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Review Article

Systematic Review and Meta-Analysis of Complications after Laparoscopic Surgery and Open Surgery in the Treatment of Pelvic Abscess

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Background. Pelvic abscess surgery consists mostly of open laparotomy and laparoscopic surgery. Open surgery is regarded as a classic procedure. With the rise and promotion of laparoscopic indications in recent years, comparative studies of the two's postoperative effectiveness have been limited. *Objective*. To compare the clinical effects of laparoscopic exploratory surgery and open surgery in the treatment of pelvic abscess. *Methods*. Through computer searches of PubMed, EMBASE, Web of Science, China National Knowledge Infrastructure (CNKI), Wanfang, and Weipu databases, we found publicly available case-control research on laparoscopic surgery and open surgery for treating pelvic abscess. The papers that met the evaluation criteria were screened, and meta-analysis was used to look at 8 papers on laparoscopic surgery and open surgery for treating pelvic abscess from 2010 to 2021. *Results*. The results of this study showed that compared with the open laparotomy group, the incidence of laparoscopic group in the incision infection rate (RR = 0.29, 95% CI (0.20, 0.41), and $P < 0.00001$), the incidence of intestinal injury (RR = 0.08, 95% CI (0.04, 0.14), and $P < 0.00001$), incidence of intestinal obstruction (RR = 0.26, 95% CI (0.08, 0.90), and $P = 0.03 < 0.05$), and postoperative pelvic abscess recurrence rate (RR = 0.34, 95% CI (0.13, 0.86), and $P = 0.02 < 0.05$) are lower than open surgery, and the difference of these four items is statistically significant. There was no difference in the risk of urinary tract injury between laparoscopic surgery and open surgery (RR = 0.92, 95% CI (0.27, 3.17), and $P = 0.89 > 0.05$). *Conclusion*. In terms of incision infection, intestinal damage, intestinal obstruction, and recurrence of pelvic abscess, the laparoscopic group clearly outperforms the open group, and it merits clinical promotion and use.

1. Introduction

Pelvic inflammatory disease (PID) is a group of common infectious diseases in the lower abdomen. In recent years, with the improvement of people's health awareness and the advancement of diagnostic technology, the detection rate of PID patients is getting higher and higher [1]. Pelvic abscess is a more serious gynecological disease, which includes fallopian tube abscess, ovarian abscess, fallopian tube ovarian abscess, and abscesses caused by acute peritonitis and pelvic connective tissue inflammation [2]. Among the infections of the reproductive tract, pelvic abscess is the most serious infection, usually manifested as acute, subacute, chronic attack, or repeated infection of pelvic organs [3–5]. The clinical manifestations of pelvic abscess are complex and diverse. Most of them manifest as recurrent pain, fever, loss of appetite, and tender masses in the lower abdomen. Some patients feel anal drop, and there are also patients with hidden disease in clinical practice, so it is a serious threat women's health.

The diagnosis of pelvic abscess is based on the minimum diagnostic criteria, additional diagnostic criteria, and specific diagnostic criteria of PID. Its clinical diagnostic accuracy is not enough [6, 7]. However, delay in diagnosis and treatment may lead to unnecessary sequelae, such as infertility and ectopic pregnancy. Early diagnosis, especially early effective treatment, is the best strategy to ensure that PID will not develop into pelvic abscess. The incidence of pelvic abscess in PID hospitalized patients is as high as 34% [8]. Therefore, the pelvic abscess should be promptly and

effectively intervened. At present, the treatment of pelvic abscess is still based on conservative treatment of drugs, and try to choose antibiotics that have a wide coverage and are directed against the pathogenic bacteria of PID [9]. However, repeated antibiotic treatment can easily lead to drug resistance and flora imbalance in patients [10, 11].

Patients with more complex or critical pelvic abscesses should seek surgical therapy to accomplish the goal of full eradication of the lesions. The following are some indications [12] for pelvic abscess surgery: (1) ineffective medical therapy, chronic, or increasing growth of the abscess mass; (2) the occurrence or suspicion of an abscess rupture; and (3) peritonitis and possibly toxic shock are possibilities. The major surgical procedures include open surgery and laparoscopic surgery, with the purpose of removing the abscess lesion. Since Reich H performed the first laparoscopic hysterectomy in 1989, the discipline of gynecology has seen tremendous advancements in laparoscopic surgery. Laparoscopic surgery is becoming more popular among physicians and patients [13].

