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Original Research

Factors that Influence Re-Pregnancy Failure and Prediction Models After Complete Curettage for Missed Abortion

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Abstract

Background: Missed abortion (MA), a type of spontaneous abortion, has become increasingly common in early pregnancy. Retained embryos may lead to dead fetus syndrome or severe hemorrhage, affecting the physical and mental health of women. This study selected MA patients undergoing uterine evacuation to construct a predictive model for factors that influence subsequent pregnancy failure, aiming to improve patient prognosis. **Methods**: A retrospective analysis of 466 women with MA after a complete uterine curettage (May 2021–May 2023) was conducted. Patients were randomly divided into a modeling (326) and a validation (140) group; the modeling group was further classified by re-pregnancy outcome. Logistic regression was used to assess risk factors for re-pregnancy failure after a complete uterine curettage for MA. The nomogram model was constructed in R software. The receiver operating characteristic (ROC) curve was plotted to evaluate the discriminative power of the nomogram model. A decision curve analysis (DCA) was used to assess the clinical value of the model. **Results**: Among 466 women, 88 (18.89%) experienced pregnancy failure. A total of 62 (19.02%) women experienced failure in the modeling group (n = 326). Multivariate logistic regression analysis identified age, prior induced abortions, early uterine fluid accumulation during re-pregnancy, complicated polycystic ovary syndrome, and transforming growth factor beta 1 (TGFβ1) as risk factors for re-pregnancy failure after complete curettage of the uterine cavity for MA ($p < 0.05$), while matrix metalloproteinase 9 (MMP9) reduced the risk of re-pregnancy failure ($p < 0.05$). The area under the curve (AUC) of the modeling group was 0.957, and the slope of the calibration curve was close to 1, with a Hosmer-Lemeshow (H-L) test value of $\chi^2 = 6.968$ and $p = 0.696$. The AUC in the validation group was 0.990, and the slope of the calibration curve was close to 1, with an H-L test value of $\chi^2 = 6.859$ and $p = 0.676$. The DCA curve showed that the high-risk threshold probabilities for the two groups were 0.07–0.78 and 0.08–0.84, respectively. The nomogram model was then used to evaluate the clinical utility of predicting re-pregnancy failure after MA curettage. **Conclusions**: Age, number of previous induced abortions, early uterine fluid accumulation during re-pregnancy, complicated polycystic ovary syndrome, MMP9, and TGFβ1 are influencing factors for re-pregnancy failure after complete curettage of the uterine cavity for MA. A prediction model constructed from these factors accurately estimated the postoperative risk of recurrent pregnancy loss.

Keywords: missed abortion; complete curettage of the uterine cavity; re-pregnancy failure; influencing factors; nomogram model

1. Introduction

Missed abortion (MA) is a type of spontaneous abortion where the embryo or fetus ceases development but is not expelled from the uterus in time [1]. MA has no typical symptoms, and most patients are diagnosed upon medical consultation due to symptoms such as lower abdominal pain or irregular vaginal bleeding. Moreover, prolonged retention of MA in the uterine cavity can lead to severe complications such as coagulation dysfunction in the mother. Therefore, it is necessary to remove the dead fetal tissue caused by pregnancy as soon as possible after diagnosis [2,3]. Curettage is currently an effective clinical treatment for MA, which can effectively remove retained embryonic tissue in the uterine cavity. However, when the pregnant woman becomes pregnant again, there is a risk of failure, which cannot meet the fertility needs of couples of childbearing age [4]. Therefore, in order to effectively reduce the failure rate of subsequent pregnancy after MA curettage, identifying factors that can affect subsequent pregnancy failure after MA curettage in clinical practice can effectively improve pregnancy outcomes. A nomogram can integrate the risk factors screened out in regression analysis to individually predict the risk value of a certain event, thereby quantifying the risk of the event [5,6]. A study established a predictive model based on the XGBoost algorithm, which can accurately predict the risk of MA in *in vitro* fertilization and embryo transfer (IVF-ET) patients, and this model outperformed the traditional logistic regression model [7]. This study constructed a nomogram model to enhance clinical applicability and assist clinicians in quantitatively predicting the risk of events. Currently, there are relatively few studies reporting such nomograms. Therefore, this study aims to analyze the influencing factors of subsequent pregnancy failure after MA curettage and construct a prediction model.

