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Open Access Original Article

Fetal and Neonatal Outcomes in Pregnancies Complicated by Antenatal Vaginal Bleeding: A Retrospective Study at a Tertiary Care Center

Review began 09/19/2026
Review ended 10/28/2026
Published 10/30/2026

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DOI: 10.7759/cureus.118843

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Abstract

Background: Vaginal bleeding during later pregnancy is an important obstetric complication that may be associated with placental pathology, preterm delivery, and adverse fetal and neonatal outcomes. Evidence describing neonatal outcomes according to the underlying causes of bleeding remains limited in Lebanon. This study aimed to characterize fetal and neonatal outcomes among pregnancies complicated by vaginal bleeding in later pregnancy and to describe these outcomes according to the documented etiology of bleeding.

Materials and methods: This retrospective observational study included 172 pregnancies complicated by vaginal bleeding during later pregnancy, with deliveries occurring at Rafik Hariri University Hospital, a tertiary referral center in Lebanon, between January 2022 and December 2025. Maternal, obstetric, fetal, and neonatal data were retrospectively extracted from medical records. Outcomes included preterm delivery, neonatal intensive care unit (NICU) admission and its recorded indication, intrauterine fetal death (IUFD), and neonatal mortality. Outcomes were also described according to the documented etiology of vaginal bleeding.

Results: Mean maternal age was 30.4 ± 6.3 years, and mean gestational age at delivery was 34.0 ± 4.7 weeks. Gestational-age classification was available for 170 pregnancies; 121 (71.2%) resulted in preterm delivery. Placental abruption or hematoma was the most frequently documented etiology of bleeding in later pregnancy (36.6%), followed by placenta previa (27.3%) and placenta accreta/percreta (25.6%). Among the 162 live births, 73 neonates (45.1%) required NICU admission, while 72 (44.4%) were discharged home without NICU admission. IUFD occurred in 10 of 172 pregnancies (5.8%), and neonatal death occurred in 17 of 162 live births (10.5%). Among live births, neonatal mortality was 11 of 55 (20.0%) in the placental abruption or hematoma group, 3 of 47 (6.4%) in the placenta previa group, and 3 of 43 (7.0%) in the placenta accreta/percreta group. IUFD occurred in 8 of 63 pregnancies (12.7%), 0 of 47 (0%), and 1 of 44 (2.3%) in these groups, respectively.

Conclusions: Pregnancies complicated by vaginal bleeding in later pregnancy in this tertiary-care cohort were characterized by substantial prematurity, NICU utilization, and fetal and neonatal mortality. Placental abruption or hematoma was the most frequently documented bleeding etiology and accounted for the highest observed proportions of IUFD and neonatal mortality among the three main bleeding etiologies. These findings highlight the importance of identifying the underlying cause of bleeding, providing close antenatal surveillance, and coordinating obstetric and neonatal management, particularly in pregnancies complicated by placental abruption.

Categories: Obstetrics/Gynecology, Pediatrics, Epidemiology/Public Health
Keywords: intrauterine fetal death, neonatal mortality, neonatal outcomes, nicu, placenta accreta spectrum, placental abruption, placenta previa, pregnancy, preterm birth, vaginal bleeding

Introduction

Vaginal bleeding in the third trimester is an important obstetric presentation that may require urgent assessment because it can reflect placental or other obstetric pathology. Antepartum hemorrhage (APH) is commonly defined as bleeding from or into the genital tract from 24 weeks of gestation until birth, and it is associated with maternal and perinatal morbidity [1]. The major clinically important causes include placental abruption and placenta previa; other causes include placenta accreta spectrum, vasa previa, trauma, and less commonly uterine rupture [1,2]. The clinical consequences depend on the underlying cause, severity and recurrence of bleeding, gestational age, and whether maternal or fetal compromise necessitates early delivery [1,3].

How to cite this article
Abdine R M, Al Ali M, Dahrouj M, et al. (October 30, 2026) Fetal and Neonatal Outcomes in Pregnancies Complicated by Antenatal Vaginal Bleeding: A Retrospective Study at a Tertiary Care Center. Cureus 18(10): e118843. DOI 10.7759/cureus.118843

Placental disorders are particularly important causes of bleeding in later pregnancy. Placental abruption can compromise fetal oxygenation through premature separation of the placenta, whereas placenta previa and the placenta accreta spectrum may cause significant antepartum or obstetric hemorrhage and lead to planned or urgent preterm delivery [1,2]. Studies of third-trimester bleeding report different neonatal outcome patterns by underlying cause, supporting the importance of describing outcomes by documented bleeding etiology rather than treating all episodes as clinically identical [3,4].

