMI).

Data collection

The following data were extracted from the hospital electronic medical record system and obstetric nursing record system: (1) maternal characteristics: age, BMI, gestational age, gravidity, and parity; (2) delivery-related data: labor analgesia, oxytocin use, fetal position, and durations of the first, second, and third stages of labor; (3) placental and neonatal data: placental attachment location (confirmed by late-pregnancy ultrasound), placental weight, placental volume, neonatal birth weight, and neonatal length; (4) postpartum blood loss: immediate postpartum blood loss (assessed by combined volumetric and gravimetric methods) and additional blood loss within 24 h postpartum; (5) uterine cavity hematoma length, width, and height measured by ultrasound at 48 h postpartum; and (6) delivery complications

(perineal laceration, episiotomy, placental adhesion, manual removal of placenta, etc.). All data were double-entered by trained researchers and cross-checked to ensure accuracy.

Statistical analysis

Data were analyzed using SPSS 26.0. Continuous variables, which deviated from a normal distribution according to the Shapiro–Wilk test, were expressed as median (interquartile range) and compared between groups using the Mann–Whitney U test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test (with continuity correction) or Fisher's exact test. Two-sided tests were used, and $P < 0.05$ was considered statistically significant.

Results

Baseline characteristics

A total of 882 women were included, comprising 589 in the midline group (301 anterior + 288 posterior, 66.8%) and 293 in the non-midline group (137 fundus + 156 lateral, 33.2%). The two groups were comparable in age, BMI, gestational age, gravidity, and parity (all $P > 0.05$) (Table 1).

Table 1
Baseline characteristics of the midline and non-midline groups [M(Q25, Q75)]

Variable	Midline group (n = 589)	Non-midline group (n = 293)	Z	P
Age (years)	31.0(28.0,34.0)	31.0(28.0,35.0)	-1.279	0.200
BMI (kg/m²)	27.1(25.2,29.4)	27.3(25.2,30.1)	-0.593	0.553
Gestational age (weeks)	39.0(38.0,40.0)	39.0(38.0,40.0)	-0.240	0.802
Gravidity	2.0(1.0,3.0)	2.0(1.0,3.0)	-1.023	0.279
Parity	1.0(1.0,2.0)	1.0(1.0,2.0)	-0.380	0.667
Note: Variables were non-normally distributed and are expressed as M(Q25, Q75); the Mann–Whitney U test was used for between-group comparisons.				

Delivery and neonatal characteristics

The two groups did not differ significantly in the first stage of labor, third stage of labor, neonatal birth weight, neonatal length, placental weight, placental volume, or the rate of oxytocin use (all $P > 0.05$). The median duration of the second stage of labor was longer in the midline group (40.0 min) than in the non-midline group (35.0 min), with a statistically significant difference ($P = 0.043$) (Table 2).

Table 2
Delivery and neonatal characteristics of the two groups [M(Q25, Q75)]

Variable	Midline group (n = 589)	Non-midline group (n = 293)	Z/χ^2	P
Oxytocin use [n(%)]	395(67.1)	182(62.1)	1.903	0.168
First stage of labor (h)	6.0(4.0,9.0)	6.0(4.0,9.0)	1.203	0.227
Second stage of labor (min)	40.0(21.0,67.0)	35.0(18.0,57.0)	2.021	0.043
Third stage of labor (min)	5.0(5.0,5.0)	5.0(5.0,5.0)	-0.934	0.174
Neonatal birth weight (g)	3280.0(3060.0,3520.0)	3280.0(3050.0,3500.0)	0.350	0.726
Neonatal length (cm)	49.0(49.0,50.0)	50.0(49.0,50.0)	-0.566	0.557
Placental weight (g)	580.0(520.0,617.5)	570.0(530.0,617.5)	-0.107	0.915
Placental volume (ml)	20.0(18.0,20.0)	19.0(18.0,20.0)	0.005	0.996

Note: Continuous variables are expressed as M(Q25, Q75) and compared using the Mann–Whitney U test; categorical variables are expressed as n(%) and compared using the chi-square test (with continuity correction).