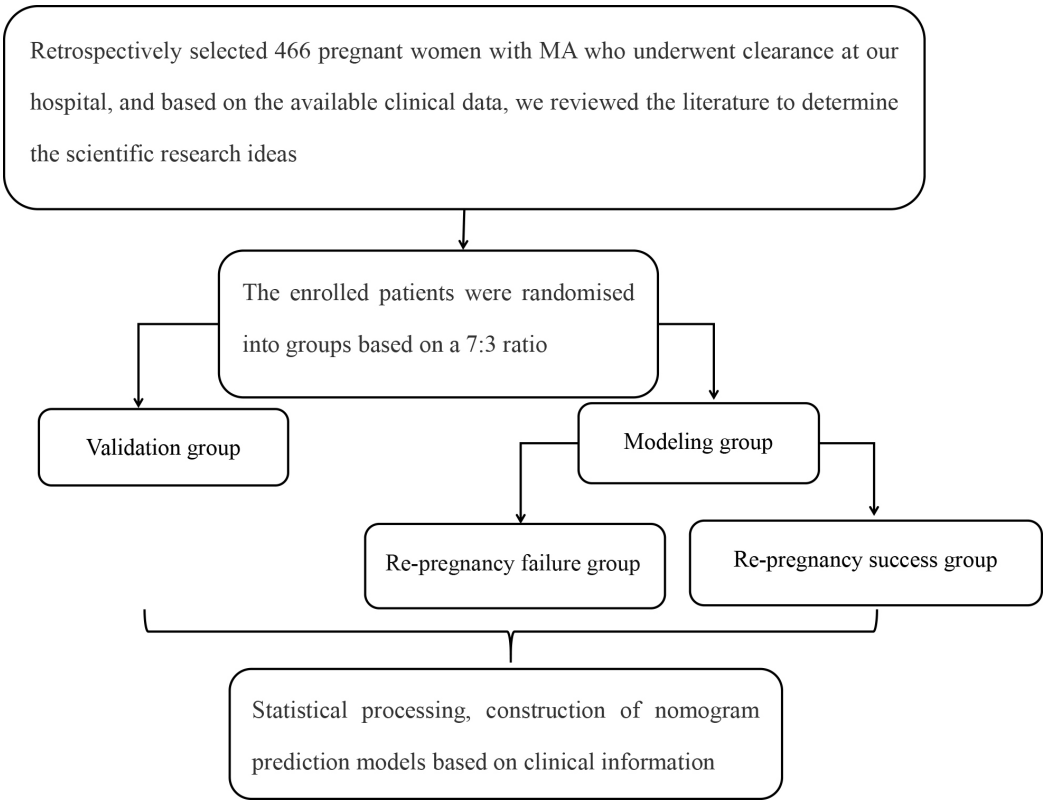

Fig. 1. Case selection flowchart. MA, missed abortion.

2. Materials and Methods

2.1 General Information

A retrospective study included 466 women with missed abortion treated by curettage from May 2021 to May 2023. They were randomly divided into modeling (n = 326) and validation (n = 140) groups (7:3). The modeling group was further classified into pregnancy failure and success groups. Case selection is shown in Fig. 1. Inclusion criterion: (1) diagnosis of MA [8]; (2) undergoing regular prenatal check-ups; (3) confirmed by B-ultrasound and having completed curettage; (4) complete data; (5) subsequent pregnancy more than 1 year after the operation, with early pregnancy failure (Follow-up endpoint: March 2025). Exclusion criteria: (1) the current pregnancy was not ectopic pregnancy, biochemical pregnancy, etc.; (2) those with severe organ dysfunction; (3) those with mental illness who could not communicate normally; (4) those with malignant tumors. The hospital ethics committee approved this study.

2.2 Diagnostic Criteria for Subsequent Pregnancy Failure

Missed abortion [9] was diagnosed by color Doppler ultrasound Voluson E10 (GE Healthcare, Chicago, IL, USA) if: (1) crown-rump length $\geq$7 mm without heartbeat; (2) mean gestational sac diameter $\geq$25 mm without embryo; (3) no embryonic heartbeat 2 weeks after a yolk sac-free gestational sac; or (4) no embryonic heartbeat 11 days after a yolk sac-containing gestational sac.

2.3 Clinical Data

Clinical and laboratory data were extracted from medical records, including demographic factors (age, body mass index (BMI), gravidity, parity, education, residence), reproductive history (curettages, induced abortions), lifestyle (smoking, alcohol), gynecologic and endocrine conditions (uterine fibroids, intrauterine fluid, cervical insufficiency, polycystic ovary syndrome, thyroid disorders, pelvic inflammatory disease), and nutritional supplementation (folic acid, calcium). All data were collected by experienced staff and validated for accuracy. Laboratory indicators included white blood cell (WBC), platelet (PLT), interleukin-6 (IL-6), tumor necrosis factor alpha (TNF-α), matrix metalloproteinase 9 (MMP9), transforming growth factor beta 1 (TGFβ1), and vascular endothelial growth factor (VEGF).

2.4 Statistical Analysis

Data were analyzed using SPSS 25.0 (IBM Corp., Armonk, NY, USA). Categorical variables were compared by χ^2 test and continuous variables by *t*-test. Logistic regression identified risk factors. A nomogram was built with R, and its performance evaluated by receiver operating characteristic (ROC) and decision curve analysis (DCA). Significance was set at $p < 0.05$.

Table 1. Baseline clinical characteristics of the modeling and validation groups.