Preterm delivery is an important outcome in pregnancies complicated by third-trimester bleeding. Delivery may occur spontaneously or be medically indicated because of recurrent hemorrhage, placental pathology, or maternal or fetal compromise [1,3]. In a population-based study of antepartum bleeding of unknown origin in the second half of pregnancy, bleeding was associated with increased odds of preterm delivery and neonatal intensive care admission [4]. Other studies of third-trimester bleeding have also described neonatal morbidity, including respiratory complications, and have highlighted the influence of the bleeding etiology and gestational age at delivery [3,5]. These findings make prematurity, neonatal intensive care unit (NICU) admission, intrauterine fetal death (IUFD), and neonatal mortality relevant outcomes when evaluating pregnancies complicated by late-pregnancy bleeding.

Evidence from Lebanon describing fetal and neonatal outcomes specifically among pregnancies complicated by bleeding in later pregnancy remains limited. A Lebanese retrospective cohort study reported associations between vaginal bleeding during pregnancy and adverse maternal and perinatal outcomes, although its population was not restricted exclusively to third-trimester bleeding [6]. Studies focused on antepartum or third-trimester hemorrhage have reported associations with preterm birth, neonatal intensive care unit (NICU) admission, and other adverse neonatal outcomes, with outcome patterns varying according to the documented cause of bleeding [3-5]. Further data from tertiary referral settings may therefore help characterize fetal and neonatal outcomes associated with the major causes of late-pregnancy bleeding, including placental abruption, placenta previa, and placenta accreta spectrum.

To address this evidence gap, the present study evaluated fetal and neonatal outcomes among pregnancies complicated by vaginal bleeding in later pregnancy at Rafik Hariri University Hospital (RHUH), a tertiary referral center in Lebanon. Specifically, we assessed preterm delivery, NICU admission, IUFD, and neonatal mortality as descriptive outcomes, and explored their distribution across documented bleeding etiologies without making causal inferences.

Materials And Methods

Study design and setting

This retrospective observational study was conducted at RHUH, a tertiary referral center in Lebanon. The study aimed to characterize fetal and neonatal outcomes among pregnancies complicated by vaginal bleeding occurring in later pregnancy, with particular emphasis on prematurity, neonatal morbidity, and mortality. The study further examined these outcomes by the documented underlying etiology of late-pregnancy bleeding.

The study included 172 pregnancies complicated by at least one documented episode of vaginal bleeding during later pregnancy, with deliveries occurring at RHUH between January 2022 and December 2025. Maternal, obstetric, fetal, and neonatal data were retrospectively retrieved from the hospital's electronic health records and archived medical files. Hospital delivery records were reviewed to identify pregnancies with documented vaginal bleeding during the study period. All pregnancies meeting the predefined eligibility criteria during the study period were included; no sampling was performed. All included pregnancies were singleton pregnancies.

Only pregnancies with documented vaginal bleeding during later pregnancy were included in the study. When an underlying etiology was documented in the medical record, it was recorded accordingly, including major obstetric causes such as placental abruption, placenta previa, and placenta accreta spectrum disorders. Neonates born from the included pregnancies were evaluated for immediate and neonatal outcomes, including preterm delivery, NICU admission, IUFD, and neonatal mortality. IUFD was evaluated separately as a fetal outcome.

Inclusion and exclusion criteria

Pregnancies were eligible for inclusion if at least one episode of vaginal bleeding during later pregnancy and before delivery was documented in the maternal medical record, the pregnancy was subsequently delivered at RHUH between January 2022 and December 2025, maternal and fetal or neonatal outcome data were available, and gestational age at delivery was documented based on ultrasonographic assessment and/or the last menstrual period.

Pregnancies were excluded if the fetus or neonate had a major congenital anomaly diagnosed antenatally or postnatally; maternal, obstetric, or fetal/neonatal medical records were incomplete or unavailable for assessment of the study outcomes; delivery occurred at another healthcare facility; or fetal/neonatal

outcome data were unavailable. Only pregnancies delivered at or after 28 completed weeks of gestation were eligible for inclusion.

