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Systematic Review

Risk of Placenta Accreta Spectrum Disorder After Prior Non–Cesarean Delivery Uterine Surgery

A Systematic Review and Meta-analysis

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OBJECTIVE: To evaluate the association between previous non–cesarean uterine surgery and placenta accreta spectrum (PAS) in subsequent pregnancies.

DATA SOURCES: PubMed, EMBASE, the Cochrane Library, ClinicalTrials.gov, CNKI (China National Knowledge Infrastructure), and Wan-fang Database were searched from inception to April 2024, supplemented by manual searches.

METHODS OF STUDY SELECTION: Studies included prospective, retrospective cohort, case–control, and cross-sectional studies involving pregnant women diagnosed with PAS and reporting at least one risk factor associated with previous uterine surgery.

TABULATION, INTEGRATION, AND RESULTS: Two authors independently screened potentially eligible studies and extracted data. The quality of the studies was assessed with the Newcastle–Ottawa Scale. The pooled odds ratios (ORs), adjusted ORs, and their 95% CIs were estimated with fixed- or random-effects models if the heterogeneity (I^2) was high. Sensitivity analyses were conducted to account for potential study bias. The main measures were myomectomy, uterine artery embolization, dilatation and curettage, hysteroscopic adhesiolysis, abortion, endometrial ablation, and operative hysteroscopy. A total of 38 studies involving 7,353,177 participants were included in the systematic review, with an overall prevalence of PAS of 0.16%, and 31 studies were included in the meta-analysis. Prior non–cesarean uterine surgeries were associated with PAS in subsequent pregnancy (pooled OR 2.29, 95% CI, 1.43–3.68). Distinct associations between specific uterine surgery and PAS included myomectomy (OR 2.29, 95% CI, 1.77–2.97), uterine artery embolization (OR 43.16, 95% CI, 20.50–90.88), dilatation and curettage (OR 2.28, 95% CI, 1.78–2.93), hysteroscopic adhesiolysis (OR 7.72, 95% CI, 4.10–14.53), abortion (OR 1.65, 95% CI, 1.43–1.92), endometrial ablation (OR 20.26, 95% CI, 17.15–23.93), and operative hysteroscopy (OR 3.10, 95% CI, 1.86–5.18).

CONCLUSION: Prior non–cesarean uterine surgery is associated with a significantly increased odds for development of PAS in subsequent pregnancy, and the risk varies depending on the types of uterine surgery.

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Placenta accreta spectrum (PAS) is a term used to describe the abnormal adherence and invasion of the placental trophoblasts to the uterine myometrium, formerly known as morbidly adherent placenta.[1] Depending on the degree of disruption of the uterine wall and location of invasion, a grading system of PAS has been proposed: grade 1, abnormally adherent placenta (placenta accreta); grade 2, abnormally invasive placenta (increta); and grade 3, abnormally invasive placenta (percreta), which is subdivided into grade 3a, limited to the uterine serosa; grade 3b, with urinary bladder invasion; and grade 3c, with invasion of other pelvic tissues or organs.[1–3] Placenta accreta spectrum is a significant contributor to severe pregnancy complications such as uterine rupture, severe postpartum hemorrhage, massive transfusion, intensive care unit admission, neonatal prematurity, neonatal intensive care unit admission, emergency hysterectomy, and maternal mortality.[4] The incidence of PAS varies worldwide, with estimates ranging from 0.08% to 2.2%, and appears to be rising, mainly as a result of the worldwide increase in cesarean rates over the past two decades.[5–8] Alarmingly, more than half of all cases remain undiagnosed before delivery, highlighting the potential for improved early identification and management.[9]

Identifying high-risk factors and accurately predicting PAS before delivery are crucial; doing so enables the application of multidisciplinary management strategies to reduce associated morbidity.[10] Previous studies have suggested that prior cesarean delivery and placenta previa are independent risk factors for the occurrence of PAS.[11–13] However, it is noteworthy that not all pregnant women with PAS exhibit these identified risk factors. Although the difference in the location and degree of endometrial or myometrial damage caused by prior non–cesarean uterine surgery varies, non–cesarean surgery still can lead to a secondary defect of endometrial–myometrial interface similar to cesarean delivery. Both types of surgeries can affect the occurrence of PAS in subsequent pregnancies.[1,2,4,14]

Therefore, this systematic review and meta-analysis aimed to summarize the current literature and to explore the association between prior non–cesarean uterine surgery and the subsequent incidence of PAS.

