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Original Research

Analysis of Risk Factors for Bleeding and Recurrence of Ovarian Endometriomas after Laparoscopic Surgery and Its Impact on Pregnancy Outcomes

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Abstract

Background: Ovarian endometriomas are a common gynecological disease in women of childbearing age. Laparoscopic surgery is the gold standard surgical procedure for treating patients with ovarian endometriomas. However, laparoscopic postoperative bleeding, recurrence, and pregnancy failure are still unavoidable problems for many patients. **Methods**: A retrospective analysis was performed of 212 patients with ovarian endometriomas treated by laparoscopic surgery in our hospital from January 2016 to December 2020, with postoperative follow-up for 2 years. The researchers completed the follow-up by telephone, email, and outpatient review. Chi-square test was used to analyze the relationship between their clinical characteristics and postoperative bleeding, recurrence, and pregnancy along with logistic regression analysis of the risk factors for postoperative bleeding and recovery. Also, the use of logistic regression analysis may influence the factors influencing pregnancy outcome after laparoscopy. **Results**: The postoperative pregnancy success rate in 212 patients with ovarian endometriomas was 63.7%. The incidence of bleeding after surgery was 31.6% and the recurrence rate was 21.2%. The results of the logistic-regression analysis demonstrated that, age (odds ratio (OR) = 1.208, $p = 0.001$), combined with deep infiltrating endometriosis (DIE) (OR = 5.18, $p = 0.023$), cystic diameter $\geq$5 cm (OR = 0.076, $p = 0.005$), bleeding during the operation $\geq$50 mL (OR = 25.769, $p = 0.000$) and intraoperative bleeding (OR = 1.295, $p = 0.000$) were independent risk factors for postoperative bleeding. Severe dysmenorrhea (OR = 6.189, $p = 0.004$), cystic diameter $\geq$5 cm (OR = 8.502, $p = 0.001$), bilaterality (OR = 85.214, $p = 0.001$) and intraoperative bleeding (OR = 0.911, $p = 0.003$) were independent risk factors for the recurrence of ovarian endometriomas. By logistic regression analysis, age, bilaterality, the revised American Fertility Society (r-AFS) stage $\geq$III were all related factors for postoperative pregnancy ($p < 0.05$). **Conclusions**: Age, combined with deep infiltrating endometriosis, cystic diameter, bleeding during the operation and intraoperative bleeding were all independent risk factors for postoperative bleeding. Severe dysmenorrhea, bilaterality, cystic diameter and intraoperative bleeding were independent risk factors for the recurrence of ovarian endometriomas. Age, bilaterality, r-AFS stage $\geq$III were related factors for postoperative pregnancy.

Keywords: laparoscopic surgery; ovarian endometriomas; postoperative bleeding; recurrence after cyst surgery; pregnancy outcome

1. Introduction

Endometriosis (EMT) [1] is a common gynecological disease, which is characterized by the appearance of endometrial tissue in the parts other than the uterine body [2, 3]. Symptoms and findings include dysmenorrhea, chronic pelvic pain, pelvic mass and infertility [4], which seriously affect women's health and quality of life [5]. EMT lesions are extensive, morphologically diverse, highly aggressive, recurrent and are characterized by sex hormone dependence [6]. No conclusive data exist on the true prevalence of EMT [7,8]. About 10% of women of childbearing age suffer from EMT, representing approximately 176 million women worldwide [4]; 20% to 50% of infertile women suffer from EMT [9], and 71% to 87% of women with chronic pelvic pain have EMT [10]. EMT is one of the main causes of dysmenorrhea [11], infertility and chronic pelvic pain, not only negatively affecting the quality of life, but also causing a significant burden on social health resources [12].

Ovarian endometriomas (OEC), also known as ovarian chocolate cyst, ovarian endometriosis, ovarian endometriosis cyst is one of the most common forms of EMT. The latest report reveals that the disease incidence is about 10%~15% with the prevalence of 17%~44%. The disease mainly occurs in women of childbearing age, which causes harm to women's quality of life as well as physical and mental health [13–16]. OEC is a pathological manifestation of the implantation, growth, and infiltration of endometrial tissue in the ovary. According to the third edition of the guidelines for Diagnosis and Treatment of Endometriosis in 2021, laparoscopic surgery has been considered the gold standard treatment for OEC, and the purpose of the surgery is to remove all visible EMT lesions, associated adhesions and restore normal anatomy [17–20]. The laparoscopic surgery to remove ectopic cysts can avoid the long-term exposure of abdominal organs to EMT and reduce the stimulation and injury of tissues. However, many patients continue to have bleeding and recurrence after surgery, which

Table 1. Baseline data of the patients.