Data collection

Data were collected retrospectively through review of maternal, obstetric, and neonatal medical records. Maternal and obstetric variables included maternal age at delivery, gravidity, parity, and gestational age at delivery. The underlying etiology of vaginal bleeding, including placental abruption, placenta previa, and placenta accreta spectrum disorders, was recorded based on diagnoses documented in the patients' medical records. No independent diagnostic reassessment was performed by the research team. Each pregnancy was assigned to one mutually exclusive etiologic category based on the diagnoses documented in the medical records. When both placenta previa and placental abruption were documented, the pregnancy was classified under the combined placenta previa and abruption category. When no specific etiology of bleeding was documented, the pregnancy was classified as having an unknown etiology.

Neonatal variables included NICU admission and its documented indications, including prematurity, respiratory distress, combined prematurity and respiratory distress, and other indications. Neonatal vital status was recorded, including survival or death during the neonatal period. Cases of IUFD were identified from the maternal medical records and recorded separately as fetal outcomes. Data were extracted from the hospital's electronic medical records by multiple researchers using a standardized data collection form. The extracted information was subsequently reviewed for accuracy and consistency.

Operational definitions

To ensure consistent data classification, the study applied prespecified operational definitions to the variables and outcomes. Vaginal bleeding was defined as any documented episode of vaginal blood loss occurring in later pregnancy, as recorded in the maternal medical record. Preterm birth was defined as delivery before 37 completed weeks of gestation. NICU admission was defined as admission of a live-born neonate to the NICU for monitoring or treatment. Neonatal mortality was defined as death of a live-born infant within the first 28 days of life. Respiratory distress and other NICU indications were classified according to the diagnoses documented in the neonatal medical record. NICU admissions were classified according to their documented indication for admission, whereas neonatal deaths represented live-born infants who died without NICU admission. IUFD was defined as fetal death occurring at or after 28 completed weeks of gestation and before delivery. IUFD was analyzed separately from neonatal mortality.

Study variables and outcomes

The study population was defined by documented vaginal bleeding occurring during later pregnancy. Because all included pregnancies had vaginal bleeding, bleeding itself was not analyzed as a comparative exposure. The primary explanatory variable was the documented etiology of bleeding, categorized as placental abruption or hematoma, placenta previa, placenta accreta/percreta, unknown etiology, combined placenta previa and abruption, or trauma. The dataset included gestational age at delivery, discharge home without NICU admission, NICU admission and its recorded indication (respiratory distress, prematurity, combined prematurity and respiratory distress, or other), IUFD, and neonatal mortality. Pregnancy was the unit of analysis.

Statistical analysis

Statistical analyses were performed using SPSS Statistics version 25.0 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY). Categorical variables were summarized as frequencies and percentages, and continuous variables as means with standard deviations or medians with interquartile ranges, as appropriate. Outcomes were described overall and stratified by documented bleeding etiology. Comparisons of outcomes across bleeding etiologies were descriptive, and no inferential statistical tests were performed. Missing data were retained as missing, and no imputation was performed. Descriptive analyses used available data, with denominators adjusted based on the availability of each variable.

Ethical considerations

The Institutional Review Board of Rafik Hariri University Hospital approved the study (approval/reference no. 2026-0801) prior to data collection. Given the retrospective nature of the study, the requirement for informed consent was waived by the IRB. All extracted data were anonymized and handled confidentially to protect patient privacy. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki [7].

Results

Maternal and obstetric characteristics

A total of 172 pregnancies complicated by vaginal bleeding were included. Table *1* describes maternal and obstetric characteristics. The mean maternal age was 30.4 ± 6.3 years (median 31 years; IQR, 26-35; range

17-46 years). Most women were aged 20-34 years (66.9%); 26.7% were aged ≥35 years, and 6.4% were aged <20 years. Syrian women represented 57.0% of the cohort, Lebanese women 31.4%, and women of other nationalities 11.6%. Mean gravidity was 4.5 ± 2.5, and mean parity was 2.7 ± 2.0.

Characteristic	Category/statistic	Value
Maternal age, years	Mean ± SD	30.4 ± 6.3
	Median (IQR)	31 (26-35)
	Range	17-46
Age group	<20 years	11 (6.4%)
	20-34 years	115 (66.9%)
	≥35 years	46 (26.7%)
Nationality	Syrian	98 (57.0%)
	Lebanese	54 (31.4%)
	Other	20 (11.6%)
Smoking status	No	120 (69.8%)
	Yes	37 (21.5%)
	Unknown	15 (8.7%)
Obstetric history	Gravida, mean ± SD	4.5 ± 2.5
	Parity, mean ± SD	2.7 ± 2.0
Gestational age at delivery	Mean ± SD, weeks	34.0 ± 4.7
	Median (IQR), weeks	35.5 (31.0-38)
	28-33+6 weeks	61/170 (35.9%)
	34-36+6 weeks	60/170 (35.3%)
	≥37 weeks	49/170 (28.8%)
	Missing category	2/172 (1.2%)

TABLE 1: Maternal and obstetric characteristics

Percentages were calculated using the total cohort (N = 172), except for gestational-age categories, for which data were available for 170 pregnancies. Gestational-age percentages were calculated using n = 170.