SOURCES

This study was conducted following the criteria of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and MOOSE (Meta analysis of Observational Studies in Epidemiology) guidelines,[15,16] and it was registered with PROSPERO (CRD42024552210). A comprehensive search from the inception of each database until April 2024 was performed. These databases included PubMed, EMBASE, the Cochrane Library, ClinicalTrials.gov, CNKI (China National Knowledge Infrastructure), and Wan-fang Database. Additional relevant literature was identified through a manual search of the reference lists of the included studies and relevant systematic reviews. We combined MeSH indexes, key word terms, and word variants searches and used the following search terms: "placenta accreta," "uterine myomectomy," "dilatation and curettage (D&C)," "endometrial ablation techniques," "abortion, induced," "hysteroscopy," "gynecologic laparoscopy," "placental removal," and "uterine surgeries," as well as their variants. The search strategy is available in Appendix 1, available online at http://links.lww.com/AOG/D984.

STUDY SELECTION

We included studies that met the following criteria: 1) the study design included cross-sectional, case–control, or cohort studies; 2) studies directly compared the risk factors (uterine surgery other than cesarean delivery) of pregnancies complicated by clinically or pathologically confirmed PAS; and 3) any type of uterine surgery other than cesarean delivery was included (myomectomy, uterine artery embolization, dilatation and curettage, hysteroscopic adhesiolysis, abortion, endometrial ablation, hysteroscopy and hysteroscopic surgery, and any other gynecologic surgical procedure) that can cause endometrial or myometrial damage.

The exclusion criteria were as follows: 1) not using PAS as a study outcome; 2) lack of data on prior uterine surgery as a risk factor for PAS; 3) any language other than English or Chinese; 4) full text not available; and 5) studies without a control group, case reports, case series, reviews, conference abstracts, unpublished articles, animal experiments, editorials, and letters.

All retrieved articles were imported into EndNote 21.1, and duplicates were removed. Two researchers (R.Y. and L.Z.) independently screened articles according to their titles and abstracts. They proceeded to obtain the full-text copies of the selected articles. Two researchers (R.Y. and L.S.) then independently retrieved articles and extracted the following data onto custom-made data collection forms: the first author's name, article title, publication journal and year, country name, study design, duration of study, exposure or case sample size and total sample size, and any

uterine surgery–related risk factors for PAS. The effect estimates, including the odds ratios (ORs), risk ratios, and their 95% CIs, were extracted and analyzed. Disagreements in the extraction process were resolved through consensus, if necessary, with discussion with a third author (L.D.).

The quality of observational studies, including case–control, cohort, and cross-sectional studies, was appraised with the Newcastle–Ottawa Scale.[17] The assessment encompassed three key aspects: subject selection, study comparability, and outcome measurement. The Newcastle–Ottawa Scale consists of eight items in three dimensions, with a total score of 9 points. A study with a score of 7 or higher is considered to be of high quality. Conversely, those with scores of 6 or lower were categorized as low quality.

All the data analysis and the graphic renderings were carried out with RevMan5.4.1 and Stata 18.0. The combined effect sizes of the risk factors for PAS were assessed with ORs and their 95% CIs, which were extracted or calculated according to the data from the included studies. The ORs were combined using the inverse variance method. When adjusted estimates were not available, unadjusted estimates were extracted. Given the limited occurrence of PAS (and thus the near equivalence of the OR and risk ratio), studies that reported a risk ratio were included. Heterogeneity indices (I^2) and the χ^2 test were used to assess statistical heterogeneity. In particular, if $I^2<50\%$ and $P>.1$, the variation of the studies was considered homogeneous, and the fixed-effect model was adopted to calculate the pooled effect size. Otherwise, the random-effect model was used. Apparent clinical heterogeneity was dealt with through subgroup analyses, sensitivity analyses, or descriptive analyses. If at least 10 studies were included in a meta-analysis, publication bias was assessed by visual inspection of a funnel plot. The Begg and Egger tests were also used to assess publication bias.