Postpartum blood loss and PPH incidence

Immediate postpartum blood loss and total blood loss within 24 h did not differ significantly between the two groups (P > 0.05). The median additional blood loss within 24 h was higher in the non-midline group (70.0 ml) than in the midline group (60.0 ml) (P = 0.023); however, total blood loss within 24 h did not differ significantly (P = 0.068) (Table 3). The overall incidence of PPH (total blood loss within 24 h ≥ 500 ml) was 2.6% (23/882), comprising 2.2% (13/589) in the midline group and 3.4% (10/293) in the non-midline group (χ^2=0.696, P = 0.404).

Table 3
Postpartum blood loss in the two groups [M(Q25, Q75), ml]

Variable	Midline group (n = 589)	Non-midline group (n = 293)	Z/χ^2	P
Immediate postpartum blood loss	200.0(150.0,200.0)	180.0(150.0,200.0)	-0.270	0.780
Additional blood loss within 24 h	60.0(50.0,80.0)	70.0(50.0,90.0)	-2.276	0.023
Total blood loss within 24 h	250.0(215.0,280.0)	250.0(220.0,300.0)	-1.828	0.068
PPH incidence [n(%)]	13(2.2)	10(3.4)	0.696	0.404

Note: Data were non-normally distributed and are expressed as M(Q25, Q75); the Mann–Whitney U test was used for between-group comparisons.

Perineal trauma, retained placenta, and occiput posterior position

The incidence of perineal trauma was significantly higher in the midline group (45.7%, 269/589) than in the non-midline group (15.0%, 44/293) (χ^2=78.974, P < 0.001). The incidence of occiput posterior position was also significantly higher in the midline group (6.3%, 37/589) than in the non-midline group (1.4%, 4/293) (χ^2=9.591, P = 0.002). All five cases of retained placenta occurred in the non-midline group (1.7%, 5/293), with none in the midline group; the difference was statistically significant (Fisher's exact test, P = 0.004) (Table 4).

Table 4
Incidence of perineal trauma, retained placenta, and occiput posterior position in the two groups [n(%)]

Variable	Midline group (n = 589)	Non-midline group (n = 293)	χ^2	P
Perineal trauma	269(45.7)	44(15.0)	78.974	< 0.001
Retained placenta	0(0.0)	5(1.7)	—	0.004
Occiput posterior position	37(6.3)	4(1.4)	9.591	0.002

Note: Perineal trauma and occiput posterior position were compared using the chi-square test (with continuity correction); retained placenta was compared using Fisher's exact test.

Uterine cavity hematoma at 48 h postpartum

The median uterine cavity hematoma volume at 48 h postpartum was 12.8 (0.0, 26.2) ml in the midline group, lower than 16.0 (0.0, 32.3) ml in the non-midline group (P = 0.049) (Table 5).

Table 5
Uterine cavity hematoma volume at 48 h postpartum in the two groups [M(Q25, Q75), ml]

Group	Valid n	Hematoma volume	Minimum	Maximum	P
Midline group	546	12.8(0.0,26.2)	0	149	0.049
Non-midline group	272	16.0(0.0,32.3)	0	110	0.049
Note: The Mann–Whitney U test was used for between-group comparison.					

Discussion

Placental attachment location and postpartum blood loss

In this series of 882 vaginal deliveries, the two groups lost essentially the same amount of blood overall (250.0 ml in both, P = 0.068), and PPH rates were similar (2.2% vs. 3.4%, P = 0.404). A midline or non-midline site therefore does not appear to change total blood loss or PPH risk in routine vaginal delivery. This agrees with earlier work: when Whitcombe et al. [6] restricted their meta-analysis to midline versus lateral placentas, PPH risk did not differ (OR 0.99). We did, however, observe a higher median additional loss in the non-midline group (70.0 vs. 60.0 ml, P = 0.023). The direction of this difference matches Granfors et al. [5], who linked a lateral placenta to severe PPH (aOR 1.42), and points to a modest effect on ongoing oozing that never reached the threshold of total blood loss, perhaps because severe events were few. In practice, placental position alone is not enough to flag a woman as high risk for PPH; immediate postpartum loss remains the more useful warning sign.