SD: standard deviation, IQR: interquartile range

The mean gestational age at delivery was 34.0 ± 4.7 weeks, and the median was 35.5 weeks (IQR, 31.0-38.0). The gestational-age category was missing for two pregnancies. Among the 170 pregnancies with available gestational-age classification, 61 (35.9%) resulted in deliveries at 28+0 to 33+6 weeks, 60 (35.3%) at 34+0 to 36+6 weeks, and 49 (28.8%) at ≥37 weeks. Accordingly, 121 of 170 pregnancies (71.2%) with available gestational-age classification delivered preterm (<37 weeks).

Etiology of vaginal bleeding

Figure *1* presents the documented etiologies of vaginal bleeding. Placental abruption or hematoma was the most frequently documented etiology, occurring in 63 pregnancies (36.6%), followed by placenta previa in 47 (27.3%) and placenta accreta/percreta in 44 (25.6%). The etiology was unknown in 16 pregnancies (9.3%). Combined placenta previa and abruption and trauma were each documented in one pregnancy (0.6%).

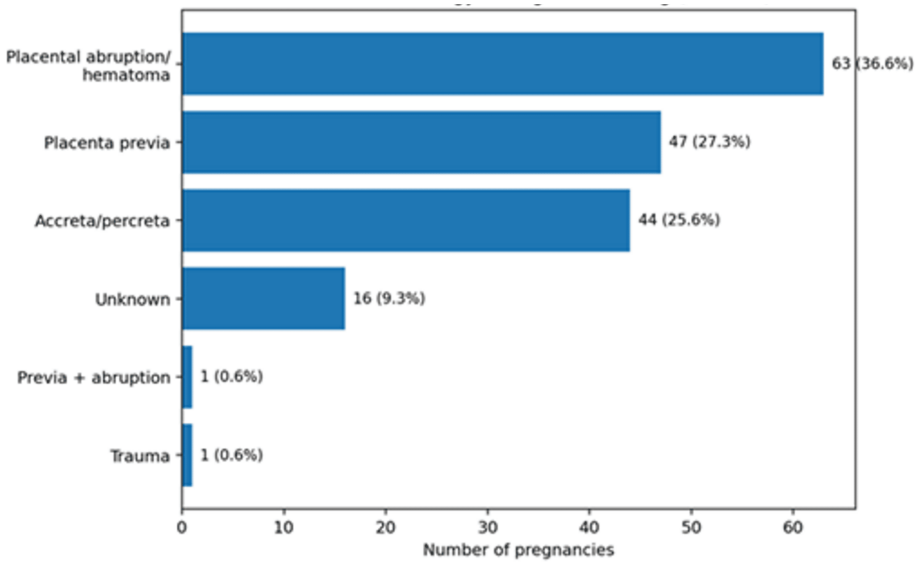


FIGURE 1: Distribution of documented etiologies of vaginal bleeding in later pregnancy

Percentages were calculated using the total study population (N = 172 pregnancies).

Fetal and neonatal outcomes

Of the 172 pregnancies, 72 (41.9%) resulted in neonates discharged home without NICU admission, 73 (42.4%) resulted in live-born neonates requiring NICU admission, 10 (5.8%) resulted in IUFD, and 17 (9.9%) resulted in neonatal death. Among NICU admissions, the recorded outcome category was respiratory distress in 30 cases, prematurity in 28, combined prematurity and respiratory distress in nine, and other indications in six. Figure *2* describes the overall fetal and neonatal outcomes. Among the 162 live births, 73 neonates (45.1%) required NICU admission, and 17 (10.5%) died during the neonatal period.