RESULTS

A total of 2,753 studies were initially retrieved; 579 duplicates were removed. To ensure a comprehensive search, an additional seven articles, which were not discovered in our systematic search, were manually identified. After evaluation of the titles and abstracts, 224 studies remained. The full texts of these 224 studies were screened, and 186 were excluded because they did not meet the eligibility criteria. In the end, 38 studies[6,7,18–53] were included in the analysis. The flowchart of the selection process is presented in Figure 1.

The 38 studies, four in Chinese and 34 in English, were published between 2009 and 2024. Among them, 25 were cohort studies, 12 were case–control studies, and one was a cross-sectional design. Of those, 31 studies[6,7,18–47] contributed data to the meta-analysis. The basic information and Newcastle–Ottawa Scale scores of each study are presented in Table 1. Of these, 26 studies demonstrated high quality with scores of 7 or higher; 12 studies had quality scores of 6 or lower (Appendix 2, available online at http://links.lww.com/AOG/D984).

The comprehensive results showed that apart from cesarean delivery, the risk of PAS in subsequent pregnancy varied from the types of previous uterine surgery. Women with a history of non–cesarean uterine surgery were at increased risk of PAS (pooled OR 2.29, 95% CI, 1.43–3.68, $I^2=68\%$, n=6 studies) (Fig. 2). When specific uterine surgery was examined, myomectomy (OR 2.29, 95% CI, 1.77–2.97, $I^2=46\%$, n=10 studies), uterine artery embolization (OR 43.16, 95% CI, 20.50–90.88, $I^2=0\%$, n=4 studies), D&C (OR 2.28, 95% CI, 1.78–2.93, $I^2=60\%$, n=8 studies), hysteroscopic adhesiolysis (OR 7.72, 95% CI, 4.10–14.53, $I^2=75\%$, n=5 studies), abortion (OR 1.65, 95% CI, 1.43–1.92, $I^2=32\%$, n=7 studies), endometrial ablation (OR 20.26, 95% CI, 17.15–23.93, $I^2=0\%$, n=2 studies), and operative hysteroscopy (OR 3.10, 95% CI, 1.86–5.18, $I^2=71\%$, n=4 studies) all showed a statistically significant association with PAS (Fig. 3).

Subgroup analyses were performed for factors that were reported in four or more studies, considering the study design and adjusting for confounding variables (Appendix 3, available online at http://links.lww.com/AOG/D984). The results of the subgroup analysis indicated a significant association between previous non–cesarean uterine surgery and PAS. In addition, although there was no significant association between operative hysteroscopy and PAS in the crude analysis, a significant association was observed in the adjusted analysis. Given that the adjusted analyses are more accurate and objective, we deem the combined effect values to be reliable.

A sensitivity analysis was conducted in four or more studies by eliminating each study in turn to assess the stability of the result and to detect any heterogeneity. The results indicated that the pooled effect size remained significant, indicating that the results produced in this meta-analysis were robust (Appendix 4, available online at http://links.lww.com/AOG/D984).

A funnel plot was specifically conducted for the risk factor myomectomy, which included 10 studies. Visually, the studies on both sides of the invalid line