Parameters	Mean ± SD or n (%)
Number	212
Age (years)	28.90 ± 6.010
BMI (kg/m^2)	23.03 ± 3.625
Intraoperative bleeding (min)	55.92 ± 11.114
Length of stay (d)	8.17 ± 1.724
Postoperative exhaust time (h)	23.14 ± 3.642
Cystic diameter	
≥5 cm	132 (62.3)
<5 cm	80 (37.7)
Cysts number	
Single	112 (52.8)
Multiple	100 (47.2)
Cysts location	
One-sided	102 (48.1)
Bilateral	110 (51.9)
r-AFS stage	
≥III	151 (71.2)
< III	61 (28.8)
Bleeding during the operation	
≥50 min	91 (42.9)
<50 min	121 (57.1)
Surgical hemostasis	
Electrocoagulation hemostasis	79 (37.3)
Suture hemostasis	133 (62.7)
Severe dysmenorrhea	
Yes	143 (67.5)
No	69 (32.5)
Combine with deep infiltrating endometriosis	
Yes	83 (39.2)
No	129 (60.8)
History of pelvic surgery	
Yes	89 (42)
No	123 (68)

BMI, body mass index; r-AFS, the revised American Fertility Society stage; SD, standard deviation.

will inevitably affect the ovarian function of patients [21–23]. There is a higher risk of recurrence after laparoscopy, with a recurrence rate exceeding 20% at 2 years and nearly 50% at 5 years [24,25]. When the cyst development deteriorates, it will destroy the normal ovarian tissue and reduce the success rate for natural pregnancy.

Therefore, clarifying the risk factors for bleeding and recurrence after OEC and adjusting them timely can effectively reduce the recurrence after OEC and help improve treatment. Meanwhile, the analysis of pregnancy outcomes in patients with reproductive needs can clarify the factors affecting pregnancy outcomes. This study aims to analyze risk factors and related pregnancy outcomes in patients with ovarian endometriomas treated by laparoscopic surgery.

2. Methods

2.1 Research Participants

A retrospective analysis was performed of 212 patients with ovarian endometriomas, age 28.90 ± 6.010, admitted to our hospital from January 2016 to December 2020. There were 61 patients with stages II, 76 patients with stages III, and 75 patients with stages IV. All 212 patients completed 2 years of postoperative follow-up.

The patients included met the following criteria: (I) confirmed diagnosis of ovarian endometriomas; (II) laparoscopic treatment; (III) complete clinical data and follow-up data; (IV) age range of 20–40 years.

Exclusion criteria included any of the following conditions: (I) patients with severe coagulation dysfunction; (II) those who had undergone surgery at another hospital before surgery in our hospital; (III) patients with major mental illness.

A total of 230 patients were initially included but 18 patients needed to be excluded (5 cases had severe coagulation dysfunction, 11 cases were treated with surgery in other hospitals before surgery in our hospital, and 2 patients with mental illness). Therefore, a total of 212 cases were included in this study, as shown in Fig. 1.

2.2 Patient Treatment Modalities

Laparoscopic surgery is minimally invasive and has the advantages of less l trauma and quicker recovery. All patients agreed to laparoscopic treatment, and the further treatment plan was formulated according to the pathological results [26,27].

Operation process: In the supine position, the incision of the umbilical hole, left and right lower abdomen was about 0.5–1.2 cm, CO_2 pneumoperitoneum was established and placed at laparoscope. During the operation, such as bleeding, blood transfusion, or extensive adhesion or dense adhesion, if necessary, transfer to the abdomen, postoperative recurrence, and strengthen the monitoring during and after surgery.

2.3 Research Factors

(I) Collection of basic personal information, including age, degree of dysmenorrhea, body mass index (BMI), and previous history of pelvic surgery.

(II) Preoperative indicators: cyst diameter, cyst type, cyst, cyst location, cyst number, the revised American Fertility Society (r-AFS) stage.

(III) Surgical indicators included surgical duration, surgical hemostasis method, and postoperative scheduling time.

(IV) Data on postoperative bleeding and recurrence was extracted from the medical records, including the degree of bleeding, bleeding time and recurrence rate.

(V) Success rate of pregnancy.

This study analyzed the risk factors for postoperative bleeding and recurrence of ovarian endometriomas and its impact on future pregnancy outcome.