Placental attachment location and perineal trauma and occiput posterior position

The clearest finding to emerge is the association between a midline placenta and perineal trauma. The midline group had a perineal trauma rate of 45.7%, roughly three times the 15.0% seen in the non-midline group (P < 0.001), and a higher rate of occiput posterior position as well (6.3% vs. 1.4%, P = 0.002). This fits with the view that an anterior placenta alters labor and fetal position [7]. A likely explanation is mechanical: with an anterior or posterior placenta, the fetal back tends to lie against the midline of the uterus, which favours engagement of the fetal head in the occiput posterior position. Because an occiput posterior delivery presents a wider diameter and distends the perineum more, it predisposes to perineal laceration. A longer second stage in the midline group (40.0 vs. 35.0 min, P = 0.043) may compound this. For the clinician, the message is that a woman whose late-pregnancy ultrasound shows a midline—particularly anterior—placenta warrants advance assessment of fetal position, recognition of occiput posterior presentation, and readiness for perineal protection or episiotomy.

Placental attachment location and retained placenta

All five cases of retained placenta (adhesion, manual removal, or retained membranes) occurred in the non-midline group (1.7%), and none in the midline group (Fisher's exact test, P = 0.004). This small but

striking difference aligns with larger studies. Schreiber et al. [8] found retained placenta to be more frequent with a lateral than an anterior, posterior, or fundal placenta (5.7% vs. 4.2%, P = 0.002) and noted that a lateral placenta independently prolonged the third stage. Whitcombe et al. [6] likewise reported a higher risk of retained placenta for lateral than midline placentas (OR 0.33, i.e., about a threefold risk for lateral location), and Meyer et al. [9] implicated both lateral and fundal positions in third-stage complications. The likely mechanism is weaker myometrial contractility and uneven perfusion at the separation plane, leading to delayed or incomplete separation. Our Chinese data reinforce this pattern and suggest that a non-midline—especially lateral—placenta calls for closer observation and active third-stage management.

Placental attachment location and uterine cavity hematoma

We also estimated uterine cavity hematoma volume at 48 h as length × width × height × 0.52. The non-midline group had a higher median volume than the midline group (16.0 vs. 12.8 ml, P = 0.049). This measure reflects residual blood and lochia drainage during involution rather than acute bleeding [10–11], so the finding points to slightly less efficient uterine emptying with a fundal or lateral placenta, possibly from weaker contraction and slower involution at the non-midline site. The difference was only marginally significant, however, and should be confirmed in larger samples. Even so, nursing assessment of involution and lochia drainage is worth particular attention when the placenta is non-midline.

Limitations

Several limitations should be kept in mind. Retained placenta was rare—only five cases, all in the non-midline group—so that particular result is fragile and needs confirmation in larger samples. Placental location was taken from a single late-pregnancy ultrasound and did not account for the normal migration of the placenta over the course of pregnancy. Because the design was retrospective, placental location is a fixed anatomical characteristic rather than an exposure that can be assigned, and residual confounding or intermediate variables such as occiput posterior position and labor progress may sit between the exposure and the outcomes. The study was also conducted at a single centre, which limits generalizability. Multicentre prospective studies that record placental laterality in a standardized way would help settle whether the associations reported here are causal or merely coincidental.

Conclusions

In women who deliver vaginally, where the placenta attaches matters for several intrapartum and postpartum outcomes. A midline placenta was associated with more perineal trauma and occiput posterior position, whereas a non-midline placenta was associated with retained placenta, greater additional blood loss, and more uterine cavity hematoma; total 24-h blood loss and PPH rates were comparable. These patterns give midwives and obstetricians two distinct checklists: for a midline placenta, plan for perineal protection and look early for occiput posterior position; for a non-midline placenta, manage the third stage actively and watch closely for bleeding and uterine cavity hematoma.

Abbreviations

BMI
body mass index
PPH
postpartum hemorrhage
OR
odds ratio
aOR
adjusted odds ratio
SPSS
Statistical Package for the Social Sciences.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of Shandong Provincial Hospital Affiliated to Shandong First Medical University (Approval No.2025 – 360). As a retrospective study using anonymized medical records, the requirement for informed consent was waived by the ethics committee.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

Yifeng Zhang and Yongzhong Gu contributed equally to this work. YFZ: conceptualization, data collection, statistical analysis, and drafting of the manuscript. YZG: data collection, data analysis, and manuscript revision. MRX: data collection and verification. CQQ: data collection. LCF: data collection and literature review. XYW: conceptualization, methodology, supervision, and critical revision of the manuscript. All authors read and approved the final manuscript.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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