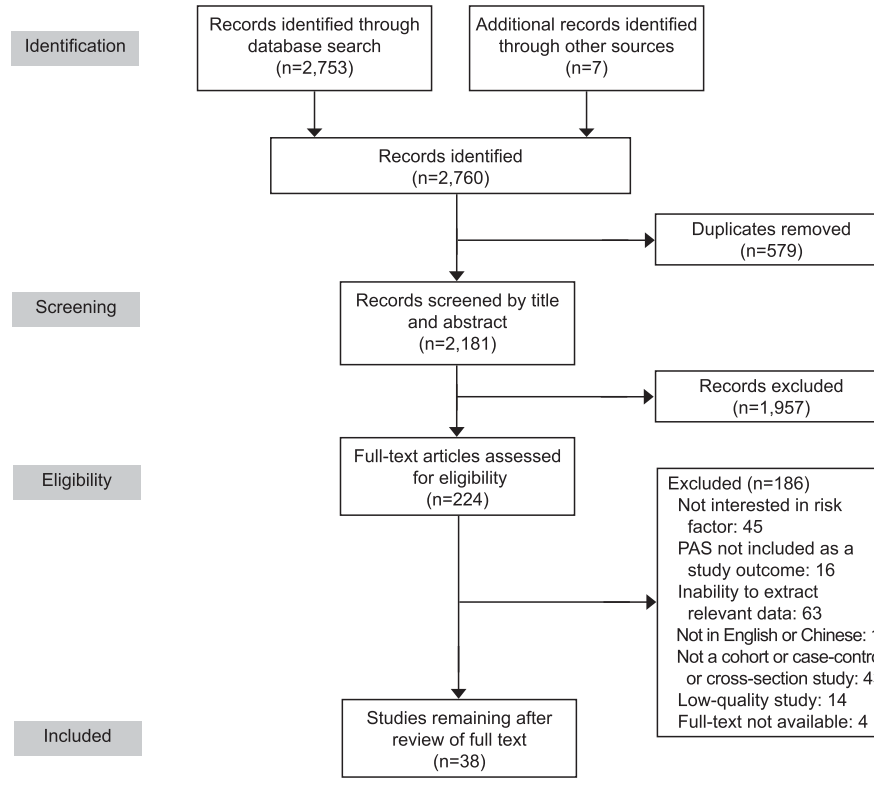

Fig. 1. Flowchart of literature search and selection. PAS, placenta accreta spectrum.
Yang. Risk of PAS After Uterine Surgery. Obstet Gynecol 2025.

appeared to be roughly symmetric (Appendix 5, available online at http://links.lww.com/AOG/D984). However, it is important to note that because of the limited number of studies included, there may be a potential significant publication bias for endometrial ablation (*P* for Begg=1.000; *P* for Egger not available) with the risk of PAS. For the remaining risk factors, the results of the Begg and Egger tests demonstrated that the included studies may have no statistically significant publication bias (*P*>.05) (Appendix 6, available online at http://links.lww.com/AOG/D984).

DISCUSSION

Twelve articles that provided data on the number of cases of PAS in general populations were used. Among the 7,148,342 births or pregnancies included, a total of 11,103 cases of PAS were diagnosed through pathologic examination, clinical assessment, or a combination of both; the prevalence of PAS was 0.16%. The main findings were as follows: 1) previous non–cesarean uterine surgery increased the risk of PAS in subsequent pregnancies, and 2) each type of uterine surgery corresponded to a different risk of PAS.

Cesarean delivery is known to cause direct and severe damage to the integrity of the uterine endometrium and smooth muscle layers of the myometrium in the lower uterine segment. The lower segment of the uterus contains fewer myofibers and more elastic connective tissue than the upper segment, which is less capable of repairing the surgical scar and is prone to the formation of larger keloidal defects.[54,55] Therefore, cesarean delivery is the most frequently reported risk factor for PAS, and the incidence of PAS is higher when combined with placenta previa. However, in PAS without placenta previa and posterior PAS, which were more difficult to diagnose prenatally, it has been reported that the occurrence of these PAS may be more influenced by prior non–cesarean uterine surgery and less correlated with previous cesarean delivery.[56–61] These studies suggest that even small injuries or focal anomalies in the uterine wall can lead to abnormal placentation.[2] Our study found that prior non–cesarean uterine surgery is a risk factor for the development of PAS (pooled OR 2.29, 95% CI, 1.43–3.68). In 2019, Mucio et al[12] published a meta-analysis showing that the risk of PAS in a second pregnancy increased for women who had undergone a cesarean in their first pregnancy (OR 3.02, 95% CI, 1.50–6.08). The association between prior non–cesarean uterine surgery and PAS is weaker than for cesarean delivery. Notably, studies investigating the history of prior non–cesarean

Table 1. Basic Characteristics of Research and the Evaluation of Research Quality

