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# Impact of Subchorionic Hematoma on Pregnancy Outcomes in Patients with Recurrent Spontaneous Abortion: A Retrospective Cohort Study

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**Research Article**

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# Impact of Subchorionic Hematoma on Pregnancy Outcomes in Patients with Recurrent Spontaneous Abortion: A Retrospective Cohort Study

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**Abstract**

**Objective:** To investigate the impact of first-trimester subchorionic hematoma (SCH) on pregnancy outcomes in patients with recurrent spontaneous abortion (RSA), and to analyze the risk characteristics associated with SCH-related adverse pregnancy outcomes, with the aim of providing clinical evidence to inform pregnancy management and prognostic assessment in this high-risk population.

**Methods:** A retrospective cohort study was conducted. Clinical data were collected from RSA patients with early singleton pregnancies who were followed up at the Reproductive Immunology Clinic and the Department of Obstetrics of our hospital from January 2021 to January 2025. Patients were assigned to the SCH group or the non-SCH group according to the presence of SCH detected on first-trimester transvaginal ultrasonography. Baseline characteristics, pregnancy maintenance, adverse pregnancy outcomes, and late-pregnancy complications were compared between the two groups. Multivariate logistic regression analysis was performed to identify independent risk factors for adverse pregnancy outcomes in RSA patients.

**Results:** A total of 386 RSA patients were included, with 68 (17.62%) in the SCH group and 318 (82.38%) in the non-SCH group. No significant differences were observed between the two groups in age, body mass index, comorbidities, or number of previous miscarriages (all $P > 0.05$), indicating comparability. The incidence of vaginal bleeding and abdominal pain was significantly higher in the SCH group ($P < 0.05$). The rates of early miscarriage and overall adverse pregnancy outcomes were significantly higher, whereas the live birth rate was significantly lower, in the SCH group than in the non-SCH group (all $P < 0.05$). Stratified analysis suggested that larger hematoma volume and longer hematoma duration were associated with an increased risk of miscarriage in RSA patients. Multivariate logistic regression analysis identified first-trimester SCH as an independent risk factor for adverse pregnancy outcomes in RSA patients (OR = 2.874, 95% CI: 1.526 – 5.412, $P = 0.001$).

**Conclusion:** In this cohort of RSA patients, first-trimester SCH was associated with an increased risk of early miscarriage and adverse pregnancy outcomes and a reduced live birth rate, and it emerged as an independent risk factor for poor pregnancy prognosis. For RSA patients with coexisting SCH, enhanced pregnancy surveillance and individualized management may be considered to help improve pregnancy outcomes.

**Abbreviations: RSA = recurrent spontaneous abortion; SCH = subchorionic hematoma; BMI = body mass index.**

**Keywords:** recurrent spontaneous abortion; subchorionic hematoma; pregnancy outcome; adverse pregnancy outcome; first-trimester pregnancy

## 1. Introduction

Recurrent spontaneous abortion (RSA) is a challenging condition in reproductive immunology, with a multifactorial etiology involving genetic, immunological, coagulation, endocrine, and uterine anatomical abnormalities [1]. Recurrent miscarriage not only adversely affects the physical and mental health of women of reproductive age but also imposes a substantial burden on families and society [2].

Subchorionic hematoma (SCH) is a common first-trimester sonographic abnormality characterized by localized blood collection between the chorion and the uterine wall, and it may present clinically as irregular vaginal bleeding or remain asymptomatic [3]. The reported incidence of SCH in the general early-pregnancy population ranges from 10% to 20% [4]. Recent studies have shown that the incidence of SCH is higher in RSA patients than in the general pregnant population, ranging from 14% to 18%, and it has been linked to unstable embryo implantation, maternal-fetal immune dysregulation, coagulation abnormalities, and decidual microcirculatory dysfunction [5], suggesting that it may serve as an imaging marker of pregnancy instability in RSA patients during the first trimester [6].