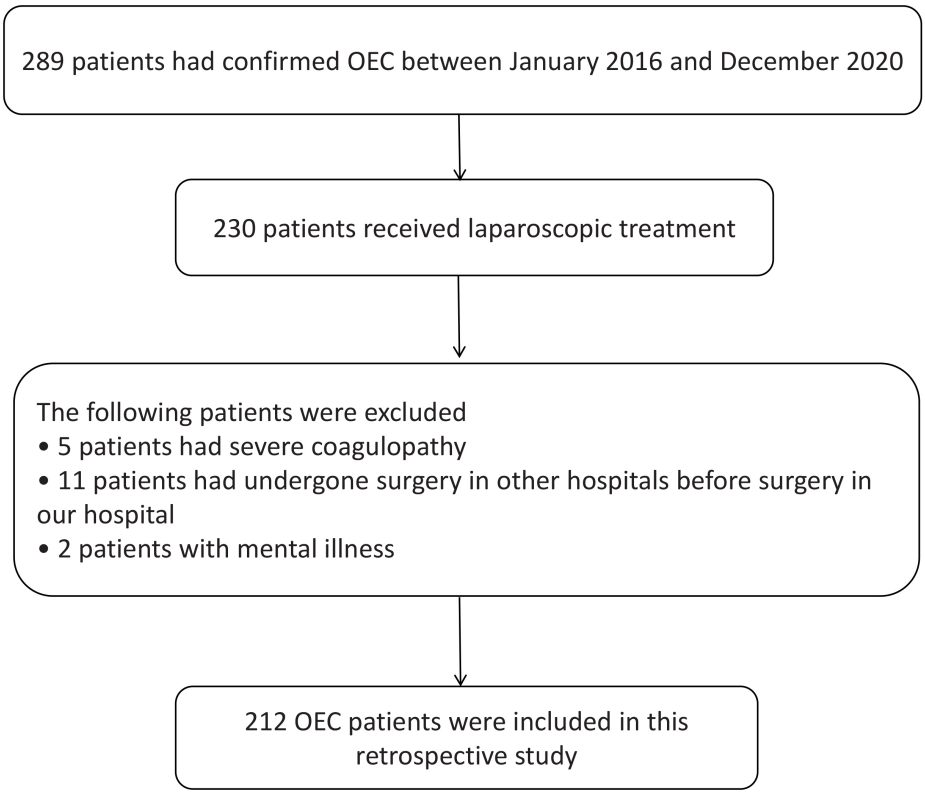

Fig. 1. Flow chart of patient selection. OEC, ovarian endometriosis cyst.

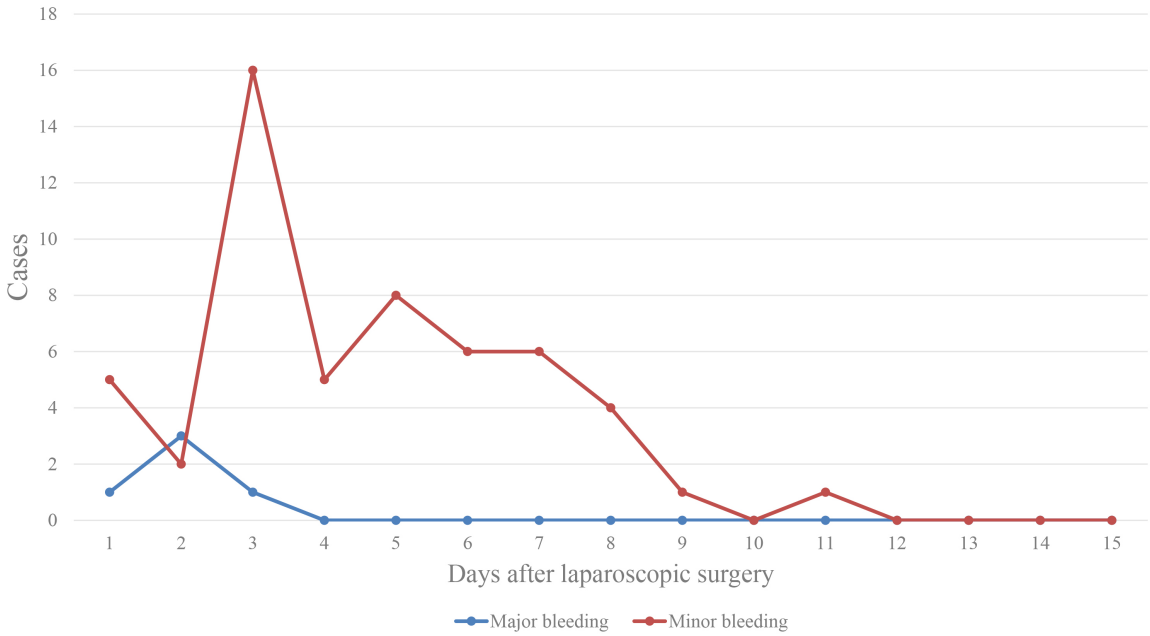

Fig. 2. Period of bleeding occurrence after surgery for endometriosis cyst.