Authors, year	Country	Study Period	Study Design	Cases (n)	Sample Size (n)	Influencing Factors	PAS Prevalence (%)	NOS Score
Zhang et al, 2023[18]	China	January 2014–August 2021	Retrospective cohort	217	97,315	⑤	—	8
Baldwin et al, 2018[19]	Australia	January 2003–December 2012	Retrospective cohort	854	38,845	③⑦⑧	—	9
Ornaghi et al, 2021[6]	Italy	September 2014–August 2016	Prospective cohort	384	459,379	⑧	0.08	8
Imafuku et al, 2021[20]	Japan	January 2010–December 2019	Prospective cohort	87	4,146	①②③⑦	2.10	7
Kaser et al, 2015[21]	United States	2005–2011	Case–control	50	199	①③⑦	—	8
Shi et al, 2018[22]	China	January 2010–September 2017	Case–control	141	307	⑤	—	9
Tadayon et al, 2022[23]	Iran	2015–2019	Case–control	187	50,037	①③⑤	0.37	7
Komatsu et al, 2023[24]	Japan	January 2020–December 2020	Retrospective cohort	973	166,999	①	0.58	8
Sun et al, 2023[25]	China	2016–2020	Retrospective cohort	67	75,773	⑤	0.09	9
Fitzpatrick et al, 2012[26]	England	March 2010–April 2011	Case–control	134	798,634	⑧	0.02	8
Hong et al, 2024[27]	China	January 2016–November 2021	Retrospective cohort	354	3,790	④	—	9
Zhu et al, 2009[28]	China	June 1998–March 2001	Prospective cohort	46	9,453	⑤	—	9
Jitsumori et al, 2020[29]	Japan	January 2012–December 2017	Retrospective cohort	43	3,155	②	1.36	7
Feng et al, 2020[30]	China	May 2012–May 2019	Retrospective cohort	57	438	④	—	9
Poggi et al, 2015[31]	United States	January 1999–December 2012	Retrospective cohort	4	35	②	—	6
Sharami et al, 2024[32]	Iran	2016–2021	Case–control	89	267	①③⑤	—	7
Gao et al, 2021[33]	China	January 2014–November 2018	Case–control	90	398	③	—	6
Hackney et al, 2018[34]	United States	1999–2016	Retrospective cohort	4,440	3,564,820	①⑥	0.13	6
Kayem et al, 2024[35]	France	November 2013–October 2015	Prospective cohort	108	520,114	⑧	0.02	7
You et al, 2024[36]	China	January 2015–December 2021	Case–control	348	1,044	①③④⑥⑦	—	9
Lin et al, 2023[37]	China	January 2008–December 2017	Retrospective cohort	2,891	1,371,458	①	0.21	9
Zhang et al, 2020[38]	China	January 2012–June 2018	Retrospective cohort	23	373	④	—	8
Türker Aras et al, 2023[39]	Turkey	June 2016–December 2020	Case–control	136	58,895	①③	—	6
Mára et al, 2023[40]	Czech	January 2009–March 2021	Prospective cohort	15	120	④	—	8
Huang et al, 2022[41]	China	January 2017–December 2017	Retrospective cohort	401	9,468	⑤	0.08	7
Tan and Huang, 2023[42]	China	January 2020–September 2020	Case–control	1,011	2,022	⑤⑧	2.10	6

(*continued*)

Table 1. Basic Characteristics of Research and the Evaluation of Research Quality (*continued*)

Authors, year	Country	Study Period	Study Design	Cases (n)	Sample Size (n)	Influencing Factors	PAS Prevalence (%)	NOS Score
Lin et al, 2019[43]	China	January 2010–January 2016	Retrospective cohort	5	35	②	—	8
Carusi et al, 2023[44]	United States	2011–2017	Retrospective cohort	44	1,931	⑧	—	6
Eshkoli et al, 2012[45]	Israel	1988–2011	Retrospective cohort	139	34,869	⑤	0.37	7
Fujita et al, 2024[46]	Japan	January 2010–March 2021	Case–control	62	402	①③⑧	0.58	8
Jing et al, 2017[47]	China	January 2010–September 2013	Retrospective cohort	40	492	⑤	0.09	7
Tavcar et al, 2023[48]	United States	January 2015–March 2019	Retrospective cohort	23	97	④	0.02	6
Mohr-Sasson et al, 2022[49]	Israel	February 2011–January 2019	Retrospective cohort	3	199	①	—	5
Imafuku et al, 2020[50]	Japan	January 2003–December 2016	Retrospective cohort	7	46	②	—	5
Zhang et al, 2019[51]	China	January 2011–December 2015	Case–control	2,219	2,219	⑤	1.36	6
An et al, 2022[52]	China	January 2016–December 2020	Case–control	132	132	⑤⑧	—	6
Zhang et al, 2022[53]	China	January 2014–December 2018	Retrospective cohort	27	139	④	—	6
Ming et al, 2022[7]	China	March 2015–December 2016	Cross-sectional	1,653	75,132	⑤	—	9

PAS, placenta accreta spectrum; NOS, Newcastle–Ottawa Scale; ① myomectomy; ② uterine artery embolization; ③ dilatation and curettage; ④ hysteroscopic adhesiolysis; ⑤ abortion; ⑥ endometrial ablation;, ⑦ operative hysteroscopy; and ⑧ prior uterine surgery other than cesarean delivery.

uterine surgery have shown substantial heterogeneity. Even after subgroup analysis depending on study design, the heterogeneity remained, possibly because of variations in the definition and types of previous uterine surgery in the included literature.