Current research on the association between SCH and pregnancy outcomes in the general pregnant population is relatively well established [7]. However, cohort studies focusing specifically on RSA patients remain limited, and existing findings are inconsistent [8]. Some studies suggest that SCH alone does not significantly increase the risk of adverse pregnancy outcomes in RSA patients and that a favorable prognosis may be achieved with standardized tocolytic intervention [9]. Nevertheless, accumulating evidence indicates that the presence of SCH, particularly when persistent or enlarging, may disrupt maternal-fetal interface homeostasis, exceed the pregnancy tolerance threshold in RSA patients, increase the risk of early pregnancy loss, and adversely affect the final live birth rate [10]. A systematic review and meta-analysis reported a significant association between SCH and adverse pregnancy outcomes [11]. Moreover, most previous studies have not incorporated quantitative indicators such as hematoma duration and volume into stratified analyses, limiting their ability to guide precise risk stratification in high-risk patients [12].

Therefore, this retrospective cohort study was designed to systematically analyze the impact of SCH and its characteristics on pregnancy outcomes in RSA patients and to explore its independent predictive value, with the aim of providing evidence-based support for individualized prenatal surveillance and clinical management of RSA patients with coexisting SCH [13].

## 2. Materials and Methods

### 2.1. Study Participants

A retrospective review was conducted of 386 RSA patients with early singleton pregnancies who were diagnosed and followed up at the Reproductive Immunology Clinic and the Department of

Obstetrics of our hospital from January 2021 to January 2025. Patients were assigned to the SCH group (n = 68) or the non-SCH group (n = 318) according to the presence of SCH detected by first-trimester transvaginal ultrasonography.

The inclusion criteria were as follows [1]: (1) meeting the diagnostic criteria for RSA, with ⩾2 previous spontaneous abortions; (2) a first ultrasound confirming a singleton intrauterine pregnancy at 5–12 weeks of gestation; and (3) complete clinical and follow-up data, with regular pregnancy monitoring and delivery follow-up at our institution.

The exclusion criteria were as follows [5]: (1) chromosomal abnormalities, including embryonic chromosomal abnormalities; (2) severe hepatic or renal dysfunction, uncontrolled autoimmune disease, or severe endocrine disorders; (3) severe uterine malformations or uncorrected intrauterine adhesions; and (4) incomplete follow-up data or loss to follow-up.

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Ethics Committee of Guangzhou Women and Children's Medical Center Liuzhou Hospital (Approval No. 2026-204). Written informed consent was obtained from all participants.

### 2.2. Diagnostic Criteria

RSA was diagnosed according to the Chinese expert consensus on the diagnosis and management of recurrent spontaneous abortion [1], defined as ⩾2 consecutive spontaneous abortions in women of childbearing age. SCH was diagnosed by ultrasonography [3], defined as an anechoic or hypoechoic fluid collection with clear margins between the gestational sac and the chorion, after excluding intrauterine fluid collection and gestational sac hemorrhage. Adverse pregnancy outcomes included early miscarriage, late miscarriage, missed abortion, preterm birth, and low birth weight [11].

### 2.3. Data Collection and Follow-up

Baseline data were collected, including age, body mass index (BMI), gravidity, number of previous miscarriages, comorbidities, vaginal bleeding, and abdominal pain. Pregnancy outcomes, including live birth rate, early miscarriage rate, overall adverse pregnancy outcome rate, and preterm birth rate, were recorded during follow-up. Stratified analyses of hematoma characteristics (duration and volume) were performed to examine their associations with pregnancy outcomes [12]. Multivariate logistic regression analysis was used to identify independent risk factors for adverse pregnancy outcomes in RSA patients.

### 2.4. Statistical Analysis

Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and compared using the independent-samples t-test. Categorical variables were expressed as numbers (percentages) and compared using the chi-squared test. Multivariate logistic regression analysis was performed to identify independent risk factors, with $P < 0.05$ considered statistically significant.

## 3. Results

### 3.1. Baseline Characteristics

A total of 386 RSA patients were included, of whom 68 (17.62%) were assigned to the SCH group and 318 (82.38%) to the non-SCH group. The baseline characteristics of the two groups are

presented in Table 1. No significant differences were observed between the groups in age, BMI, number of previous miscarriages, or comorbidities (thyroid disorders, coagulation abnormalities, and endocrine disorders) (all $P > 0.05$), indicating baseline comparability. The incidence of first-trimester vaginal bleeding and abdominal pain was significantly higher in the SCH group ($P < 0.05$).