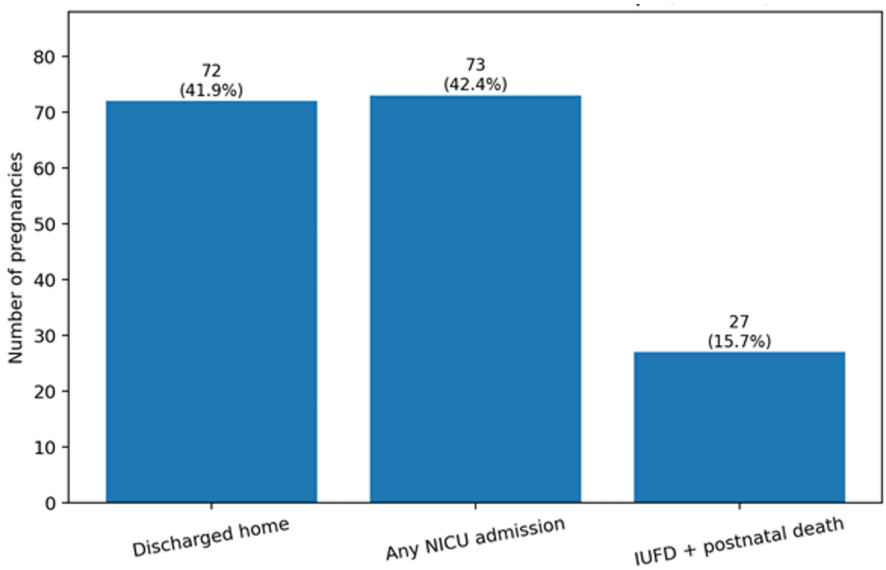


FIGURE 2: Distribution of fetal and neonatal outcomes among the 172 pregnancies

Percentages represent mutually exclusive pregnancy outcome categories and were calculated using the total cohort (N = 172). Neonatal deaths accounted for 17 of 172 pregnancies (9.9%), corresponding to 17 of 162 live births (10.5%).

IUFD: intrauterine fetal death, NICU: neonatal intensive care unit

Outcomes according to bleeding etiology

Outcome distributions varied descriptively across etiologic groups and are described in Table 2. Among pregnancies complicated by placenta previa, 23 of 47 (48.9%) resulted in neonates who were discharged home without NICU admission, no cases of IUFD occurred, and 3 of 47 (6.4%) resulted in neonatal death. Among placenta accreta/percreta pregnancies, 20/44 (45.5%) neonates were discharged home, 1/44 (2.3%) pregnancies resulted in IUFD, and 3/44 (6.8%) neonates died. In the placental abruption or hematoma group, 24/63 (38.1%) neonates were discharged home, 8/63 (12.7%) pregnancies resulted in IUFD, and 11/63 (17.5%) neonates died. No inferential statistical tests were performed; therefore, these comparisons are descriptive. Figure 3 further shows these descriptive differences in fetal and neonatal outcome distributions across major bleeding etiologies.

Etiology	Discharged	IUFD	NICU other	NICU prematurity	NICU prematurity + RD	NICU respiratory distress	Neonatal death
Accreta/percreta	20 (45.5%)	1 (2.3%)	1 (2.3%)	5 (11.4%)	3 (6.8%)	11 (25.0%)	3 (6.8%)
Placenta previa	23 (48.9%)	0 (0.0%)	0 (0.0%)	6 (12.8%)	3 (6.4%)	12 (25.5%)	3 (6.4%)
Placental abruption or hematoma	24 (38.1%)	8 (12.7%)	3 (4.8%)	10 (15.9%)	1 (1.6%)	6 (9.5%)	11 (17.5%)
Previa + abruption	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Trauma	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Unknown	5 (31.2%)	1 (6.2%)	1 (6.2%)	6 (37.5%)	2 (12.5%)	1 (6.2%)	0 (0.0%)

TABLE 2: Fetal and neonatal outcomes according to the etiology of vaginal bleeding during pregnancy

Values are presented as n (row %), with percentages calculated using the total number of pregnancies within each etiologic category. Outcome categories are mutually exclusive. Neonatal death percentages represent proportions of pregnancies within each etiologic category rather than neonatal mortality rates among live births. The combined placenta previa-abruption and trauma categories each contained one pregnancy and should not be interpreted comparatively.