2.4 Postoperative Hemorrhage

Postoperative bleeding can be divided into early bleeding and delayed bleeding. Early bleeding refers to bleeding occurring within 12 hours after surgery, and delayed bleeding refers to bleeding from 12 hours to 14 days after surgery [28]. Postoperative bleeding may lead to postoperative pain and discomfort and may also increase the risk of surgical complications and prolong the recovery time. Therefore, understanding the risk factors for postoperative bleeding is important to prevent and reduce the occurrence of bleeding.

Table 2. Comparisons of the baseline data about postoperative bleeding, recurrence, and pregnancy.

Parameters	Postoperative hemorrhage			Recurrence after surgery			Pregnancy outcome		
	No	Yes	*p*	No	Yes	*p*	No	Yes	*p*
Number	145	67		167	45		77	135	
Age (years)	27.29 ± 4.284	32.41 ± 7.565	0.000	29.36 ± 6.354	27.21 ± 4.145	0.014	33.05 ± 6.817	26.54 ± 3.873	0.043
BMI (kg/m^2)	23.27 ± 3.750	22.52 ± 3.308	0.252	23.09 ± 3.576	22.83 ± 3.839	0.468	23.11 ± 3.593	22.99 ± 3.656	0.468
Intraoperative bleeding (min)	51.22 ± 5.704	66.08 ± 13.066	0.468	57.11 ± 11.888	51.50 ± 5.819	0.468	56.63 ± 11.007	55.51 ± 11.197	0.468
Length of stay (d)	7.94 ± 1.676	8.67 ± 1.735	0.050	8.22 ± 1.740	7.99 ± 1.671	0.468	8.35 ± 1.677	8.07 ± 1.749	0.468
Postoperative exhaust time (h)	23.24 ± 3.717	22.95 ± 3.495	0.051	23.06 ± 3.706	23.48 ± 3.416	0.468	23.29 ± 3.724	23.07 ± 3.607	0.468
Cystic diameter			0.408			<0.001			0.018
≥5 cm	93 (64.1)	39 (58.2)		92 (55.1)	40 (88.9)		56 (72.7)	76 (56.3)	
<5 cm	52 (35.9)	28 (41.8)		75 (44.9)	5 (11.1)		21 (27.3)	59 (43.7)	
Cysts number			0.548			0.098			0.000
Single	56 (38.6)	23 (34.3)		67 (40.1)	12 (26.7)		60 (77.9)	73 (54.1)	
Multiple	89 (61.4)	44 (65.7)		100 (59.9)	33 (73/3)		17 (22.1)	62 (45.9)	
Cysts location			0.509			0.004			0.000
One-sided	72 (49.7)	30 (44.8)		89 (53.3)	13 (28.9)		24 (31.2)	78 (57.8)	
Bilaterality	73 (50.3)	37 (55.2)		78 (46.7)	32 (71.1)		53 (68.9)	57 (42.2)	
r-AFS stage			0.001			0.010			0.000
≥III	93 (64.1)	58 (86.6)		112 (67.1)	39 (86.7)		69 (89.6)	82 (60.7)	
< III	52 (35.9)	9 (13.4)		55 (32.9)	6 (13.3)		8 (10.4)	53 (39.3)	
Bleeding during the operation			0.000			0.005			0.554
≥50 min	40 (27.6)	51 (76.1)		80 (47.9)	11 (24.4)		31 (40.3)	60 (44.4)	
<50 min	105 (72.4)	16 (23.9)		87 (52.1)	34 (75.6)		46 (59.7)	75 (55.6)	
Surgical hemostasis			0.006			0.669			0.838
Electrocoagulation hemostasis	63 (43.4)	16 (23.9)		61 (36.5)	18 (40.0)		28 (36.4)	51 (37.8)	
Suture hemostasis	82 (56.6)	51 (76.1)		106 (63.5)	27 (60.0)		49 (63.6)	84 (62.2)	
Severe dysmenorrhea			0.376			0.627			0.555
Yes	95 (65.5)	48 (71.6)		114 (68.3)	29 (64.4)		50 (64.9)	93 (68.9)	
No	50 (34.5)	19 (28.4)		53 (31.7)	16 (35.6)		27 (35.1)	42 (31.1)	
Combine with deep infiltrating endometriosis			0.008			0.895			0.004
Yes	48 (33.1)	35 (52.2)		65 (38.9)	18 (40)		40 (51.9)	43 (31.9)	
No	97 (66.9)	32 (47.8)		102 (61.1)	27 (60)		37 (48.1)	92 (68.1)	
History of pelvic surgery			0.246			0.473			0.101
Yes	57 (39.3)	32 (47.8)		68 (40.7)	21 (46.7)		38 (49.4)	51 (37.8)	
No	88 (60.7)	35 (52.3)		99 (59.3)	24 (53.3)		39 (50.6)	84 (62.2)	