Factor	Modeling group (n = 326) n (%)	Validation group (n = 140) n (%)	t/χ^2	p
Age (years)			0.040	0.841
<35	183 (56.13)	80 (57.14)		
≥35	143 (43.87)	60 (42.86)		
Pre-pregnancy BMI (kg/m^2)			0.084	0.772
<24	66 (20.25)	30 (21.43)		
≥24	260 (79.75)	110 (78.57)		
Gravidity (times)			0.026	0.872
<2	161 (49.39)	68 (48.57)		
≥2	165 (50.61)	72 (51.43)		
Parity (times)			0.148	0.701
<1	146 (44.79)	60 (42.86)		
≥1	180 (55.21)	80 (57.14)		
Number of curettages (times)			0.022	0.882
<1	128 (39.26)	56 (40.00)		
≥1	198 (60.74)	84 (60.00)		
Number of previous induced abortions (times)			0.700	0.403
<1	186 (57.06)	74 (52.86)		
≥1	140 (42.94)	66 (47.14)		
Education level			0.015	0.903
Junior high school and below	161 (49.39)	70 (50.00)		
Senior high school and above	165 (50.61)	70 (50.00)		
Residence			0.235	0.628
Urban	224 (68.71)	93 (66.43)		
Rural	102 (31.29)	47 (33.57)		
Smoking			0.261	0.610
Yes	108 (33.13)	43 (30.71)		
No	218 (66.87)	97 (69.29)		
Alcohol consumption			0.248	0.619
Yes	122 (37.42)	49 (35.00)		
No	204 (62.58)	91 (65.00)		
History of uterine fibroids			0.381	0.537
Yes	54 (16.56)	20 (14.29)		
No	272 (83.44)	120 (85.71)		
Early pregnancy intrauterine fluid			0.511	0.475
Yes	119 (36.50)	56 (40.00)		
No	207 (63.50)	84 (60.00)		
Combined acquired cervical insufficiency			0.127	0.722
Yes	58 (17.79)	23 (16.43)		
No	268 (82.21)	117 (83.57)		
Combined polycystic ovary syndrome			0.010	0.921
Yes	125 (38.34)	53 (37.86)		
No	201 (61.66)	87 (62.14)		
Hyperthyroidism			0.165	0.684
Yes	20 (6.13)	10 (7.14)		
No	306 (93.87)	130 (92.86)		
Subclinical hypothyroidism			0.086	0.769
Yes	38 (11.66)	15 (10.71)		
No	288 (88.34)	125 (89.29)		
Hypothyroidism			0.569	0.451
Yes	25 (7.67)	8 (5.71)		
No	301 (92.33)	132 (94.29)		

Table 1. Continued.

Factor	Modeling group (n = 326) n (%)	Validation group (n = 140) n (%)	t/χ^2	p
History of pelvic inflammatory disease			0.381	0.537
Yes	54 (16.56)	20 (14.29)		
No	272 (83.44)	120 (85.71)		
Folic acid supplementation			0.130	0.718
Yes	229 (70.25)	96 (68.57)		
No	97 (29.75)	44 (31.43)		
Calcium supplementation			0.043	0.836
Yes	277 (84.97)	120 (85.71)		
No	49 (15.03)	20 (14.29)		
WBC ($\times 10^9$/L)	6.37 $\pm$ 1.10	6.38 $\pm$ 1.13	0.089	0.929
PLT ($\times 10^9$/L)	205.79 $\pm$ 33.39	205.34 $\pm$ 32.89	0.134	0.893
IL-6 (µg/mL)	3.52 $\pm$ 0.79	3.50 $\pm$ 0.80	0.250	0.803
TNF-α (µg/mL)	2.19 $\pm$ 0.44	2.20 $\pm$ 0.43	0.226	0.821
MMP9 (mg/L)	10.78 $\pm$ 1.71	10.83 $\pm$ 1.68	0.291	0.771
TGFβ1 (ng/L)	28.20 $\pm$ 3.06	28.08 $\pm$ 3.08	0.387	0.699
VEGF (ng/L)	33.74 $\pm$ 4.55	33.23 $\pm$ 4.48	1.424	0.155

BMI, body mass index; WBC, white blood cell; PLT, platelet; IL-6, interleukin-6; TNF-α, tumor necrosis factor alpha; TGFβ1, transforming growth factor beta 1; MMP9, matrix metalloproteinase 9; VEGF, vascular endothelial growth factor.

3. Results

3.1 Comparison of Clinical Characteristics in Modeling and Validation Groups

No significant differences in baseline clinical characteristics were observed between the modeling and validation groups ($p > 0.05$) (Table 1).

3.2 Comparison of Clinical Data Between Subsequent Pregnancy Failure and Success Groups

Of the 466 women, 88 (18.89%) had subsequent pregnancy failure. In the modeling cohort (n = 326), 62 (19.02%) failed to conceive again. Significant differences were observed between the two groups in age, number of prior induced abortions, early intrauterine fluid, presence of polycystic ovary syndrome, MMP9, and TGFβ1 levels ($p < 0.05$). Other clinical variables showed no significant differences ($p > 0.05$) (Table 2).