Table 1. Baseline Characteristics of Patients With and Without SCH

| Characteristic | SCH (n=68) | Non-SCH (n=318) | P value |
|---|---|---|---|
| Age, years, mean ± SD | 29.36 ± 3.12 | 28.95 ± 3.26 | 0.355 |
| BMI, kg/m$^2$, mean ± SD | 22.45 ± 2.08 | 22.31 ± 2.15 | 0.637 |
| Previous miscarriages, n, mean ± SD | 2.71 ± 0.62 | 2.68 ± 0.59 | 0.697 |
| Underlying diseases, n (%) | 14 (20.59) | 58 (18.24) | 0.643 |
| Vaginal bleeding, n (%) | 49 (72.06) | 63 (19.81) | < 0.001 |
| Abdominal pain, n (%) | 32 (47.06) | 41 (12.89) | < 0.001 |

Note: SCH = subchorionic hematoma; SD = standard deviation; BMI = body mass index. P values were calculated using independent t-test for continuous variables and chi-square test for categorical variables.

**3.2. Pregnancy Outcomes**

The pregnancy outcomes of the two groups are compared in Table 2. The early miscarriage rate and the overall adverse pregnancy outcome rate were significantly higher, whereas the live birth rate was significantly lower, in the SCH group than in the non-SCH group (all $P < 0.05$). No significant differences were observed in the preterm birth rate or the late miscarriage rate between the two groups ($P > 0.05$). These findings suggest that first-trimester SCH primarily increases the risk of early pregnancy loss, which appears to be a key contributor to pregnancy failure and the reduced live birth rate in RSA patients, whereas no significant impact on mid-to-late pregnancy complications was observed in this cohort.

Table 2. Pregnancy Outcomes Between SCH and Non-SCH Groups, n (%)

| Outcome | SCH (n=68) | Non-SCH (n=318) | P value |
|---|---|---|---|
| Early miscarriage (≤ 12 weeks) | 21 (30.88) | 45 (14.15) | 0.001 |
| Late miscarriage (12–28 weeks) | 4 (5.88) | 12 (3.77) | 0.568 |
| Preterm birth (< 37 weeks) | 6 (8.82) | 24 (7.55) | 0.722 |
| Overall adverse outcomes | 31 (45.59) | 81 (25.47) | 0.002 |
| Live birth | 37 (54.41) | 237 (74.53) | 0.002 |

*P values refer to the comparison of rates across all subgroups within each stratified factor (e.g., chi-square test for trend or Fisher's exact test).

**3.3. Stratified Analysis of SCH Characteristics and Pregnancy Outcomes**

To further clarify the association between SCH characteristics and pregnancy outcomes, the SCH group was stratified by hematoma duration and volume, as shown in Table 3.

Currently, there is no universally accepted consensus on the classification of SCH size [14]. In the present study, we adopted a volume-based grading system. Hematoma volume (mL) was calculated using the ellipsoid formula V = L × W × H × 0.52, where L, W, and H represent the maximum length, width, and height of the hematoma measured by ultrasonography. Based on the calculated volume, hematomas were categorized as small (<5 mL), moderate (5–10 mL), or large (>10 mL) [15]. Hematoma duration was classified into two groups: ≤4 weeks and >4 weeks.

Stratified analysis revealed that patients with a hematoma duration exceeding 4 weeks and those with moderate-to-large hematoma volumes had significantly higher early miscarriage rates and significantly lower live birth rates, with statistically significant differences between subgroups ($P < 0.05$). These findings suggest a possible dose–response relationship between SCH characteristics and pregnancy outcomes in RSA patients, with prolonged hematoma persistence and larger hematoma volumes associated with an elevated risk of adverse pregnancy outcomes.