2.5 Recurrence after Surgery

Relapse was defined as recurrence of cysts at the site where laparoscopic surgery was performed during follow-up [2,29]. For relapsed patients, ultrasound was performed to determine recurrence of the cyst. All enrolled patients were followed for 2 years by telephone, internet or clinic visits to determine cyst recurrence. The last follow-up visit occurred in December, 2022.

2.6 Pregnancy Outcome

OEC is one of the most common types of EMT, which will cause the ovarian cortex to atrophy, and the cyst will have dense adhesion and congestion within normal ovarian tissue [30]. Laparoscopic surgery is widely used in the treatment of EMT. Laparoscopic surgery for resection of cysts can effectively improve the ability for future pregnancy. However, many factors affect the pregnancy outcome of patients after surgery.

2.7 Statistical Analysis

The data were processed using the SPSS 26.0 (IBM SPSS, Armonk, NY, USA) software. Measurements are expressed as the mean and the standard deviation and count data are expressed as frequency and percentages. Statistical analysis between groups was performed using chi-square test, and logistic regression analysis was performed for risk factors affecting postoperative bleeding, recurrence and factors affecting pregnancy outcome. A two-sided *p*-value of <0.05 was considered statistically significant.

Table 3. Complications in patients.

Parameters	Total, n (%)
Number	212
All complications	116 (54.7)
Early postoperative bleeding	59 (27.8)
Delayed postoperative bleeding	6 (2.8)
Recurrence after surgery	45 (21.2)
Some other complications	6 (2.8)

3. Results

3.1 Baseline Data

This study included 212 patients with ovarian endometriomas undergoing laparoscopic surgery, with a mean age of 28.90 $\pm$ 6.010 (years), BMI of 23.03 $\pm$ 3.625 (kg/m^2), intraoperative bleeding of 55.92 $\pm$ 11.114 (min), length of stay of 8.17 $\pm$ 1.724 (d), and postoperative recovery time of 23.14 $\pm$ 3.642 (h). There were 67 postoperative hemorrhages, 45 postoperative cyst recurrences and 135 postoperative pregnancies.

In the postoperative bleeding group, the mean age was 32.41 $\pm$ 7.565 years. A total of 58 (86.6%) patients had stage of disease (r-AFS stage), 51 (76.1%) patients had bleeding during the operation, 51 (76.1%) used suture hemostasis and 35 (52.2%) had deep infiltrating endometriosis (DIE); age, stage of disease (r-AFS stage), bleeding during the operation, surgical hemostasis and deep infiltrating endometriosis were all statistically significant ($p < 0.05$).

In the postoperative recurrence group, the mean age was 27.21 $\pm$ 4.145 years. A total of 40 patients (88.9%) had cystic diameter $\geq$5 cm, 32 (71.1%) patients had multiple cysts, 32 (71.1%) patients had bilateral cysts, 39 (86.7%) patients r-AFS stage, and 11 (24.4%) patients with a procedure duration of 50 minutes; postoperative recurrence differences in age, cyst diameter, cyst number, cyst location, r-AFS stage and non-recurrence group were statistically significant ($p < 0.05$).

In the successful postoperative pregnancy group, the mean age was 26.54 $\pm$ 3.873 years. A total of 76 (56.3%) patients had 5 cm cyst diameter, 77 (57.0%) single cysts, 78 (57.8%) one-sided, 53 (39.3%) patients with r-AFS stage $<$ stage, and 92 (68.1%) with deep infiltrating endometriosis. Age, cyst diameter, cyst number, cyst location, r-AFS stage, and the presence of deep infiltrating endometriosis were all statistically significant ($p < 0.05$) (Tables 1,2).