3.3 Analysis of Influencing Factors for Subsequent Pregnancy Failure After MA Curettage

Subsequent pregnancy failure after MA curettage was set as the dependent variable (yes = 1, no = 0), and factors with $p < 0.05$ were used as independent variables (see Table 3 for assignments). Collinearity testing showed all variance inflation factors (VIFs) <10, indicating no collinearity. Multivariable logistic regression (forward stepwise) identified age, prior induced abortions, early intrauterine fluid, polycystic ovary syndrome, and TGFβ1 as risk factors ($p < 0.05$), while MMP9 was protective ($p < 0.05$) (Table 4).

3.4 Development of a Nomogram for Predicting Subsequent Pregnancy Failure After MA Curettage

In this model, the factors influencing the scoring are, in descending order of impact: MMP9, TGFβ1, combined polycystic ovary syndrome, early pregnancy intrauterine fluid, age, and number of previous induced abortions. For example, for a pregnant woman aged $\geq$35 years (25.50 points), with <1 previous induced abortion (0 points), no early pregnancy intrauterine fluid (23.50 points), combined polycystic ovary syndrome (31.50 points), MMP9 (8.01 $\pm$ 1.01) mg/L (58.50 points), and TGFβ1 (30.21 $\pm$ 3.05) µg/mL (34.50 points). By summing the above scores, a total score of 150 points can be obtained. Drawing a vertical line downward from the total score position shows that the predicted probability of pregnancy failure after MA curettage is 76%. See Fig. 2.

3.5 Nomogram Model in the Modeling Group

The calibration curve of the nomogram for predicting recurrent pregnancy failure after MA uterine evacuation demonstrated good agreement with the observed outcomes in the modeling cohort. The model achieved an area under the curve (AUC) of 0.957 (95% confidence interval (CI): 0.924–0.990), a Brier score of 0.0018, and a Hosmer-Lemeshow test of $\chi^2 = 6.968$, $p = 0.696$, indicating excellent agreement between predicted and observed probabilities (Fig. 3).

3.6 Nomogram Model in the Validation Group

The calibration curve of the nomogram predicting recurrent pregnancy failure after MA uterine evacuation showed good agreement with the observed outcomes in the

Table 2. Comparison of clinical data between the subsequent pregnancy failure group and the subsequent pregnancy success group.

Factor	Subsequent pregnancy failure group (n = 62) n (%)	Subsequent pregnancy success group (n = 264) n (%)	t/χ^2	p
Age (years)			22.839	<0.001
<35	18 (29.03)	165 (62.50)		
≥35	44 (70.97)	99 (37.50)		
Pre-pregnancy BMI (kg/m^2)			0.038	0.846
<24	12 (19.35)	54 (20.45)		
≥24	50 (80.65)	210 (79.55)		
Gravidity (times)			0.209	0.648
<2	29 (46.77)	132 (50.00)		
≥2	33 (53.23)	132 (50.00)		
Parity (times)			0.004	0.947
<1	28 (45.16)	118 (44.70)		
≥1	34 (54.84)	146 (55.30)		
Number of curettages (times)			0.229	0.632
<1	26 (41.94)	102 (38.64)		
≥1	36 (58.06)	162 (61.36)		
Number of previous induced abortions (times)			19.213	<0.001
<1	20 (32.26)	166 (62.88)		
≥1	42 (67.74)	98 (37.12)		
Education level			0.084	0.772
Junior high school and below	32 (51.61)	129 (48.86)		
Senior high school and above	30 (48.39)	135 (51.14)		
Residence			0.533	0.465
Urban	45 (72.58)	179 (67.80)		
Rural	17 (27.42)	85 (32.20)		
Smoking			0.026	0.871
Yes	20 (32.26)	88 (33.33)		
No	42 (67.74)	176 (66.67)		
Alcohol consumption			0.054	0.816
Yes	24 (38.71)	98 (37.12)		
No	38 (61.29)	166 (62.88)		
History of uterine fibroids			0.431	0.511
Yes	12 (19.35)	42 (15.91)		
No	50 (80.65)	222 (84.09)		
Early pregnancy intrauterine fluid			23.022	<0.001
Yes	39 (62.90)	80 (30.30)		
No	23 (37.10)	184 (69.70)		
Combined acquired cervical insufficiency			0.528	0.467
Yes	13 (20.97)	45 (17.05)		
No	49 (79.03)	219 (82.95)		
Combined polycystic ovary syndrome			22.183	<0.001
Yes	40 (64.52)	85 (32.20)		
No	22 (35.48)	179 (67.80)		
Hyperthyroidism			0.013	0.908
Yes	4 (6.45)	16 (6.06)		
No	58 (93.55)	248 (93.94)		
Subclinical hypothyroidism			0.116	0.734
Yes	8 (12.90)	30 (11.36)		
No	54 (87.10)	234 (88.64)		
Hypothyroidism			0.017	0.896
Yes	5 (8.06)	20 (7.58)		
No	57 (91.94)	244 (92.42)		

Table 2. Continued.