Indeed, the location and degree of damage in the endometrium and myometrium caused by uterine surgery may explain the different risk factors for PAS. In the present study, a separate risk assessment of PAS was conducted for several common types of uterine surgery.

Of the 31 studies reviewed, 10 described the history of myomectomy in pregnant women and found a significantly increased risk of PAS compared with unexposed pregnant women (OR 2.29, 95% CI, 1.77–2.97). Two large retrospective population-based cohort studies[24,37] focused on the effect of myomectomy on the risk of PAS. The risk of PAS after myomectomy was increased, with or without a history of cesarean delivery. Regardless of whether the myomectomy was performed through laparotomy, laparoscopy, or hysteroscopic surgery, all procedures carried an increased risk for PAS, with hysteroscopic myomectomy showing the highest risk (OR 3.88, 95% CI, 2.68–5.63).[37] In addition, a study highlighted that breaching the uterine cavity during laparoscopic myomectomy increased the risk of PAS (OR 5.1, 95% CI, 1.51–17.3).[62] Another study showed that PAS was more common in patients who underwent nonhysteroscopic myomectomy before pregnancy with an interval of less than 12 months compared with more than 12 months.[63] It is necessary for obstetricians to review patients' surgical records related to previous myomectomy because most pregnant women may not be able to clearly recall the relevant circumstances or may provide incorrect information on the number, size, and location of the myoma; whether the myomectomy procedure penetrated the endometrial cavity; and the type of surgery and sutures used to assess the risks more accurately.

Our study highlights a significant association between D&C and the development of PAS (OR 2.28, 95% CI, 1.78–2.93). In contrast, a meta-analysis conducted by Iacovelli et al[13] did not find any effect of uterine curettage on PAS development, which was inconsistent with our findings. However,

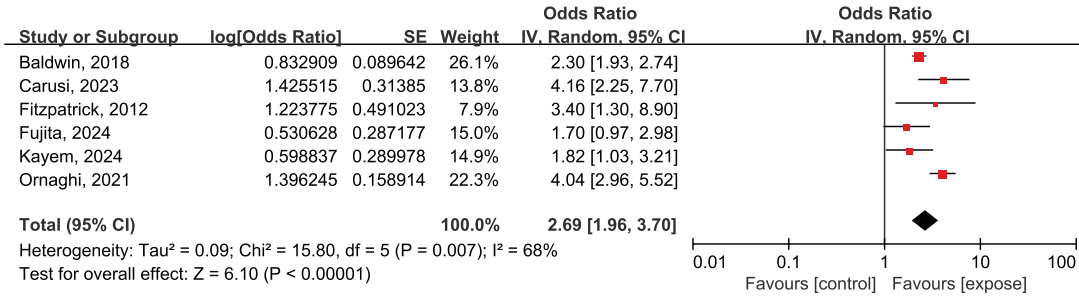

Fig. 2. Comparison of the risk of placenta accreta spectrum between pregnant women with and those without previous non–cesarean uterine surgery in six studies. SE, standard error; IV, inverse variance; df, degrees of freedom.