Table 3. Pregnancy Outcomes Stratified by Hematoma Characteristics in the SCH Group, n (%)

| Stratification | Subgroup | No. of patients | Early miscarriage | Live birth | P value* |
|---|---|---|---|---|---|
| Hematoma duration | ≤ 4 weeks | 42 | 9 (21.43) | 28 (66.67) | 0.018 |
| | > 4 weeks | 26 | 12 (46.15) | 9 (34.62) | |
| Hematoma volume | Small (< 5 mL) | 30 | 6 (20.00) | 22 (73.33) | 0.012 |

| Stratification | Subgroup | No. of patients | Early miscarriage | Live birth | P value* |
|---|---|---|---|---|---|
| | Medium (5–10 mL) | 24 | 8 (33.33) | 12 (50.00) | |
| | Large (> 10 mL) | 14 | 7 (50.00) | 3 (21.43) | |

*P values refer to the comparison of rates across all subgroups within each stratified factor (e.g., chi-square test for trend or Fisher's exact test).

**3.4. Multivariate Logistic Regression Analysis of Adverse Pregnancy Outcomes**

Multivariate logistic regression analysis was performed with adverse pregnancy outcome as the dependent variable (0 = no, 1 = yes), adjusting for age, BMI, number of previous miscarriages, comorbidities, vaginal bleeding, abdominal pain, and first-trimester SCH. The results are presented in Table 4. First-trimester SCH (OR = 2.874, 95% CI: 1.526–5.412, P = 0.001), ⩾3 previous miscarriages (OR = 2.136, 95% CI: 1.214–3.762, P = 0.008), and persistent first-trimester abdominal pain with bleeding (OR = 1.982, 95% CI: 1.105–3.554, P = 0.022) were identified as independent risk factors for adverse pregnancy outcomes in RSA patients. Among these factors, SCH showed the strongest association with adverse outcomes in the present cohort.

Table 4. Multivariate Logistic Regression Analysis of Adverse Pregnancy Outcomes in Patients With RSA

| Variable | β coefficient | SE | Wald $\chi^2$ | Adjusted OR (95% CI) | P value |
|---|---|---|---|---|---|
| First-trimester SCH | 1.056 | 0.328 | 10.385 | 2.87 (1.53–5.41) | 0.001 |
| ≥ 3 previous miscarriages | 0.759 | 0.292 | 6.752 | 2.14 (1.21–3.76) | 0.008 |
| Persistent pain/bleeding | 0.684 | 0.301 | 5.173 | 1.98 (1.11–3.55) | 0.022 |

**4. Discussion**

Recurrent spontaneous abortion is a challenging condition in reproductive immunology. Patients with RSA commonly present with multiple underlying pathologies, including maternal-fetal immune tolerance imbalance, coagulation dysfunction, and decidual developmental abnormalities, which may reduce first-trimester embryonic implantation stability compared with that of healthy women of reproductive age and render them a high-risk population for early

pregnancy loss [16]. Subchorionic hematoma, one of the most common first-trimester sonographic abnormalities, represents localized hemorrhage resulting from vascular rupture between the chorionic plate and the decidua parietalis, and is thought to reflect a complex interplay of maternal-fetal microcirculatory disturbance, abnormal trophoblast invasion, and local inflammatory activation [5]. In RSA patients, whose pregnancy tolerance is already compromised, the occurrence of SCH may further disrupt maternal-fetal homeostasis and amplify the risk of adverse pregnancy outcomes [8].

In the present study, the incidence of first-trimester SCH in RSA patients was 17.62%, and the rates of early miscarriage and overall adverse pregnancy outcomes were significantly higher in the SCH group than in the non-SCH group ($P < 0.05$). Multivariate logistic regression identified first-trimester SCH as an independent risk factor for adverse pregnancy outcomes in RSA patients (OR = 2.874, P = 0.001), which is in line with the findings of Fu et al. [10], who reported that SCH increased the risk of miscarriage by approximately 2.7-fold in RSA patients. These findings further support an independent negative impact of SCH on pregnancy prognosis in RSA patients.