3.2 Postoperative Complications

Postoperative complications occurred in 116 (54.7%) patients. Of these, 59 (27.8%) had early postoperative bleeding, 6 (2.8%) had delayed bleeding, 45 (21.2%) had recurrent OEC 2 years after surgery, and 6 (2.8%) had other complications (Table 3). The statistical results demonstrated that the patients in the laparoscopic early bleeding group had the highest number of minor bleeding on day 2 (3 cases). The number of patients in the group was highest on day 3 (16 cases) (Fig. 2).

3.3 Risk Factors for Postoperative Bleeding and Recurrence of Endometriosis Cyst with Ovarian Endometriosis by Laparoscopic Surgery

The results of the logistic-regression analysis demonstrated that age (odds ratio (OR) = 1.208, $p = 0.001$), deep infiltrating endometriosis (OR = 5.18, $p = 0.023$), cystic diameter $\geq$5 cm (OR = 0.076, $p = 0.005$), bleeding during the operation $\geq$50 mL (OR = 25.769, $p = 0.000$) and intraoperative bleeding (OR = 1.295, $p = 0.000$) were independent risk factors for postoperative bleeding (Table 4). Severe dysmenorrhea (OR = 6.189, $p = 0.004$), cystic diameter $\geq$5 cm (OR = 8.502, $p = 0.001$), bilaterality (OR = 85.214, $p = 0.001$) and intraoperative bleeding (OR = 0.911, $p = 0.003$) were independent risk factors for the recurrence of ovarian endometriomas (Table 5).

3.4 Factors Influencing Pregnancy Outcomes

The univariate analysis affecting laparoscopic pregnancy in OEC patients, divided 135 patients in pregnant

Table 4. Risk factors for postoperative bleeding as analyzed by binary logistic regression models.

Parameters	B	SE	Wald	*p*	OR	95% CI	
						Upper	Lower
Age (years)	0.189	0.057	10.889	0.001	1.208	1.352	1.080
Severe dysmenorrhea	–0.359	0.859	0.174	0.676	0.698	3.765	0.130
BMI (kg/m^2)	0.014	0.090	0.024	0.876	1.014	1.211	0.850
Combine with deep infiltrating endometriosis	1.645	0.722	5.190	0.023	5.180	21.323	1.258
History of pelvic surgery	0.011	0.714	0.000	0.987	1.011	4.095	0.250
rAFS stage ≥III	0.428	1.409	0.092	0.761	1.534	24.274	0.097
Cystic diameter ≥5 cm	–2.578	0.910	8.031	0.005	0.076	0.452	0.013
Multiple cysts	0.895	1.209	0.548	0.459	2.447	26.152	0.229
Bilaterality	–0.768	1.151	0.445	0.505	0.464	4.431	0.049
Bleeding during the operation ≥50 mL	3.249	0.757	18.436	0.000	25.769	113.558	5.847
Intraoperative bleeding (min)	0.259	0.054	22.685	0.000	1.295	1.441	1.164
Electrocoagulation hemostasis	1.051	0.828	1.610	0.204	2.860	14.500	0.564
Length of stay (d)	0.132	0.214	0.380	0.537	1.141	1.737	0.750
Postoperative exhaust time (h)	0.085	0.092	0.851	0.356	1.089	1.305	0.909

B, beta; SE, standard error; OR, odds ratio; 95% CI, 95% confidence interval.

Table 5. Risk factors for post-cystectomy recurrence as analyzed by binary logistic regression models.

Parameters	B	SE	Wald	*p*	OR	95% CI	
						Upper	Lower
Age (years)	–0.087	0.047	3.421	0.064	0.917	1.005	0.836
Severe dysmenorrhea	1.823	0.628	8.422	0.004	6.189	21.195	1.807
BMI (kg/m^2)	–0.097	0.062	2.408	0.121	0.908	1.026	0.804
Combine with deep infiltrating endometriosis	–0.913	0.537	2.891	0.089	0.401	1.150	0.140
History of pelvic surgery	–0.218	0.466	0.219	0.640	0.804	2.003	0.323
rAFS stage ≥III	1.071	0.868	1.522	0.217	2.918	15.988	0.533
Cystic diameter ≥5 cm	2.140	0.630	11.555	0.001	8.502	29.207	2.475
Multiple cysts	–2.227	1.273	3.063	0.080	0.108	1.306	0.009
Bilateral	4.445	1.366	10.589	0.001	85.214	1239.633	5.858
Bleeding during the operation ≥50 mL	–0.803	0.488	2.704	0.100	0.448	1.167	0.172
Intraoperative bleeding (min)	–0.093	0.032	8.739	0.003	0.911	0.969	0.856
Electrocoagulation hemostasis	–1.122	0.489	5.252	0.022	0.326	0.850	0.125
length of stay (d)	–0.121	0.130	0.863	0.353	0.886	1.143	0.687
Postoperative exhaust time (h)	0.016	0.064	0.059	0.809	1.016	1.152	0.896

group and 77 patients without pregnant group according to whether the patients had successful pregnancy within 2 years after surgery.

