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Original Article

Endometrial hyperplastic changes as an independent predictor of recurrence after hysteroscopic polypectomy: a retrospective cohort study

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Abstract: Objective: To identify risk factors for recurrence after hysteroscopic endometrial polypectomy, with particular emphasis on postoperative pathological features (endometrial hyperplastic changes) and potential protective role of medical therapy using progestins. Methods: This retrospective cohort study included 145 patients who underwent hysteroscopic polypectomy at XianJu People's Hospital from January 2020 to December 2023. Data on demographics, polyp characteristics (number, size), postoperative pathology (presence of hyperplastic changes), and postoperative progestin therapy were collected. The primary outcome was polyp recurrence, defined as a new lesion confirmed by ultrasound or hysteroscopy at least six months after surgery. Survival analysis using the Kaplan-Meier method and Cox proportional hazards regression were performed to screen for independent risk factors. Results: The mean follow-up time was 24.28 months. Recurrence occurred in 57 of 145 patients (39.3%). Multivariate Cox regression analysis identified endometrial hyperplastic changes as a significant independent risk factor for recurrence (HR = 2.016, 95% CI: 1.199-3.389, P = 0.008). Postoperative progestin therapy was associated with a 37% reduction in recurrence risk, although this did not reach statistical significance (HR = 0.626, 95% CI: 0.364-1.076, P = 0.090). Conclusion: Endometrial hyperplastic changes in postoperative pathology are a key independent predictor of polyp recurrence after hysteroscopic polypectomy, nearly doubling the risk. While progestin therapy did not show a statistically significant protective effect, the observed trend toward risk reduction is clinically meaningful. Postoperative pathological findings should be used for risk stratification, and intensified follow-up should be considered for high-risk patients.

Keywords: Endometrial polyp, recurrence, hysteroscopy, endometrial hyperplasia, risk factors, retrospective cohort study

Introduction

Endometrial polyps are a common benign gynecological condition, formed by the localized excessive proliferation of endometrial glands, stroma, and blood vessels protruding into the uterine cavity [1, 2]. Their clinical presentation is diverse, ranging from asymptomatic (approximately 20-30%) to abnormal uterine bleeding, infertility, and postmenopausal bleeding [3-5]. They are one of the primary causes of menstrual disorders and reduced fertility in women. With the widespread use of imaging techniques such as transvaginal ultrasound, the diagnostic rate has significantly increased, making it a common disease in gynecological outpatient clinics [6, 7].

The advent of hysteroscopic surgery represents a significant milestone in the diagnosis and treatment of endometrial polyps [8]. Hysteroscopic polypectomy allows for precise and complete removal of lesions under direct visualization, effectively alleviating symptoms and obtaining tissue for pathological diagnosis. It is currently recognized as the "gold standard" for treating endometrial polyps [9, 10]. Compared to traditional blind curettage, this procedure offers distinct advantages, including minimal invasiveness, rapid recovery, and thorough

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lesion removal, greatly improving short-term patient outcomes [9, 11].

However, clinical practice and long-term follow-up observations have revealed a non-negligible issue: the recurrence of endometrial polyps after resection. Despite continuous advancements in surgical techniques, the reported postoperative recurrence rates in the literature vary widely, ranging from 3.7% to 43.6%. This variability may be attributed to differences in study population characteristics, duration of follow-up, and, more critically, the differing definitions of "recurrence". Postoperative recurrence not only implies the reappearance of symptoms, such as troublesome abnormal bleeding, but for patients desiring fertility, it may again act as a mechanical barrier to embryo implantation, affecting pregnancy outcomes. Furthermore, recurrence means patients may face repeated examinations, medical treatments, or even repeated surgeries. This not only increases the patient's physical pain and psychological burden but also exacerbates the medical and economic burden on families and society. Therefore, investigating the patterns of postoperative recurrence and identifying high-risk factors hold significant clinical importance.

Currently, although some discussions have been conducted in the academic community regarding the risk factors for postoperative recurrence of endometrial polyps, the conclusions have not yet been unified. Multiple studies suggest that patient factors, such as younger age (especially in the reproductive period), premenopausal status (indicating a high estrogen environment), and obesity (adipose tissue as an important site for peripheral estrogen conversion), may be associated with an increased risk of recurrence. Characteristics of the polyps themselves are also considered important influencing factors, such as multiple polyps, large size (diameter > 1.5-2 cm), or pathological findings indicating hyperplastic changes. Surgical factors, such as the thoroughness of resection and whether adjacent endometrium is treated simultaneously (e.g., curettage), are also taken into consideration. In recent years, postoperative management strategies, particularly whether anti-estrogen therapies using progestins (including oral progestins or the levonorgestrel-releasing intrauterine system) are applied to inhibit endometrial hyperplasia, have become a research hotspot. However, the evaluation results of these factors in different studies are contradictory. For example, regarding the protective effect of postoperative progestin therapy, some studies show that it can significantly reduce the recurrence rate, while others do not find a statistical difference. These contradictions may stem from differences in study design (prospective vs. retrospective), sample size, follow-up duration, medication regimens (drug type, dosage, course), and the degree of control for confounding factors.