The etiology of SCH is multifactorial, involving immune dysregulation, coagulation abnormalities, and uterine anatomical anomalies [5,17–19]. Immunological abnormalities—primarily elevated positivity rates of antiphospholipid antibodies and antinuclear antibodies, as well as reduced protein S activity—may contribute to SCH formation by interfering with trophoblast invasion and placental vascular remodeling [17]. With respect to coagulation, patients with SCH may exhibit a coagulation–fibrinolysis imbalance; decreased protein S activity and reduced antithrombin-III levels can promote local microthrombus formation, impair decidual vascular perfusion, and predispose to subchorionic hemorrhage [18,19]. In addition, uterine anatomical anomalies such as septate uterus and intrauterine adhesions may induce abnormal uterine contractions that stretch the chorionic plate and rupture local vessels, which is consistent with the significantly higher incidence of vaginal bleeding and abdominal pain observed in the SCH group. RSA patients, who often concurrently harbor multiple underlying pathologies, may be more susceptible to SCH, which may partly explain, from an etiological perspective, the independent association between SCH and adverse pregnancy outcomes in this population.

In terms of prognostic mechanisms, SCH may exacerbate pregnancy failure in RSA patients through several pathways, including immune dysregulation, coagulation dysfunction, trophoblast impairment, and intrauterine microenvironment disruption [17,18]. Local hematoma formation may activate decidual inflammatory infiltration, releasing pro-inflammatory cytokines and disrupting maternal-fetal immune tolerance; it may also activate the coagulation cascade, inducing microthrombus formation and impairing embryonic blood supply. In addition, mechanical compression by the hematoma may damage trophoblast invasive function, and oxidative stress products generated during hematoma absorption may further impair endometrial receptivity, potentially establishing a vicious cycle of hematoma formation, microenvironment disruption, and pregnancy failure [20].

Current research on the association between SCH and pregnancy outcomes remains controversial [4,8]. Some early studies suggested that SCH represents a transient first-trimester imaging finding without clinical intervention value that does not significantly increase the risk of miscarriage [21]. However, those studies predominantly included low-risk pregnant women and did not perform stratified analyses of RSA patients, limiting their applicability to recurrent miscarriage management [7]. Norman et al. [21] reported in a large early-stage study that

ultrasound-detected SCH was associated with adverse obstetric outcomes and that this association was more pronounced in high-risk populations. Recent targeted studies, together with the present findings, suggest that the clinical impact of SCH varies across populations: low-risk pregnant women generally have favorable prognoses, whereas in high-risk populations—including those with RSA, recurrent biochemical pregnancy, or a history of intrauterine procedures—SCH may serve as an important predictor of early pregnancy loss [8,10].

The present study extended previous work by conducting quantitative stratified analyses of SCH characteristics, and the results suggest a dose–response relationship between SCH and pregnancy outcomes in RSA patients, addressing the limitation of previous qualitative analyses that lacked quantitative evidence [12]. Patients with a hematoma duration >4 weeks and those with a hematoma volume >10 mL had early miscarriage rates of 46.15% and 50.00%, respectively, with live birth rates of 34.62% and 21.43%, indicating a poorer prognosis. In contrast, patients with a hematoma duration ≤4 weeks and those with a hematoma volume <5 mL who received standardized tocolytic intervention achieved live birth rates of 66.67% and 73.33%, with relatively favorable outcomes [12]. These findings suggest that the impact of SCH on pregnancy outcomes is not absolute but varies with hematoma burden and duration [20]. Small, short-duration hematomas may resolve through self-repair mechanisms and symptomatic intervention, allowing restoration of maternal-fetal homeostasis, whereas persistent large hematomas may continuously activate local inflammation and hypercoagulability, chronically impair placental development, and ultimately exceed the pregnancy tolerance threshold, leading to pregnancy failure. Hu et al. [12] similarly reported that hematoma volume and duration are independent predictors of prognosis in high-risk pregnant women with SCH, which is consistent with the present stratified findings. These results also suggest that, in the management of RSA pregnancies, prognosis should not be judged solely on the presence or absence of a hematoma; rather, risk stratification incorporating hematoma size, absorption rate, and duration may help guide individualized management [22].