By logistic regression analysis, Age, Bilateral, r-AFS stage ≥III are related factors of postoperative pregnancy ($p < 0.05$) (Table 6).

4. Discussion

Laparoscopic surgery, which is minimally invasive with rapid postoperative recovery, has been widely used in gynecological surgery. Laparoscopic surgery has surgical risks, such as bleeding, infection, intestinal adhesions, intestinal obstruction, carbon dioxide poisoning, subcutaneous emphysema, air embolism and diaphragmatic hernia. Cardiovascular and cerebrovascular accidents may be possible [31].

The statistical results of this study demonstrated that age (years), r-AFS stage, bleeding during the operation, surgical hemostasis and deep infiltrating endometriosis were statistically significant in the bleeding and non-bleeding group ($p < 0.05$). Utilizing logistic regression analysis, age, deep infiltrating endometriosis, cystic diameter ≥5 cm, bleeding during the operation ≥50 mL and intraoperative bleeding were independent risk factors for postoperative bleeding. Older patients and patients with more severe disease were more likely to develop postoperative bleeding. Furthermore, long surgical duration and certain specific surgical modalities were also associated with an increased risk of postoperative bleeding. The r-AFS stage ≥III and large volume cysts can be explained by bilateral ovarian involvement, large cyst volume, and severe adhesions that are more likely to cause postoperative bleeding.

Table 6. Influencing factors for pregnancy outcome as analyzed by binary logistic regression models.

Parameters	B	SE	Wald	*p*	OR	95% CI	
						Upper	Lower
Age (years)	–0.302	0.050	36.669	0.000	0.739	0.815	0.670
Severe dysmenorrhea	–1.070	0.565	3.585	0.058	0.343	1.038	0.113
BMI (kg/m^2)	–0.060	0.055	1.188	0.276	0.942	1.049	0.845
Combine with deep infiltrating endometriosis	–0.470	0.466	1.017	0.313	0.625	1.558	0.251
History of pelvic surgery	0.153	0.439	0.121	0.728	1.165	2.754	0.493
rAFS stage $\geq$III	–2.540	0.840	9.139	0.003	0.079	0.409	0.015
Cystic diameter $\geq$5 cm	–0.897	0.557	2.591	0.107	0.408	1.216	0.137
Multiple cysts	–0.173	0.819	0.044	0.833	0.841	4.186	0.169
Bilateral	–1.788	0.813	4.836	0.028	0.167	0.823	0.034
Bleeding during the operation $\geq$50 mL	0.548	0.446	1.506	0.220	1.729	4.147	0.721
Intraoperative bleeding (min)	0.032	0.021	2.189	0.139	1.032	1.077	0.990
Electrocoagulation hemostasis	0.714	0.454	2.471	0.116	2.041	4.969	0.839
Length of stay (d)	–0.106	0.125	0.713	0.399	0.900	1.150	0.704
Postoperative recovery time (h)	0.078	0.058	1.770	0.183	1.081	1.212	0.964

Intraoperative hemostasis is an important part of surgery, but different hemostatic methods have different effects on the ovary and endometrium, which leads to different degrees of postoperative ovarian function. Studies of bipolar electrocoagulation and suture hemostasis on postoperative ovarian function of OEC patients revealed that the patients receiving bipolar electrocoagulation hemostasis, the operating time was shorter than the patients receiving suture hemostasis but was not statistically significant between the groups [32]. Although the operation of suture hemostasis is complicated, it can effectively reduce the damage to normal ovarian tissues. As electrocoagulation hemostasis relies on high temperature to promote tissue solidification, it is easy to damage follicles and granulosa cells by excessive burns, leading to the ovarian function damage [32].