Factor	Subsequent pregnancy failure group (n = 62) n (%)	Subsequent pregnancy success group (n = 264) n (%)	t/χ^2	p
History of pelvic inflammatory disease			0.077	0.782
Yes	11 (17.74)	43 (16.29)		
No	51 (82.26)	221 (83.71)		
Folic acid supplementation			0.019	0.890
Yes	44 (70.97)	185 (70.08)		
No	18 (29.03)	79 (29.92)		
Calcium supplementation			0.072	0.788
Yes	52 (83.87)	225 (85.23)		
No	10 (16.13)	39 (14.77)		
WBC ($\times 10^9$/L)	6.49 ± 1.02	6.34 ± 1.12	0.965	0.335
PLT ($\times 10^9$/L)	203.58 ± 32.64	206.31 ± 33.56	0.579	0.563
IL-6 (μg/mL)	3.54 ± 0.72	3.52 ± 0.81	0.179	0.858
TNF-α (μg/mL)	2.21 ± 0.54	2.18 ± 0.42	0.478	0.633
MMP9 (mg/L)	8.42 ± 1.68	11.34 ± 1.72	–12.082	<0.001
TGFβ1 (ng/L)	32.65 ± 3.12	27.15 ± 3.04	12.756	<0.001
VEGF (ng/L)	34.02 ± 4.62	33.68 ± 4.53	0.530	0.597

Table 3. Assignment method of independent variables.

Variable	Assignment method
Age	<35 years = 0, ≥35 years = 1
Number of previous induced abortions	<1 time = 0, ≥1 time = 1
Early pregnancy intrauterine fluid	No = 0, Yes = 1
Combined polycystic ovary syndrome	No = 0, Yes = 1
MMP9	Continuous variable
TGFβ1	Continuous variable

Table 4. Analysis of influencing factors for subsequent pregnancy failure after MA curettage.

Variable	β	SE	Wald χ^2	p	OR	95% CI
Age	1.949	0.517	14.220	<0.001	7.024	2.550~19.346
Number of previous induced abortions	1.722	0.500	11.879	0.001	5.595	2.102~14.895
Early pregnancy intrauterine fluid	1.978	0.539	13.463	<0.001	7.232	2.513~20.807
Combined polycystic ovary syndrome	2.418	0.529	20.923	<0.001	11.223	3.983~31.628
MMP9	–0.572	0.152	14.150	<0.001	0.564	0.419~0.760
TGFβ1	0.267	0.087	9.398	0.002	1.306	1.101~1.549
Constant	–6.988	2.766	6.153	0.013	0.001	-

SE, standard error; OR, odds ratio; CI, confidence interval.

validation cohort. The validation cohort achieved an AUC of 0.990 (95% CI: 0.977–1.000), a Brier score of 0.0001, and a Hosmer-Lemeshow test of $\chi^2 = 6.859$, $p = 0.676$, indicating excellent agreement between predicted and observed probabilities (Fig. 4).

3.7 Curve of the Nomogram Model

The DCA curve shows that the high-risk threshold probabilities for the two groups were 0.07–0.78 and 0.08–0.84, respectively, where the nomogram provided a higher net benefit. The nomogram model was then used to evaluate the clinical utility of predicting re-pregnancy failure after MA curettage (Fig. 5).

4. Discussion

The etiology of MA remains unclear but may involve chromosomal abnormalities, reproductive tract infections, and immune factors [10,11]. Most MA pregnant women have no clinical signs and are generally found during prenatal check-ups (based on ultrasound images) that the embryo or fetus has remained in the uterine cavity and has not been expelled in time. Curettage is required to remove the embryo or fetus and reduce adverse effects on the pregnant woman's body [12]. However, because curettage is an invasive procedure, it may damage the basal layer of the endometrium, and there is a certain risk of subsequent pregnancy failure after the operation [8,13]. The results of this