Yang. Risk of PAS After Uterine Surgery. Obstet Gynecol 2025.

the odds of PAS for women who had D&Cs (two or more previous curettages) was 4.12 (95% CI, 2.24–7.59) (two studies provided data for this comparison).[33,36] We also observed that a history of abortion (including surgical abortion, medical abortion, and spontaneous abortion) posed a risk for PAS, although not as significant as a history of curettage (OR 1.65, 95% CI, 1.43–1.92). Analysis of data from three

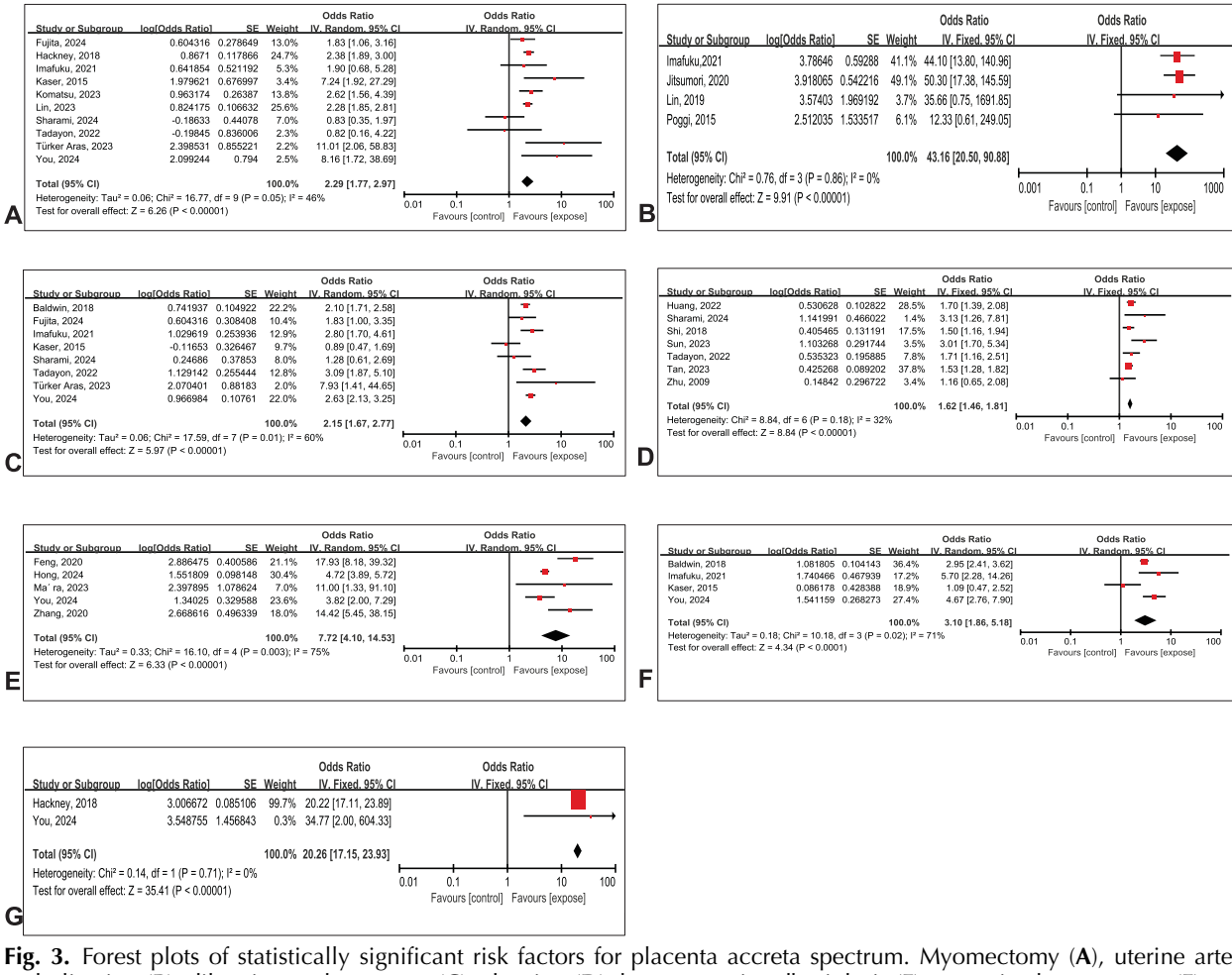

Fig. 3. Forest plots of statistically significant risk factors for placenta accreta spectrum. Myomectomy (**A**), uterine artery embolization (**B**), dilatation and curettage (**C**), abortion (**D**), hysteroscopic adhesiolysis (**E**), operative hysteroscopy (**F**), and endometrial ablation (**G**). SE, standard error; IV, inverse variance; df, degrees of freedom.