This study demonstrated that patient age, cyst diameter, cyst location, r-AFS stage, and bleeding during the operation were all associated with the risk of recurrence after laparoscopy. Severe dysmenorrhea, stage of disease (r-AFS stage), cystic diameter, bilaterality and intraoperative bleeding were independent risk factors for the recurrence of OEC. The onset of OEC is mostly hormone-dependent. Patients with r-AFS stage usually have extensive pelvic adhesions, which are more difficult for adequate exposure during surgical treatment, leading to difficulty in completely removing the cyst lesions. Without drug control after surgery, the residual lesions are prone to recurrent bleeding and hyperplasia under the action of intrinsic hormones, leading to the recurrence of OEC and aggravating the physiological pain of patients. The most common clinical symptom of preoperative dysmenorrhea EMT is pelvic pain. 70%~80% of patients have different degrees of pelvic pain, including dysmenorrhea, chronic pelvic pain, sexual pain and anal falling pain. Dysmenorrhea is also the main symptom in the presence of OEC [33]. Dysmenorrhea is usually related to pelvic adhesions and DIE. The invasion area is large, and surgery is unlikely to result in a cure. Both pelvic adhesions and DIE are considered to be factors affecting recurrence. This may explain the association between dysmenorrhea and the recurrence of OEC. Therefore, compared to asymptomatic patients, clinicians should pay more attention to the recurrence of OEC in patients with a history of dysmenorrhea.

Cyst diameter is a factor affecting OEC recurrence. Some studies have demonstrated that the recurrence rate of cysts after 2 years reaches 20% [22,25]. The statistical results of this study revealed that the recurrence rate of postoperative cysts at 2 years is 21.2%, which is consistent with the data of previous studies. Therefore, the recurrence rate of cysts after laparoscopy remains high [11].

In 212 patients, 135 had successful pregnancy with a success rate of 63.7% and 77 had unsuccessful pregnancy, accounting for 36.3%.

Related studies have shown that one of the main determinants of pregnancy success is the presence of ovarian reserve with good quality oocytes resulting in a high success rate for pregnancy [22,31]. The factors influencing postoperative pregnancy outcomes in patients with OEC are: (I) significant correlation between the ovarian reserve ability and age. According to large data statistical studies, the ovarian function of people aged 35 and below gradually decreases, but the ovarian function of women declines rapidly after the age of 36, which has a significant impact on the ovarian reserve [1,7,9]. (II) With the gradual increase of infertility time, the pelvic environment will affect ovulation function. (III) The study showed that in the controlled ovarian stimulation test for patients undergoing OEC dissection surgery, the ovarian function decreased to varying degrees, indicating that the operation had an impact on ovarian function [33]. However, multiple lesions are more widespread than solitary lesions with the contact area between the cyst and the ovarian wall being larger, so the degree of damage

to the ovarian cortex caused by surgery will be relatively high, and the degree of damage to ovarian function after surgery will also increase. (IV) The r-AFS stage directly reflects the severity of the patient's disease, and it is also an important indicator to estimate the probability of a natural postoperative pregnancy. As seen in previous studies, patients with successful spontaneous delivery generally had low r-AFS stage and relatively high endometriosis fertility index (EFI) [31,32]. It can be seen that the preoperative staging index can also be used as one of the main factors affecting the postoperative pregnancy outcome for patients.

The main drawback of this study was that the long-term follow-up was relatively short due to limited time and manpower availability. It is suggested that the follow-up time be extended in future studies.

5. Conclusions

The probability of laparoscopic hemorrhage and cyst recurrence was higher in patients with OEC. Clinically, close attention should be paid to the clinical characteristics of cysts, such as the size, number, morphology and location. Relevant risk factors should be identified as soon as possible, and individualized treatment measures implemented to reduce the possibility of postoperative bleeding and cyst recurrence.

OEC often occurs in women of childbearing age, seriously impairing female reproductive function. Clinically, the factors affecting pregnancy outcome should be clarified to improve the success rate for postoperative pregnancy.

Availability of Data and Materials

The data sets generated and/or analyzed during the current study are available in the Registry of Research Data Repositories, https://www.re3data.org/.

Author Contributions

(I) Conception and design: JH; (II) Administrative support: LZ; (III) Provision of study materials or patients: JH; (IV) Collection and assembly of data: JH and LZ; (V) Data analysis and interpretation: JH and LZ; (VI) Manuscript writing: JH and LZ. 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.

Ethics Approval and Consent to Participate

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by Ethics Committee of Wuxi Maternal and Child Health Hospital (No. LCKY2015392). Informed consent was obtained from all patients.

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Conflict of Interest

The authors declare no conflict of interest.

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