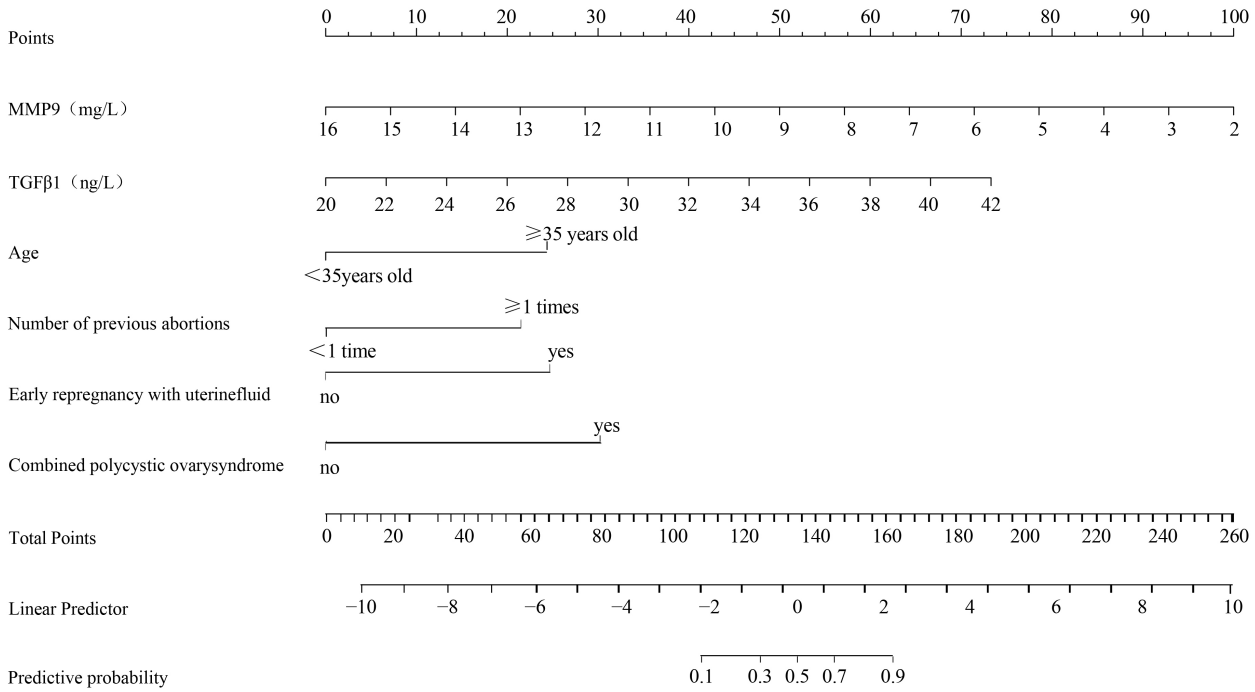

Fig. 2. Nomogram model for predicting subsequent pregnancy failure after MA curettage.

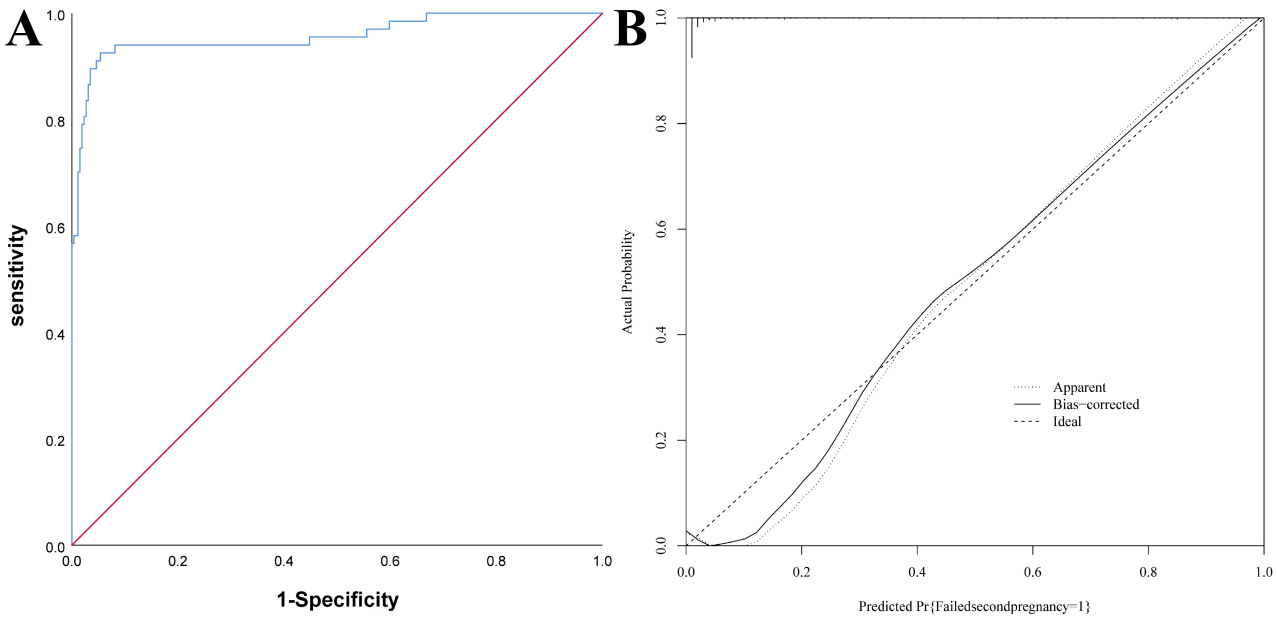

Fig. 3. Nomogram performance in the modeling group. (A) ROC curve. (B) Calibration curve. ROC, receiver operating characteristic.

study found that 88 of the 466 pregnant women experienced subsequent pregnancy failure, with an incidence rate of 18.89%. In the modeling group (n = 326), 62 women experienced subsequent pregnancy failure (19.02%), indicating a high incidence. Therefore, identifying factors that affect subsequent pregnancy failure after MA curettage in clinical practice and intervening in a timely manner can effectively improve pregnancy outcomes for pregnant women.