More importantly, there is currently a lack of large-sample, long-follow-up retrospective cohort studies in China to systematically and comprehensively evaluate the independent impact of multidimensional factors-such as patient baseline characteristics, polyp characteristics, surgical details, and postoperative treatment-on recurrence risk. Most existing studies either have limited sample sizes or insufficient follow-up durations, making it difficult to comprehensively capture recurrence events (the median recurrence time is often 12-24 months postoperatively); or they only perform univariate comparisons in statistical analysis, failing to control for mutual interference between variables, and thus the reliability of their conclusions needs to be verified.

In addition, current evidence remains fragmented and contradictory. Most existing studies suffer from limited sample sizes, short follow-up durations, or a reliance on simple univariate comparisons that fail to control confounding variables. Crucially, few studies have systematically evaluated the independent predictive value of specific postoperative pathological features, such as 'hyperplastic changes', while simultaneously accounting for the potential modifying effect of postoperative progestin therapy within a time-to-event analytical framework.

To address these gaps, this retrospective cohort study was designed with the following innovative aspects and clinical aims: (1) Novelty: To our knowledge, this is one of the few studies in the Chinese population to employ multivariate survival analysis (Kaplan-Meier and Cox regression) to simultaneously assess the impact of patient characteristics, polyp fea-

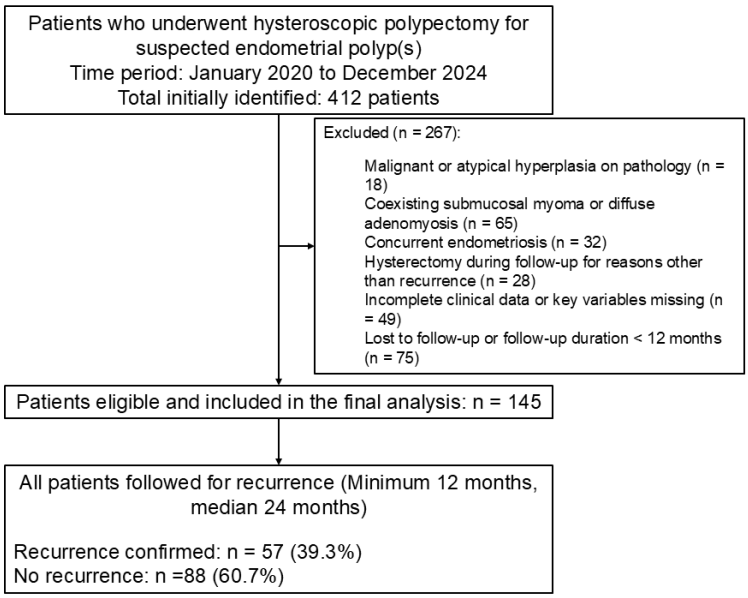

Figure 1. Flowchart of patient selection. Abbreviation: EMR, electronic medical record; LIS, laboratory information system; PACS, picture archiving and communication system.

tures, pathological findings, and postoperative treatment on recurrence risk. (2) Clinical significance: By identifying 'endometrial hyperplastic changes' as a potential high-risk marker and clarifying the real-world effectiveness of progestins, our findings will empower clinicians to implement pathology-driven, individualized postoperative management, thereby intensifying surveillance for high-risk patients and optimizing resource allocation to ultimately reduce the burden of recurrence.

Materials and methods

Patient selection

This single-center retrospective cohort study was conducted at the Department of Gynecology, XianJu People's Hospital. The study protocol was approved by the Institutional Review Board/Ethics Committee of XianJu People's Hospital, and the study was performed in accordance with the Declaration of Helsinki (as revised in 2013).

A systematic search of the hospital's electronic medical record (EMR), laboratory information (LIS), and picture archiving and communication (PACS) systems was performed to identify all patients who underwent hysteroscopic surgery between January 2020 and December 2023. The search strategy employed the following keywords: "endometrial polyp", "hysteroscopic polypectomy", and "polypectomy" (**Figure 1**).

Patients were included if they met all of the following criteria: age ≥ 18 years; preoperative transvaginal ultrasound highly suspicious for endometrial polyps; underwent hysteroscopic endometrial polypectomy (either electrosurgical or cold-knife resection); postoperative histopathology confirmed benign endometrial polyps; regular follow-up at XianJu People's Hospital for at least 12 months after surgery, with transvaginal ultrasound examinations performed at 3, 6, 12, and 24 months postoperatively; and availability of complete clinical data including demographic characteristics, surgical records, pathology reports, and follow-up ultrasound images. Consistent with previous studies [12], only patients undergoing their first polypectomy were enrolled to avoid confusion between true recurrence and residual or de novo lesions.

Exclusion criteria were: postoperative pathological diagnosis of atypical endometrial hyperplasia, endometrial cancer, or malignant transformation of the polyp; coexistence of submucosal myomas, diffuse adenomyosis, or endometriosis that could interfere with the diagnosis of recurrence, as these conditions have been independently associated with increased recurrence risk [11, 13]; total hysterectomy during the follow-up period for reasons other than polyp recurrence; a history of prior endometrial polypectomy; and missing critical clinical data (defined as > 20% missing for any of the core variables including age, BMI, polyp number, pathology findings, or key follow-up timepoints). For patients lost to follow-up, outcome information was verified by telephone. The study follow-up cutoff date was December 31, 2025.

Data extraction and variable definition

Data were extracted independently by two researchers (J.W. and F.L.) using a standardized data collection form. Any discrepancies were resolved by discussions with a third researcher

(X.X.C.). Extracted data were cross-validated against the original medical records to ensure accuracy.