IUFD: intrauterine fetal death, NICU: neonatal intensive care unit, RD: respiratory distress

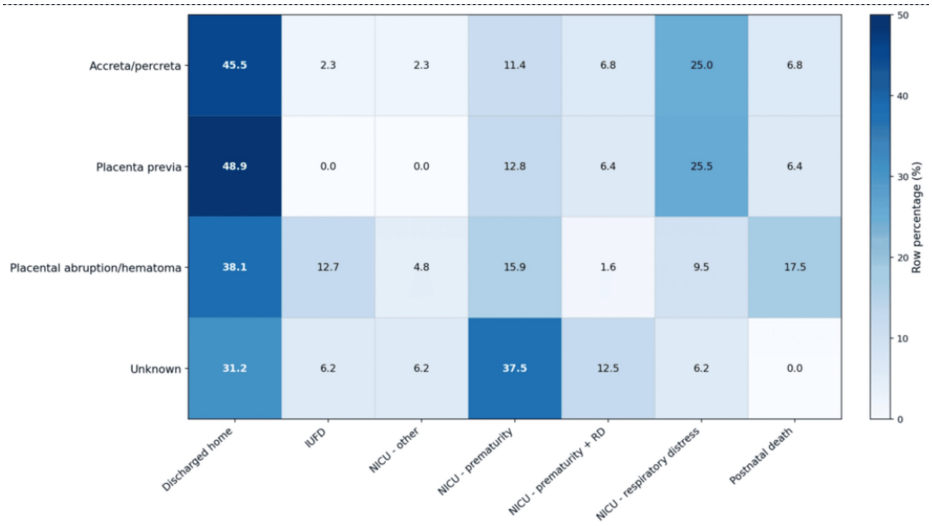


FIGURE 3: Distribution of fetal and neonatal outcomes across etiologic groups with more than one case

Percentages were calculated using the total number of pregnancies within each etiologic group. Neonatal death percentages represent pregnancy-level outcome proportions rather than mortality rates among live births. Comparisons between etiologic groups are descriptive only.

IUFD: intrauterine fetal death, NICU: neonatal intensive care unit

Discussion

In this retrospective study of 172 pregnancies complicated by vaginal bleeding and managed at a tertiary referral center in Lebanon, a substantial burden of adverse fetal and neonatal outcomes was observed. Among pregnancies with available gestational-age classification, 71.2% resulted in preterm delivery. Of the 162 live-born neonates, 45.1% required NICU admission and 10.5% died during the neonatal period. IUFD occurred in 5.8% of the 172 pregnancies. Placental abruption or hematoma was the most frequently documented bleeding etiology. In this group, IUFD occurred in eight of 63 pregnancies (12.7%), and neonatal death occurred in 11 of 55 live births (20.0%). These findings are descriptive and do not establish a statistically significant difference between bleeding etiologies. Collectively, these findings demonstrate the substantial fetal and neonatal morbidity observed among pregnancies complicated by vaginal bleeding in later pregnancy, particularly when bleeding occurs in association with placental pathology.

These findings are consistent with a broader body of evidence linking vaginal bleeding during pregnancy with adverse obstetric and neonatal outcomes [3-5,8,9]. Antepartum hemorrhage remains an important obstetric concern because of its association with adverse maternal and neonatal outcomes. The elevated neonatal morbidity and mortality associated with APH may be partly explained by its association with preterm delivery [10]. However, previous studies have identified APH as an independent risk factor for adverse neonatal outcomes in both very preterm and late preterm neonates. Among these groups, APH has been independently associated with increased neonatal mortality and morbidity, particularly severe respiratory disorders, higher rates of NICU admission, and longer hospital stays [11]. Although these previous studies provide important comparative evidence, the present study extends this literature by characterizing fetal and neonatal outcomes across documented etiologies of vaginal bleeding in a tertiary-care Lebanese population.

Prematurity was one of the most prominent findings in our cohort. The gestational-age category was available for 170 pregnancies, of which 121 (71.2%) delivered before 37 completed weeks of gestation. The mean gestational age at delivery was 34.0 ± 4.7 weeks. Previous studies have similarly identified vaginal bleeding as a marker of increased risk for subsequent preterm delivery. Early-pregnancy bleeding has been associated with an approximately 1.57-fold increased risk of preterm delivery, with particularly strong associations reported for spontaneous preterm labor. Women experiencing bleeding during both the first and second trimesters have also been reported to have substantially increased risks of spontaneous preterm labor, medically indicated preterm delivery, and preterm premature rupture of membranes compared with women without bleeding [12]. Several mechanisms may contribute to this relationship, including abnormal placentation, uteroplacental dysfunction, inflammatory pathways, and the need for medically indicated early delivery in the setting of recurrent bleeding or maternal or fetal compromise.