In this study, multivariate analysis screened out 6 factors (age, number of previous induced abortions, early pregnancy intrauterine fluid, combined polycystic ovary syndrome, MMP9, and TGFβ1). The reasons are analyzed as follows: (1) As pregnant women age and miss the golden age for childbearing, the body's tolerance and uterine physiological function decline, and the risk of gestational complications increases, thus increasing the risk of subsequent pregnancy failure [14]. Therefore, prenatal guidance should be provided to older pregnant women to them adjust to the best reproductive state and prevent gestational complications. (2) An increased number of previous

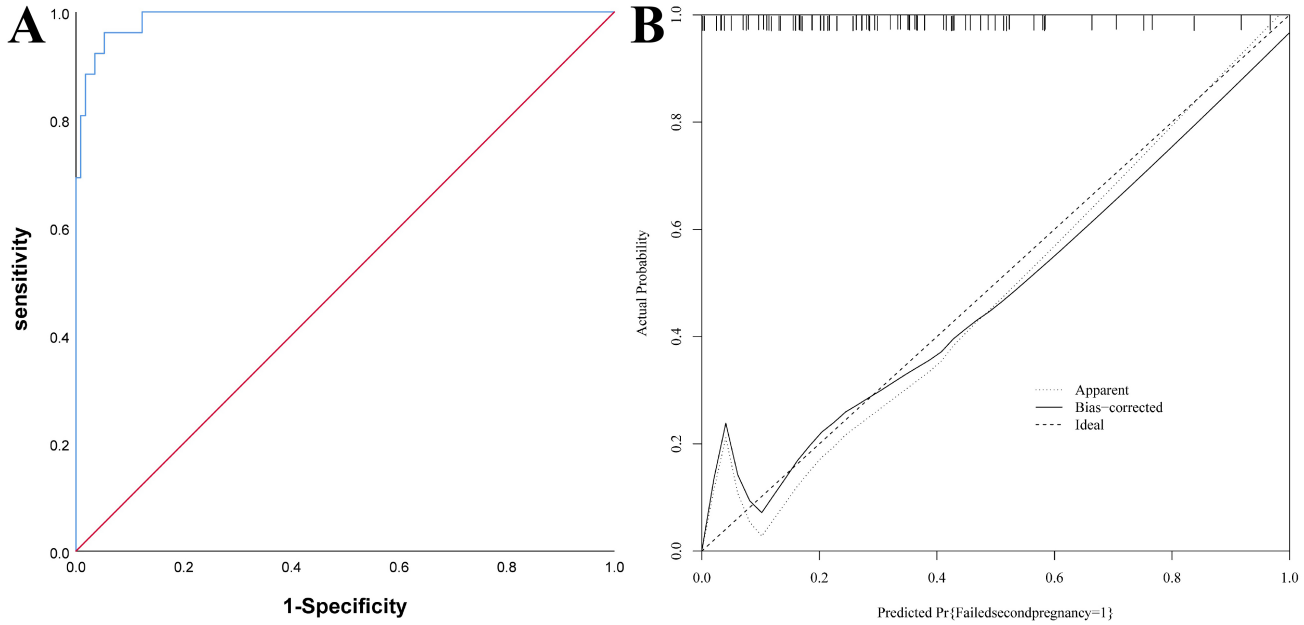

Fig. 4. Nomogram model in the validation group. (A) ROC curve for the validation group. (B) Calibration curve for the validation group.