The following variables were collected: (1) baseline characteristics (age, body mass index [BMI], menopausal status, comorbidities); (2) polyp characteristics (number, maximum diameter, location, and pathological features including the presence of "hyperplastic changes" or "dense glandular proliferation"); (3) surgical details (resection technique, concomitant procedures); and (4) postoperative medical treatment (use of progestins, drug type, duration). Multiple polyps were defined as two or more polyps detected on preoperative ultrasound or during hysteroscopy. Regular use of postoperative progestins was defined as continuous or cyclical administration according to medical advice for at least one month. Follow-up data were collected at scheduled visits (3, 6, 12, and 24 months postoperatively) and included transvaginal ultrasound findings and symptom assessment. Recurrence diagnosis was based on ultrasound findings and confirmed by at least one sonographer with the qualification of associate chief physician or above.

Outcome measures

The primary outcome was polyp recurrence, defined as the presence of a new, well-demarcated isoechoic or hyperechoic mass with detectable feeding vessels on transvaginal ultrasound occurring at least six months after surgery, and/or confirmed by hysteroscopy and pathology. Time to recurrence was calculated in months from the date of surgery to the date of first ultrasound suspicion or hysteroscopic confirmation. Secondary outcomes included symptomatic recurrence (e.g., abnormal uterine bleeding) requiring reintervention and, for patients with preoperative fertility requirements, pregnancy status before the end of follow-up.

Statistical analysis

Descriptive statistics were presented as mean ± standard deviation for normally distributed continuous variables, median (interquartile range) for non-normally distributed variables, and frequency (percentage) for categorical variables. Group comparisons were performed using the independent samples t-test, Mann-Whitney U test, chi-square test, or Fisher's exact test as appropriate.

Cumulative recurrence-free survival curves were estimated using the Kaplan-Meier method and compared between subgroups using the log-rank test. Univariate Cox proportional hazards regression was first performed to screen for potential risk factors (age, BMI, polyp number, endometrial hyperplasia, postoperative treatment). Variables with $P < 0.10$ in univariate analysis were entered into a multivariate Cox model. To adjust for potential clinical confounders, age, polyp number, postoperative treatment, and BMI were also forced into the final model regardless of their univariate *P*-value. Results are presented as hazard ratios (HR) with 95% confidence intervals (CI). The proportional hazards assumption was assessed using the Grambsch-Therneau test based on Schoenfeld residuals, and no significant violation was detected ($P > 0.05$ for all covariates).

Sample size was estimated based on the requirements for multivariate Cox regression. According to the Prentice criterion, approximately 10-15 outcome events are required for each independent variable examined. With approximately five main covariates planned in the final model, at least 50-75 recurrence events were required. Based on a preliminary estimated 24-month recurrence rate of 40%, a two-sided α of 0.05, power (1-β) of 0.80, and a hazard ratio of 2.0, PASS 15.0 software estimated a required sample size of approximately 150 patients after accounting for 10% loss to follow-up. The final cohort of 145 patients with 57 recurrence events satisfied these requirements.

All statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA) and R software version 4.1.2 (R Foundation for Statistical Computing, Vienna, Austria). A two-sided $P < 0.05$ was considered statistically significant.

Results

Study population characteristics and baseline features

A total of 145 patients who underwent hysteroscopic endometrial polypectomy were finally included for retrospective analysis. As shown in

Table 1. Descriptive statistics of baseline patient characteristics

	Value
Total cases, n	145
Age, years	38.9 ± 7.5
BMI, kg/m^2	23.70 ± 3.53
Follow-up time, months	24.28 ± 8.52
Recurrence rate, %	39.3%
Age Group: < 40 years	77 (53.1%)
Age Group: ≥ 40 years	68 (46.9%)
Polyp Number: Multiple	81 (55.9%)
Polyp Number: Single	64 (44.1%)
Endometrial Hyperplasia: No	100 (69.0%)
Endometrial Hyperplasia: Yes	45 (31.0%)
Postoperative Treatment: Yes	94 (64.8%)
Postoperative Treatment: No	51 (35.2%)

Abbreviation: BMI, body mass index.

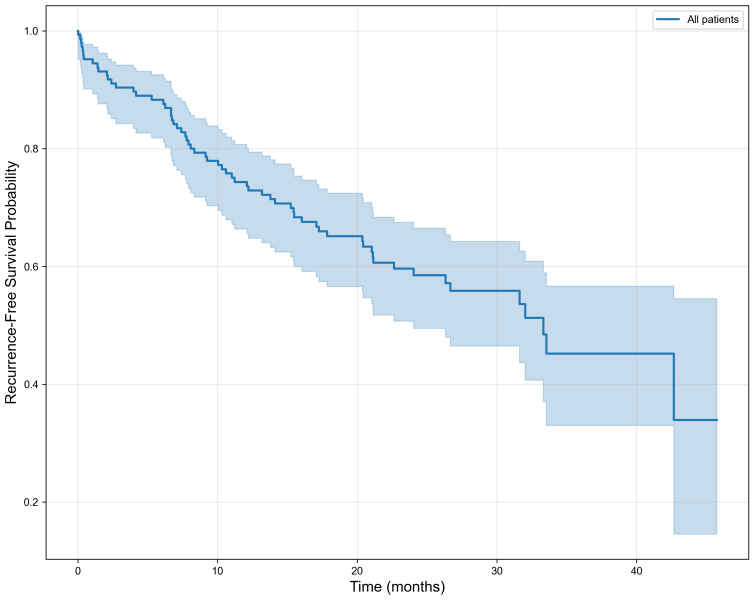

Figure 2. Overall recurrence-free survival curve.