The high proportion of preterm deliveries in our cohort is clinically important when considered alongside

the observed need for neonatal intensive care. Among the 162 live births, 73 neonates (45.1%) required NICU admission. Within the mutually exclusive NICU outcome categories used in the present dataset, respiratory distress alone was recorded in 30 cases (17.4% of the overall cohort), prematurity alone in 28 (16.3%), and combined prematurity and respiratory distress in nine (5.2%). These findings indicate that respiratory and prematurity-related conditions accounted for a substantial proportion of neonatal intensive care utilization. This pattern is biologically plausible given the established relationship between prematurity and pulmonary immaturity. However, because the present dataset categorized NICU outcomes rather than independently measuring the incidence of individual neonatal complications, these findings should not be interpreted as estimates of the overall incidence of respiratory distress among all neonates in the cohort.

Placental disorders accounted for the majority of documented bleeding etiologies. Placental abruption or hematoma was the most frequent, occurring in 36.6% of pregnancies, followed by placenta previa (27.3%) and placenta accreta/percreta (25.6%). The predominance of placental pathology is clinically relevant because disruptions in placental integrity and uteroplacental circulation may compromise fetal oxygenation and contribute to preterm delivery. Placental abruption, in particular, involves premature separation of the placenta and may acutely reduce the functional surface available for maternal-fetal gas and nutrient exchange. Depending on its extent and severity, this process may result in fetal compromise, growth restriction, preterm delivery, and fetal or neonatal death [13,14].

Among the 63 pregnancies complicated by placental abruption or hematoma, IUFD occurred in 8 (12.7%), and 11 of the 55 live-born neonates (20.0%) died during the neonatal period. In this group, 24 of 63 pregnancies (38.1%) resulted in neonates discharged home without NICU admission. Among pregnancies complicated by placenta previa, no cases of IUFD occurred, and 23 of 47 (48.9%) resulted in neonates discharged home without NICU admission. In the placenta accreta/percreta group, IUFD occurred in 1 of 44 pregnancies (2.3%), while 20 of 44 (45.5%) resulted in neonates discharged home without NICU admission. These findings are descriptive, and no statistical tests were performed to compare outcomes between groups. Without adjustment for gestational age at delivery, it is not possible to determine whether these differences were associated with the underlying bleeding etiology or with prematurity.

Placenta previa and placenta accreta spectrum disorders remain clinically important causes of maternal bleeding and neonatal morbidity. Previous studies have reported associations between placenta previa and outcomes including preterm birth, low birth weight, low Apgar scores, NICU admission, and fetal mortality [15,16]. Delivery timing is an important management consideration because clinicians must balance the risks of ongoing or recurrent hemorrhage against those of prematurity. In uncomplicated placenta previa, delivery at approximately 36-37 weeks has generally been recommended [2,16], whereas earlier delivery may become necessary in the presence of significant or recurrent bleeding or maternal or fetal compromise. In pregnancies with placenta accreta spectrum, planned delivery is recommended earlier, with exact timing depending on the clinical circumstances and current guideline recommendations [2,17]. Thus, part of the neonatal morbidity associated with placental bleeding disorders may reflect both the underlying placental pathology and the consequences of spontaneous or medically indicated preterm delivery.

Fetal and neonatal mortality were also important findings. Ten of the 172 pregnancies (5.8%) resulted in IUFD, while 17 of the 162 live-born neonates (10.5%) died during the neonatal period. Together, these deaths accounted for 27 of the 172 pregnancies (15.7%). Importantly, the present dataset did not establish the individual causes of these deaths; therefore, they cannot be attributed specifically to asphyxia, extreme prematurity, or placental insufficiency. Nevertheless, mortality was concentrated particularly in the placental abruption or hematoma group, which accounted for eight of the ten IUFDs and 11 of the 17 neonatal deaths observed in the cohort.

The mean maternal age was 30.4 ± 6.3 years, and approximately two-thirds of women were aged 20-34 years. Previous population-based evidence describes a U-shaped relationship between maternal age and preterm birth, with the lowest risk occurring between approximately 24 and 30 years of age [18,19]. However, the absence of a non-bleeding comparison group and the lack of adjusted multivariable analyses in the present study preclude determining the independent contribution of maternal age, bleeding, or other maternal characteristics to neonatal outcomes. Maternal age should therefore be regarded as a descriptive characteristic of the cohort rather than evidence that the observed outcomes were attributable to vaginal bleeding itself.