Based on the present findings and recent clinical evidence, a stratified management approach may be considered for RSA patients with coexisting SCH [9,23]. Yu et al. [9], in a retrospective study of 257 RSA patients with SCH, reported that the fondaparinux sodium combined with conventional treatment group achieved a term live birth rate of 88.75%, which was higher than that of the low-molecular-weight heparin group (81.25%) and the conventional treatment group (68.04%) ($P < 0.05$). The fondaparinux sodium group also had shorter hematoma resolution times for both mild and severe SCH and a lower adverse reaction rate (8.75% vs. 27.50%, $P < 0.05$) [9]. Peng et al. [24], in a study of 86 patients with first-trimester SCH, reported that the combined treatment group (prednisone plus low-molecular-weight heparin) had significantly smaller mean hematoma areas at 1 and 2 months after treatment than at baseline and than the control group ($P < 0.05$), together with a lower incidence of adverse pregnancy outcomes. Tan et al. [23] also suggested that fondaparinux sodium combined with conventional therapy may improve pregnancy outcomes in SCH patients with protein S deficiency. For patients with small-volume, short-duration hematomas and no obvious symptoms, a conservative approach comprising appropriate rest, dynamic ultrasound monitoring, and microcirculation improvement may be reasonable. For patients with moderate-to-large hematomas, persistent hematoma, or ongoing vaginal bleeding and abdominal pain, earlier initiation of comprehensive interventions—including immunomodulation, anticoagulation with low-molecular-weight heparin or

fondaparinux sodium, and progesterone support—may be considered [24], although treatment choices should be individualized according to each patient's risk–benefit profile. In addition, the present study found no significant association between SCH and mid-to-late pregnancy complications (late miscarriage, preterm birth), suggesting that the detrimental effects of SCH may be largely confined to the first trimester. Therefore, early individualized intervention, promotion of hematoma resolution, and restoration of pregnancy homeostasis during the first trimester may represent a critical window for improving overall prognosis [25].

Several limitations of this study should be acknowledged. First, this was a single-center retrospective cohort study with a limited sample size, which may have introduced selection bias and provides a lower level of evidence than prospective randomized controlled trials [13]. Second, patients were not stratified by intervention protocol (tocolysis alone, anticoagulation, or immunomodulation), precluding identification of the optimal individualized treatment strategy for different SCH grades. Third, laboratory parameters, including coagulation, immunological, and hormonal markers, were not incorporated into the joint stratified analysis, and thus mechanistic quantitative validation is lacking [6]. Fourth, spontaneous and assisted reproductive conceptions were not distinguished. Future multicenter, large-sample prospective cohort studies integrating imaging-based hematoma parameters with laboratory biomarkers are warranted to develop prognostic prediction models for RSA patients with SCH [22]. In addition, controlled studies exploring optimal intervention strategies for different SCH grades and elucidating the mechanisms by which SCH affects pregnancy outcomes in RSA patients are needed to refine the stratified diagnostic and therapeutic approach for this high-risk population [22].

## 5. Conclusion

First-trimester subchorionic hematoma is relatively common in patients with recurrent spontaneous abortion. In this cohort, it was associated with an increased risk of early miscarriage and overall adverse pregnancy outcomes and a reduced live birth rate, and it was identified as an independent risk factor for poor pregnancy prognosis in RSA patients. The adverse prognosis may be associated with hypercoagulability, immune dysregulation, and intrauterine microenvironment disruption. For pregnant women with RSA and coexisting SCH, early etiological screening and miscarriage risk assessment, dynamic monitoring of hematoma changes, and individualized tocolytic, immunological, and anticoagulant interventions may be considered to strengthen pregnancy surveillance and help improve pregnancy outcomes.

## Declarations

### Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board (IRB) of Guangzhou Women and Children's Medical Center Liuzhou Hospital (Approval No. 2026-204). As this was a retrospective observational study using fully anonymized patient data, the requirement for written informed consent was waived by the Institutional Review Board.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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**Availability of data and materials**

The datasets generated and/or analyzed during the current study are not publicly available owing to patient confidentiality and institutional ethical restrictions, but are available from the corresponding author on reasonable request.

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**Authors' information**

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**Authors' contributions**

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