Table 1, the study population exhibited the following baseline characteristics: the mean patient age was 38.9 ± 7.5 years, with 53.1% of patients under 40 years old. The mean Body Mass Index (BMI) was 23.70 ± 3.53 kg/m^2. 55.9% (81/145) of the patients had multiple polyps. Postoperative pathological examination indicated that 31.0% (45/145) of the patients had concomitant endometrial hyperplastic changes. Regarding postoperative management, 64.8% (94/145) of the patients received medical therapy (primarily progestins). All patients completed at least 12 months of follow-up, with a mean follow-up time of 24.28 months.

Recurrence incidence and univariate association analysis

By the end of the follow-up, 57 patients were diagnosed with recurrence, yielding an overall recurrence rate of 39.3% (57/145). Using the Kaplan-Meier method to assess time-related recurrence risk, the results showed that the cumulative recurrence-free survival rate of all patients decreased over time postoperatively, with cumulative recurrence-free survival rates of 80.7% and 57.9% at 12 and 24 months postoperatively, respectively (**Figure 2**).

To preliminarily evaluate the association between various factors and recurrence, we first compared the baseline characteristics between the recurrence group (n = 57) and the non-recurrence group (n = 88). The results of baseline characteristic comparisons showed that there were no statistically significant differences between the recurrence group and the non-recurrence group in all observed variables, including age, BMI, polyp number and size, menopausal status, polyp pathological type, presence of endometrial hyperplasia, tamoxifen use, and postoperative treatment (all P > 0.05). Notably, the mean follow-up time in the recurrence group was shorter than that in the non-recurrence group (P = 0.035); however, this difference was adjusted for the subsequent survival analysis using time-to-event data (**Table 2**).

Univariate Cox proportional hazards regression analysis (**Table 3**) revealed that endometrial hyperplastic changes were a significant risk factor for recurrence (HR = 1.915, 95% CI: 1.152-3.183, P = 0.011). Age ≥ 40 years, mul-

Table 2. Comparison of baseline characteristics between recurrence and non-recurrence groups

Variable	Non-recurrence (n = 88)	Recurrence (n = 57)	χ^2/t	*P*-value
Age, years	38.7 ± 7.4	39.1 ± 7.8	0.307	0.759
Age group			0.177	0.674
< 40 y	46 (52.3%)	28 (49.1%)		
≥ 40 y	42 (47.7%)	29 (50.9%)		
BMI, kg/m^2	23.37 ± 3.33	24.14 ± 3.75	1.307	0.193
BMI group			1.266	0.260
< 25	58 (65.9%)	33 (57.9%)		
≥ 25	30 (34.1%)	24 (42.1%)		
Polyp number			0.606	0.436
Single	45 (51.1%)	26 (45.6%)		
Multiple	43 (48.9%)	31 (54.4%)		
Polyp size, cm	1.92 ± 0.77	1.78 ± 0.69	-1.161	0.248
Polyp size group			1.266	0.260
< 2 cm	50 (56.8%)	38 (66.7%)		
≥ 2 cm	38 (43.2%)	19 (33.3%)		
Menopausal status			2.271	0.132
No	68 (77.3%)	38 (66.7%)		
Yes	20 (22.7%)	19 (33.3%)		
Polyp type			0.020	0.887
Functional	50 (56.8%)	31 (54.4%)		
Non-functional	38 (43.2%)	26 (45.6%)		
Endometrial hyperplasia			0.133	0.715
No	60 (68.2%)	40 (70.2%)		
Yes	28 (31.8%)	17 (29.8%)		
Tamoxifen use			2.117	0.146
No	81 (92.0%)	48 (84.2%)		
Yes	7 (8.0%)	9 (15.8%)		
Postoperative treatment			0.221	0.638
No	25 (28.4%)	15 (26.3%)		
Yes	63 (71.6%)	42 (73.7%)		
Follow-up time, months	25.58 ± 8.66	22.58 ± 8.08	-2.124	0.035

Abbreviation: BMI, body mass index; y, years.

Table 3. Univariate Cox regression analysis for recurrence after endometrial polypectomy

Variable	HR (95% CI)	Wald test	*P*-value
Age ≥ 40 years	1.310 (0.799-2.149)	1.071	0.284
Multiple polyps	1.124 (0.676-1.870)	0.450	0.652
Endometrial hyperplasia	1.915 (1.164-3.152)	2.558	0.011
Postoperative treatment	0.774 (0.462-1.295)	-0.976	0.329
BMI ≥ 25 kg/m^2	1.411 (0.857-2.325)	1.352	0.176

Abbreviation: HR, hazard ratio; CI, confidence interval.

tiple polyps, postoperative treatment, and BMI ≥ 25 kg/m^2 did not show statistically significant associations in this univariate model (all P > 0.05). Kaplan-Meier survival curves stratified by each potential risk factor are presented in **Figure 3**. As shown in **Figure 3A**, there was no significant difference in recurrence-free survival between age groups (log-rank P = 0.283). Similarly, polyp number did not significantly affect recurrence-free survival (**Figure 3B**, log-rank P = 0.653). In contrast, patients with endometrial hyperplastic changes had a significantly shorter recurrence-free survival compared with those without hyperplasia (**Figure**