The small subgroup of pregnancies with an unknown bleeding etiology exhibited heterogeneous outcomes. Among these 16 pregnancies, 31.2% resulted in neonates discharged home without NICU admission, while prematurity represented the most frequent NICU outcome category. Combined placenta previa and abruption and trauma were each represented by only one pregnancy. Given these very small numbers, meaningful comparisons with the major etiologic groups cannot be made.

Overall, our findings highlight the clinical importance of pregnancies presenting with vaginal bleeding, particularly those associated with placental pathology. Recognizing the underlying etiology, assessing gestational age and fetal status, and anticipating potential preterm delivery may facilitate timely obstetric and neonatal management. The high frequency of NICU utilization and fetal and neonatal mortality

observed in this tertiary-care cohort further emphasizes the need for coordinated management between obstetric and neonatal teams, particularly in pregnancies complicated by placental abruption or recurrent or severe bleeding.

Strengths and limitations

This study has several strengths. It included 172 pregnancies managed over a four-year period and evaluated fetal and neonatal outcomes across multiple documented etiologies of vaginal bleeding. The etiologic classification of bleeding, including placental abruption or hematoma, placenta previa, placenta accreta/percreta, and other causes, enabled a more detailed descriptive assessment of outcome patterns than would be possible by considering vaginal bleeding as a single homogeneous exposure. Furthermore, the study was conducted at a tertiary referral center managing high-risk pregnancies and therefore provides clinically relevant data regarding a population requiring substantial obstetric and neonatal care.

Several limitations should also be acknowledged. First, the retrospective design relied on the accuracy and completeness of existing medical records and resulted in missing information for some variables, including gestational-age classification in two pregnancies. Second, this was a single-center study conducted at a tertiary referral hospital, where complicated and high-risk pregnancies are more likely to be managed. The high frequencies of prematurity, NICU admission, and mortality observed in this cohort may therefore reflect referral and selection bias and should not be interpreted as population-level estimates.

The study did not include a comparison group of pregnancies without vaginal bleeding, making it difficult to determine whether the adverse outcomes observed were independently associated with bleeding. Comparisons between bleeding etiologies were descriptive, as the study performed no inferential statistical tests or multivariable analyses. These findings should therefore be interpreted with caution, especially given the small number of pregnancies in some groups and the possibility that other maternal or obstetric factors influenced the outcomes.

The retrospective design also limited the information available for analysis. Gestational-age classification was missing for two pregnancies, so the analyses of gestational-age categories and preterm delivery were based on 170 pregnancies. Information on the timing, severity, and recurrence of bleeding, maternal comorbidities, antenatal corticosteroid use, and placental findings was not consistently available. Bleeding etiologies were taken from diagnoses documented in the medical records and were not independently reassessed. Although the extracted data were reviewed for accuracy and consistency, agreement between researchers was not formally assessed. Other neonatal outcomes, such as low birth weight, sepsis, hypoglycemia, and jaundice, were not analyzed separately. Long-term neonatal outcomes were also not evaluated.

Conclusions

In this retrospective study of pregnancies complicated by vaginal bleeding at a tertiary referral center in Lebanon, adverse fetal and neonatal outcomes were observed. Preterm delivery and NICU admission were common, while both IUFD and neonatal death were also observed. Placental abruption or hematoma was the most frequently documented bleeding etiology and had the highest observed proportions of IUFD and neonatal death among the three main bleeding etiologies. However, these comparisons were descriptive, and differences between etiologic groups were not evaluated using inferential statistical tests.

These findings identify pregnancies complicated by vaginal bleeding in later pregnancy, particularly those involving placental abruption, as an important high-risk population in which adverse fetal and neonatal outcomes were observed. Further multicenter prospective studies incorporating non-bleeding comparison groups, adjustment for maternal and obstetric confounders, characterization of the timing and severity of bleeding, and longer-term neonatal follow-up are needed to better define the independent contribution of vaginal bleeding and its underlying etiologies to neonatal outcomes.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Ahmad M. Hammoud, Rim M. Abdine, Maria Al Ali, Mohammad Zahtari, Kariman Ghazal

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Critical review of the manuscript for important intellectual content: Rim M. Abdine, Maria Al Ali, Mohammad Zahtari, Kariman Ghazal

Supervision: Rim M. Abdine, Maria Al Ali, Kariman Ghazal

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Review Board of Rafik Hariri University Hospital issued approval 2026-0801. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Acknowledgements

Rim Abdine and Maria Al Ali contributed equally to the work and should be considered co-first authors.

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