Yang. Risk of PAS After Uterine Surgery. Obstet Gynecol 2025.

studies[18,45,47] involving recurrent miscarriages (two or more pregnancy losses) showed that women with a history of recurrent miscarriage had an increased risk for developing PAS in subsequent pregnancies (OR 3.66, 95% CI, 2.06–6.51). Both curettage and abortion can cause endometrial–myometrial injury, leading to incomplete or absent decidualization. This allows abnormal adhesion or even invasion of placental anchoring villous and trophoblast infiltration, which subsequently contributes to the development of PAS, especially in cases of excessive curettage and repeated abortions.[54,64,65] These findings emphasize the significance of considering a history of D&C and abortions when assessing the risk of PAS in pregnant women.

Intrauterine adhesions or Asherman syndrome typically occurs after a prior intrauterine operative trauma.[66] Hysteroscopic adhesiolysis is considered the preferred treatment for intrauterine adhesions.[67] In this review, hysteroscopic adhesiolysis (OR 7.72, 95% CI, 4.10–14.53) was found to be associated with an increased risk of PAS. Wenzhi et al[68] conducted a meta-analysis on obstetric outcomes in patients undergoing hysteroscopic adhesiolysis. However, this study only pooled the prevalence of PAS, and the included studies lacked controls from the normal population. In addition, the endometrium damage caused by uterine cavity fibrosis over time in postoperative women with intrauterine adhesions and insufficient blood supply to the endometrium increases the likelihood of PAS in subsequent pregnancies.[68–70]

Our study also observed that endometrial ablation serves as a notable risk factor for PAS among pregnant women (OR 20.26, 95% CI, 17.15–23.93). Endometrial ablation treats abnormal uterine bleeding by destroying the functional layer of the endometrium. Because of the lower pregnancy rates in women undergoing endometrial ablation, limited studies are available on subsequent pregnancy outcomes after the procedure. A systematic review by Kohn et al[71] reported a prevalence of approximately 12% for PAS in pregnancies after endometrial ablation based primarily on case reports.

Several studies have examined operative hysteroscopic procedures and examined the risk of PAS and found that operative hysteroscopy is a risk factor (OR 3.10, 95% CI, 1.86–5.18).[19–21,36] In the present study, we also found that pregnant women who had previously undergone uterine artery embolization for postpartum hemorrhage (PPH) had a higher risk of developing PAS (OR 43.16, 95% CI, 20.50–90.88). This evidence amounts to an update of the meta-analysis of Matsuzaki et al.[72] Updates include our selection of more recent studies with a larger sample size by the same author[20] and the inclusion of one study written in Chinese.[43] Uterine artery embolization is one of the main measures for the treatment of PPH. If the cause of PPH in the first pregnancy is clinical PAS, the higher recurrence rate of PAS in subsequent pregnancies may be attributable to the influence of PAS in the previous pregnancy. In addition, uterine artery embolization can lead to intrauterine adhesions that are more severe and difficult to treat compared with other types of adhesions. Uterine artery embolization may cause endometrial necrosis.[73]

A major strength of this meta-analysis is the in-depth investigation of the association between prior non–cesarean uterine surgery and the occurrence of PAS. We performed separate qualitative and quantitative assessments for each type of uterine surgery to provide a comprehensive overview. Finally, we included many recent studies, predominantly cohort studies, yielding more reliable findings and significant implications for clinical practice and future research.

In addition, this study had several limitations. First, only Chinese and English literature was searched, and the number of studies that included risk factor analyses was relatively limited, which may introduce bias. Second, there was a lack of uniformity among the authors in the diagnostic criteria for PAS, and the characteristics of the study population varied such as the inclusion of only primiparous women or women who conceived through assisted reproductive technology, which may influence the association of specific risk factors. Third, there is a lack of studies examining the association between uterine procedures such as gynecologic laparoscopic surgery and manual removal of the placenta and PAS. Therefore, expanding the search is necessary to enhance the comprehensiveness of the systematic review.

Our review revealed that previous non–cesarean uterine surgery was a significant risk factor for PAS during subsequent pregnancies with the risk varying according to the types of uterine surgery. In clinical practice, it is crucial to enhance the assessment of PAS risk in pregnant women with a history of uterine surgery. Gaining a thorough understanding of the type and number of surgeries they have undergone can enhance the prenatal diagnosis of PAS. This, in turn, can help to designate an individualized treatment plans and ultimately improve the prognosis.

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