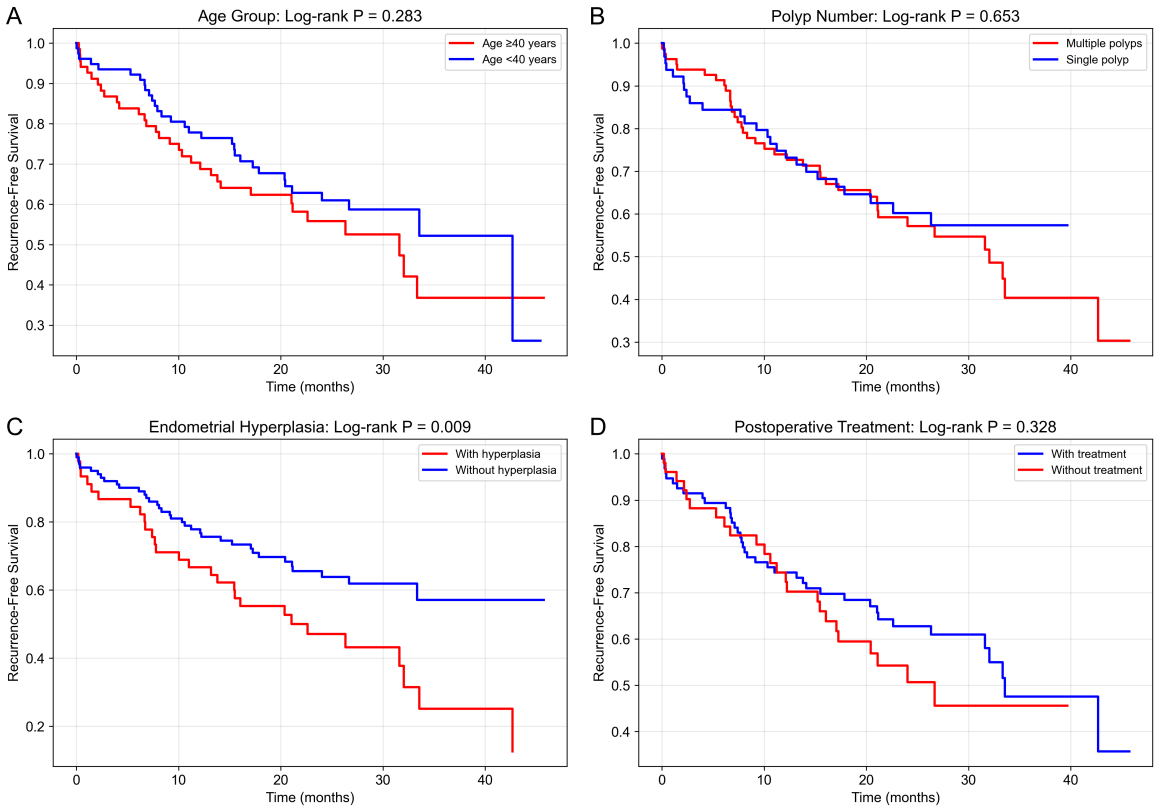

Figure 3. Stratified recurrence-free survival curves by risk factors. A. (Age group), Recurrence-free survival curves stratified by age group (Log-rank test P = 0.283). The blue curve represents patients aged < 40 years, and the red curve represents patients aged ≥ 40 years. B. (Polyp number), Recurrence-free survival curves stratified by polyp number (Log-rank test P = 0.653). The blue curve represents patients with solitary polyps, and the red curve represents patients with multiple polyps. C. (Endometrial hyperplasia), Recurrence-free survival curves stratified by endometrial hyperplasia status (Log-rank test P = 0.009). The blue curve represents patients without endometrial hyperplasia, and the red curve represents patients with concomitant endometrial hyperplasia. D. (Postoperative treatment), Recurrence-free survival curves stratified by postoperative treatment status (Log-rank test P = 0.328). The blue curve represents patients who received postoperative treatment, and the red curve represents patients who did not receive postoperative treatment.

3C, log-rank P = 0.009). Postoperative medical therapy showed no statistically significant benefit (**Figure 3D**, log-rank P = 0.328).

Multivariate Cox regression analysis of independent risk factors for recurrence

Variables with P < 0.10 in the univariate analysis (i.e., endometrial hyperplastic changes) were entered into a multivariate Cox proportional hazards model. To assess potential confounding factors and provide clinically relevant estimates, age, polyp number, postoperative treatment, and BMI were also retained in the model for adjustment. The analysis confirmed that endometrial hyperplastic changes were an independent risk factor for postoperative recurrence (HR = 2.016, 95% CI: 1.199-3.389, P = 0.008). Postoperative medical therapy showed a trend toward reducing recurrence risk (HR = 0.626), but did not reach statistical significance (95% CI: 0.364-1.076, P = 0.090). Age, polyp number, and BMI were not independent risk factors (all P > 0.05).

Risk stratification by hyperplastic changes and postoperative treatment

To further elucidate the combined effect of endometrial hyperplastic changes and postoperative progestin therapy on recurrence, patients were stratified into four groups based on the presence of hyperplasia (yes/no) and receipt of postoperative treatment (yes/no). The Kaplan-Meier curves for these four groups are presented in **Figure 4**.