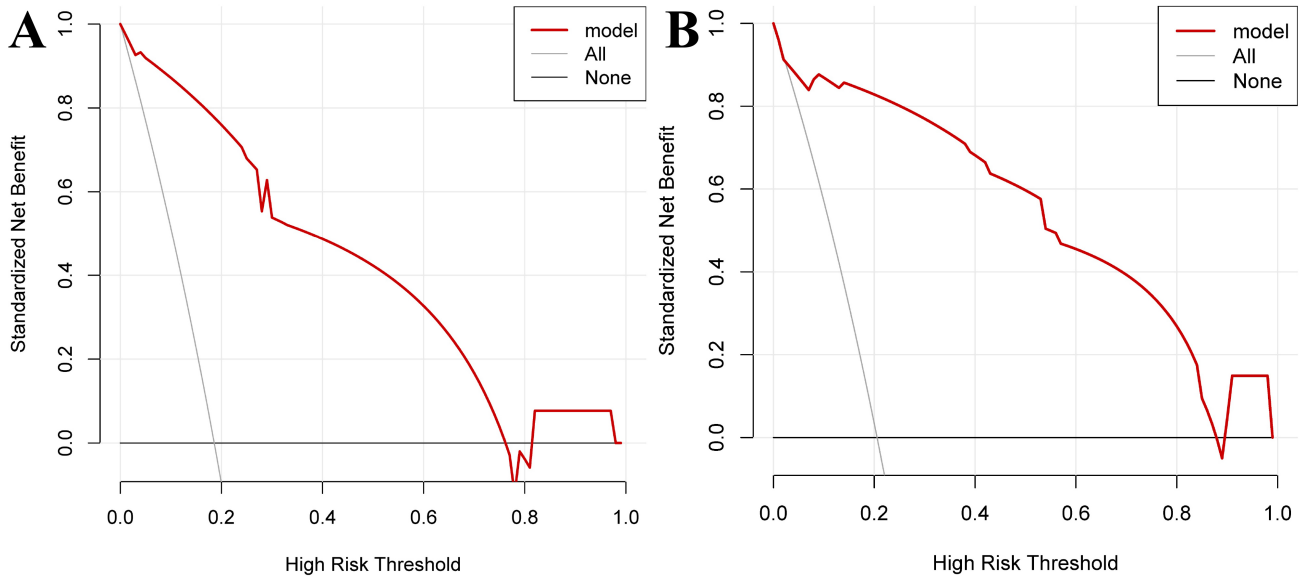

Fig. 5. DCA curve of the nomogram model. (A) Modeling group. (B) Validation group. Note: The horizontal axis represents the high-risk threshold, ranging from 0 to 1, and the vertical axis represents the net benefit, also ranging from 0 to 1. DCA, decision curve analysis.

induced abortions indicates a thinner endometrium, which is unfavorable for subsequent sperm implantation. It can also lead to intrauterine adhesions and increase the risk of perineal reproductive tract infections and uterine damage, all of which increase the risk of subsequent pregnancy failure [15]. Therefore, it is important to understand the pregnant woman's abortion history before the operation and ensure complete removal without residue during the curettage. (3) Early pregnancy intrauterine fluid is also a high-risk factor. Intrauterine fluid is generally caused by abnormal hormone levels or external factors and is a manifestation of abnormal pregnancy, significantly increasing the risk of miscarriage [16]. Therefore, pregnant women diagnosed with this condition should pay attention to rest and receive threatened abortion treatment. (4) For pregnant women with combined polycystic ovary syndrome, due to their special endocrine environment (hyperandrogenism, metabolic disorders, etc.), oocyte development is affected, and the receptivity of the endometrium is impacted, thereby affecting early embryonic development and increasing the likeli-

hood of miscarriage. Therefore, these patients need to undergo progesterone treatment to improve uterine endometrial receptivity and reduce the risk of subsequent pregnancy failure [17,18]. (5) Lower levels of MMP9 reduce proteolytic activity, promote the degradation and deposition of the extracellular matrix, and promote endometrial fibrosis leading to intrauterine adhesions, increasing the risk of subsequent pregnancy failure [19]. (6) High expression of TGFβ1 is associated with reduced endometrial volume and decreased blood perfusion. Reduced endometrial blood perfusion is not conducive to the self-repair of endometrial damage caused by curettage. Possibly, TGFβ1 combines with receptor 1 to promote the hydrolysis of the extracellular matrix, promoting the adhesion of endometrial tissue [20,21].

The nomogram model can integrate multiple influencing factors into a single statistical model, allowing for relatively accurate prediction of patient conditions and demonstrating high clinical utility. Using this intuitive nomogram tool, clinicians can quickly combine multi-factor information to quantitatively predict individual patient outcomes, thereby supporting clinical decision-making and improving the precision and personalization of diagnosis and treatment. A Study has found that predictive models for MA based on coagulation function tests, including D-dimer, AT-III, and PC, have significant predictive value for MA [22]. In this study, the nomogram model yielded AUCs of 0.957 and 0.990 for the modeling and validation groups, respectively, indicating high discrimination. Moreover, the slope of the calibration curve was close to 1, indicating good consistency. Moreover, the DCA curves for both groups showed that when the probability ranged from 0.07–0.78 and 0.08–0.84, respectively, the nomogram model demonstrated high clinical utility. It can help clinicians assess the risk of subsequent pregnancy failure after surgery based on influencing factors, and early intervention can effectively improve patient prognosis. However, this study has several limitations. As a study with inherent limitations, the sample size was relatively small, and there was potential selection bias and uncontrolled confounding factors. Future research will expand the sample size and adopt a prospective, multicenter design to further explore and validate the effects of environmental and genetic factors.

5. Conclusions

Age, number of previous induced abortions, early pregnancy intrauterine fluid, combined polycystic ovary syndrome, MMP9, and TGFβ1 are influencing factors for subsequent pregnancy failure after MA curettage. The nomogram model constructed based on these factors can better predict the risk of subsequent pregnancy failure after surgery.

Availability of Data and Materials

Data is available from the corresponding author on reasonable request.

Author Contributions

XZ and LT designed the research study. XZ performed the research. LT analyzed the data. Both authors contributed to editorial changes in the manuscript. Both authors read and approved the final manuscript. Both authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work. All work was conceived and completed by XZ and LT.

Ethics Approval and Consent to Participate

This study was conducted in accordance with the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Xuancheng Central Hospital (No.202406012). Informed consent was obtained from all patients or their families/legal guardians prior to participation.

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Conflict of Interest

The authors declare no conflict of interest.

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