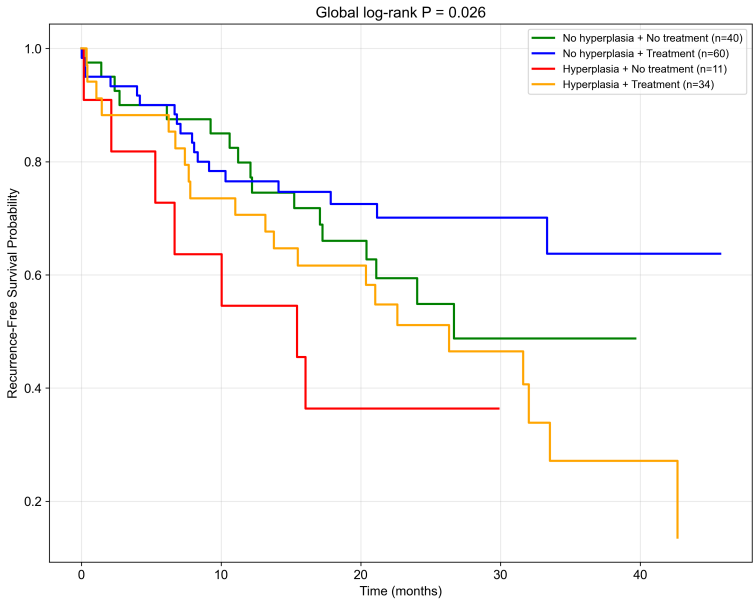

Figure 4. Risk stratification curves by endometrial hyperplastic changes and postoperative treatment. Patients were stratified into four groups: no hyperplasia + no treatment (n = 40), no hyperplasia + treatment (n = 60), hyperplasia + no treatment (n = 11), and hyperplasia + treatment (n = 34). Global log-rank P = 0.026. Blue: no hyperplasia + treatment; Green: no hyperplasia + no treatment; Orange: hyperplasia + treatment; Red: hyperplasia + no treatment. Abbreviation: LNG-IUS, levonorgestrel-releasing intrauterine system.

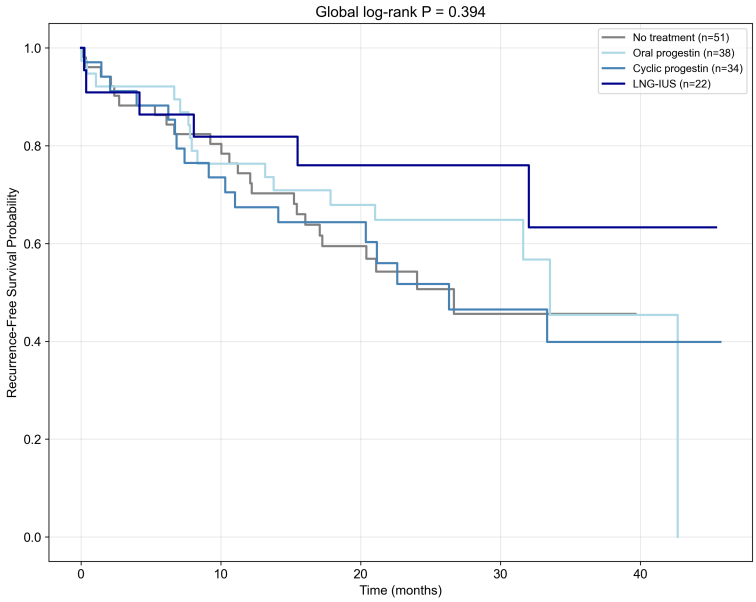

Figure 5. Recurrence-free survival curves by type of postoperative medical therapy. Four groups were compared: no treatment (n = 51), oral progestin (n = 38), cyclic progestin (n = 34), and LNG-IUS (n = 22). Global log-rank P = 0.394. LNG-IUS showed the longest median survival (not reached). Abbreviation: LNG-IUS, levonorgestrel-releasing intrauterine system.

The global log-rank test showed a statistically significant difference among the four groups (P = 0.026). Patients with hyperplastic changes who did not receive postoperative treatment had the poorest prognosis, with a median recurrence-free survival of 15.4 months (n = 11, 7 recurrences). In contrast, patients without hyperplastic changes who received postoperative treatment achieved the best outcome, with median survival not reached during follow-up (n = 60, 18 recurrences). Patients with hyperplastic changes who received treatment had a median survival of 26.3 months (n = 34, 21 recurrences), while those without hyperplasia but without treatment showed a median survival of 26.7 months (n = 40, 17 recurrences).

Recurrence-free survival by type of postoperative medical therapy

We also compared recurrence-free survival among different types of postoperative medical therapy (no treatment, oral progestin, cyclic progestin, and LNG-IUS). The Kaplan-Meier curves are shown in **Figure 5**.

The global log-rank test did not reveal a statistically significant difference among the four groups (P = 0.394). However, descriptive trends were observed: patients receiving LNG-IUS had the longest median recurrence-free survival (not reached, n = 22, 6 recurrences), followed by oral progestin (33.5 months, n = 38, 16 recurrences), cyclic proges-

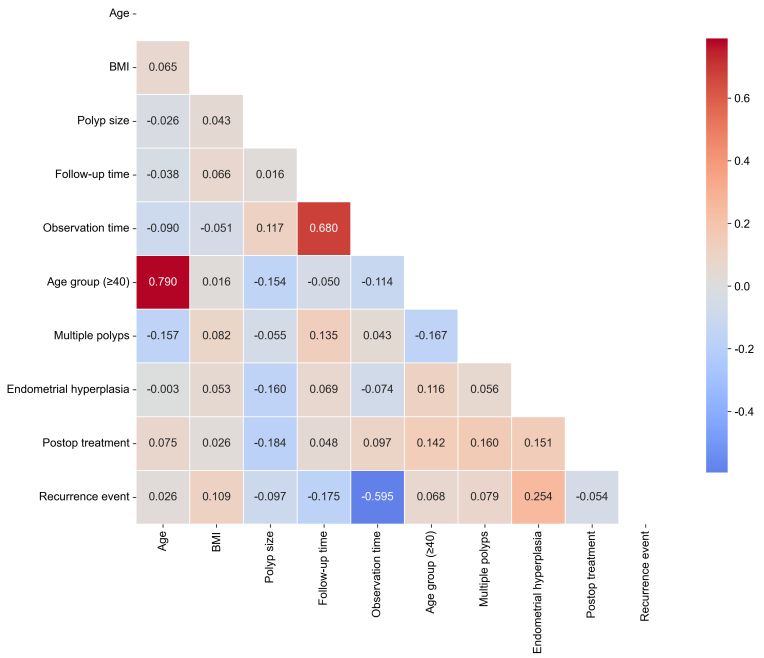

Figure 6. Correlation heatmap of clinical variables. Abbreviation: BMI, body mass index.

tin (26.3 months, n = 34, 17 recurrences), and no treatment (26.7 months, n = 51, 24 recurrences).

Correlation of clinical variables and subgroup recurrence rates

The correlation heatmap (**Figure 6**) showed only weak correlations (|r| < 0.3) among the main clinical variables, supporting the stability of the multivariate regression model by indicating low multicollinearity. Notably, a modest positive correlation was observed between recurrence events and endometrial hyperplastic changes.

When examining simple recurrence proportions at the end of follow-up (**Table 4**), the rates between key subgroups showed minimal differences. Specifically, the recurrence rate was 37.8% (17/45) in patients with endometrial hyperplastic changes versus 40.0% (40/100) in those without. In contrast to the multivariable Cox model which identifies independent predictors while adjusting for time and confounders, **Table 4** provides simple, unadjusted recurrence proportions for descriptive purposes. The apparent discrepancy-e.g., similar crude recurrence rates between patients with and without hyperplastic changes (37.8% vs. 40.0%) versus the significant HR in the Cox model-highlights that hyperplastic changes primarily shorten the time to recurrence rather than merely increasing the overall proportion.

Discussion

This study conducted a retrospective analysis of 145 patients who underwent endometrial polypectomy, aiming to systematically evaluate the risk factors for postoperative recurrence. Our primary findings are as follows: pathologically confirmed endometrial hyperplastic changes serve as an independent risk factor for recurrence, nearly doubling the risk (HR 2.016). Although postoperative medical therapy (primarily progestin) showed a trend toward reducing recurrence risk (HR 0.626), it did not reach statistical significance in this study. Age, polyp multiplicity, and BMI were not significant independent predictors in our model [13, 14].

The most prominent finding of this study is that endometrial hyperplastic changes are a strong predictor of polyp recurrence. This result has a profound pathophysiological basis. The essence of endometrial polyps is the excessive proliferation of local endometrium. When this proliferation is explicitly labeled as “hyperplastic changes” in pathology, it often indicates that the polyp’s growth is not merely an isolated, focal anomaly, but rather reflects a widespread endometrium with high reactivity to estrogen stimulation or persistent functional disorders in the basal layer [15-17]. Therefore, even if the visible polyp lesions are surgically removed, the “soil” that promotes polyp formation-that is, the endometrial environment with proliferative potential-remains. This explains why such patients have a significantly higher risk of developing new polyps (true recurrence) or experiencing continued growth of residual micro-lesions (pseudo-recurrence). Our correlation analysis

Table 4. Recurrence rates stratified by risk factors

Risk Factor	Subgroup	Total cases, n	Recurrence, n	Recurrence rate, %
Age group	≥ 40 years	68	32	47.1%
Age group	< 40 years	77	31	40.3%
Polyp number	Multiple	81	38	46.9%
Polyp number	Single	64	25	39.1%
Endometrial hyperplasia	Yes	45	17	37.8%
Endometrial hyperplasia	No	100	40	40.0%
Postoperative treatment	Yes	94	39	41.5%
Postoperative treatment	No	51	24	47.1%

also confirms the positive correlation trend between recurrence events and this pathological feature. This finding strongly suggests that "hyperplastic changes" in postoperative pathology reports should be regarded as a critical risk warning signal, prompting clinicians to pay close attention to such patients [18, 19].

Our study found that postoperative medical therapy was associated with a 37% reduction in recurrence risk (HR 0.626), although the *P*-value was borderline (P = 0.090). This trend is entirely consistent with the theoretical basis of progestins counteracting estrogen and inducing endometrial atrophy, thereby inhibiting polyp regeneration [20, 21]. Some domestic and international studies also support that postoperative use of progestins or the levonorgestrel-releasing intrauterine system (LNG-IUS) can effectively reduce recurrence rates [22, 23]. The lack of statistical significance in this study may stem from several reasons: First, heterogeneity in treatment protocols. We analyzed oral progestins and LNG-IUS together as a "postoperative treatment" group, but there are significant differences between these two in terms of administration routes, local drug concentration, and patient compliance, which may have obscured the significant effect of one specific type of medication. Second, inconsistency in medication duration and compliance. Retrospective studies make it difficult to accurately quantify the actual duration and regularity of medication for each patient, and irregular use may have weakened the overall treatment effect. Finally, limitations in sample size, particularly the absolute number of recurrence events in the treated versus untreated subgroups, may have been insufficient to detect a true effect difference. However, considering the protective trend observed in subgroup recurrence rate analysis and multivariate analysis, we believe that the clinical value of postoperative medical therapy, especially LNG-IUS, for high-risk patients (such as those with hyperplastic changes) should not be overlooked and warrants further verification in prospective randomized controlled trials.

In this study, the cumulative recurrence rate at 24 months post-polypectomy was 42.1%, which falls within the higher range of rates reported in the literature. This may be attributed to the composition of our study cohort and our intensive follow-up protocol [24-27]. More importantly, our survival analysis uncovered a distinct pattern of recurrence risk: while endometrial hyperplastic changes did not increase the ultimate proportion of patients who experienced recurrence (37.8% vs. 40.0%), it powerfully predicted a markedly accelerated time to recurrence (HR = 2.016). This finding suggests that hyperplasia primarily acts as a catalyst for earlier polyp regeneration rather than solely determining the final recurrence status. The regular ultrasound surveillance in our study likely captured these earlier events, contributing to the observed cumulative incidence. This dynamic risk profile underscores the importance of using time-to-event analysis, rather than simple proportion comparisons, to identify true risk factors. Consequently, endometrial hyperplastic changes should be considered a core indicator for identifying patients at risk for rapid recurrence, warranting closer surveillance and consideration of early preventative intervention.

Contrary to some previous studies [12, 28-30], in the multivariate model of this study, age (≥ 40 years), multiple polyps, and obesity (BMI ≥ 25 kg/m^2) were not independent predictors.

This may be due to the following reasons: First, the average age of the study population was relatively young (38.9 years) and concentrated, which may have weakened the comparative effect of age; the influence of age may be mediated more by hormonal status. Second, although multiple polyps showed a higher recurrence rate (46.9% vs. 39.1%) in descriptive analysis, its effect in multivariate analysis may have been overshadowed or confounded by a stronger predictor-endometrial hyperplastic changes-suggesting that multiple polyps may also be a manifestation of widespread endometrial instability. Finally, although obesity is associated with peripheral estrogen conversion, in this cohort, it may not have shown an independent effect due to limited BMI variation and the dominant role of endogenous ovarian estrogen in relatively young patients.

The strength of this study lies in the strict definition of recurrence criteria and the use of survival analysis methods to handle time-to-event data, avoiding biases from simply comparing rates. Meanwhile, we comprehensively evaluated multidimensional variables including clinical, pathological, and therapeutic aspects and controlled for confounding effects through a multivariate model. However, this study also has several limitations: First, inherent flaws of retrospective design, such as dependence on medical records for data completeness, may lead to information bias and unmeasurable confounding factors (e.g., detailed endocrine levels). Second, a single-center sample where the sample size may be insufficient for certain subgroup analyses (e.g., comparison of different drug types), requires caution when generalizing the conclusions. Third, for non-randomized treatment, the decision and regimen for postoperative medication were determined by clinicians based on experience, potentially introducing selection bias (e.g., more severe patients were more likely to be advised to take medication). Fourth, although the follow-up time met basic requirements, a longer follow-up period might capture more late recurrence events.

Based on the results of this study, we propose the following clinical recommendations: For patients after hysteroscopic polypectomy, postoperative pathology reports should be highly valued. If "hyperplastic changes" are indicated, the patient should be flagged as high-risk for recurrence and considered for more aggressive postoperative management, including fully communicating recurrence risks with the patient, recommending closer ultrasound follow-up (e.g., every 6-12 months), and strongly recommending individualized postoperative medical therapy (especially considering the proven efficacy of LNG-IUS). Even for patients without hyperplastic changes in pathology, postoperative medical therapy may still be beneficial and should be decided by comprehensively considering the patient's fertility needs, symptoms, and preferences.

Future research directions should include: conducting multicenter, large-sample prospective cohort studies or randomized controlled trials to clarify the efficacy and cost-effectiveness of different postoperative drug regimens (especially LNG-IUS) in preventing recurrence; exploring deeper molecular pathological markers (such as estrogen receptor subtypes, Ki-67 index, etc.) to further accurately identify high-risk individuals on the basis of traditional pathology; and tracking and comparing the long-term fertility outcomes of recurrent and non-recurrent patients.

Conclusion

In conclusion, this retrospective cohort study confirms that endometrial hyperplastic changes are a key independent risk factor for predicting recurrence after endometrial polypectomy. Although postoperative progestin therapy did not reach statistical significance in this study, it demonstrated a clear trend toward reducing recurrence risk, which holds important clinical implications. We recommend that risk stratification in clinical practice should be based on postoperative pathology results, and high-risk patients should receive pathology-directed intensified management and individualized treatment, with the aim of reducing recurrence rates and improving patient outcomes.

Disclosure of conflict of interest

None.

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