Laparoscopic surgery provides the physiological benefits of tiny incisions, less bleeding, and less damage as compared to standard open laparotomy surgery [14]. Can, however, laparoscopic surgery prevent organ damage during pelvic abscess treatment? Can the patient gain more? There are still concerns about the aforementioned difficulties. As a result, this article employs meta-analysis to investigate open or laparoscopic surgery for pelvic abscess, observe the occurrence of surgical complications, investigate the best surgical method for pelvic abscess, and provide patients with reasonable and optimal surgical methods, thereby reducing complications.

2. Methods

2.1. Search Strategy. Using a computer, search the databases of PubMed, EMBASE, Web of Science, Cochrane Library, CNKI, Wanfang, and Weipu. A collection of publications published between January 2010 and May 2021 are relevant to case-control studies of laparoscopic surgery and conventional laparotomy in the treatment of pelvic abscesses. Laparoscopy, laparotomy, pelvic abscess, fallopian tube abscess, fallopian tube ovarian abscess, ovarian abscess, pelvic inflammatory illness, and case-control study are the search phrases.

2.2. Inclusion Criteria. All the included study cases were pathologically diagnosed after surgery and had positive bacterial cultures; they were all patients in the same period; they were all analyzed through case-control on the occurrence of complications after laparoscopic surgery and open surgery for the treatment of pelvic abscess. All included studies are the clinical effects of laparoscopic surgery and open surgery in the treatment of pelvic abscess; the research methods are case-control trials; the clinical data are complete. Research indicators include the following: postoperative wound infection, intestinal injury, postoperative intestinal obstruction, recurrence of pelvic abscess, and urinary tract injury. The language is Chinese or English.

2.3. Exclusion Criteria. Preoperative patients with pregnancy; postoperative confirmation of patients with malignant tumors; data provided in the article is incomplete; the type of study is not a case-control study; there is too little information about clinical cases reported in the article; the article is of the type of case reports, reviews, etc.

2.4. Paper Screening and Data Extraction. Carry out the preliminary screening of articles according to the following steps: ① preliminary screening. Preliminary screening was performed according to the title and abstract of the literature, and the literature that had nothing to do with the surgical method of pelvic abscess was excluded. ② Research the full text of all selected articles. ③ Read the full text of the selected articles one by one, and exclude the articles that do not meet the requirements of the inclusion criteria. As a result, a total of 5 Chinese literatures and 3 English literatures were included. All literature research types were retrospective case-control studies.

The title of the article, the first author, the date of publication, and the source of the article; the sample size of the laparoscopic surgery group for pelvic abscess treatment and the sample size of patients with pelvic abscess treated by laparotomy; whether the grouping is randomized; and postoperative complications data such as wound infection, intestinal injury, postoperative intestinal obstruction, and recurrence of p. According to the characteristics of these data, only RCT research can be selected.

2.5. Quality Assessment. The quality of the included literature is evaluated separately by two researchers. When the assessment reveals a discrepancy, it is resolved via conversation. If the debate fails, the third researcher's view will be requested. The NOS scale (Newcastle-Ottawa Scale) quality evaluation contains a total of 10 points, with 7 split into high-quality research and 7 divided into low-quality research; the assessment material includes the following: patient selection, group comparability, and exposure variables.

2.6. Statistical Analysis. The statistical software uses the RevMan 5.3 software provided by the Cochrane Collaboration to perform meta-analysis on the data extracted from the literature. The heterogeneity test is to analyze the heterogeneity of the statistics in the included similar research literature. This study uses statistics P value and I^2 value to detect heterogeneity. When $P > 0.10$ and $I^2 \leq 50\%$, it means that the statistics included in the literature are less heterogeneous, and the fixed effects model is more reliable; when $P < 0.10$ and $I^2 > 50\%$, it means that the statistic is highly heterogeneous, and it is recommended to choose a random effects model. $P < 0.05$ indicates that the difference between the two is statistically significant, and vice versa, the difference between the two is deemed not to be statistically significant. For the binary variable data, the risk ratio (RR) is used as the effect indicator, and the combined RR value and 95% confidence interval (CI) are calculated. The publication bias of the article is identified by the funnel plot generated by the RevMan 5.3 software, and this study only performed the

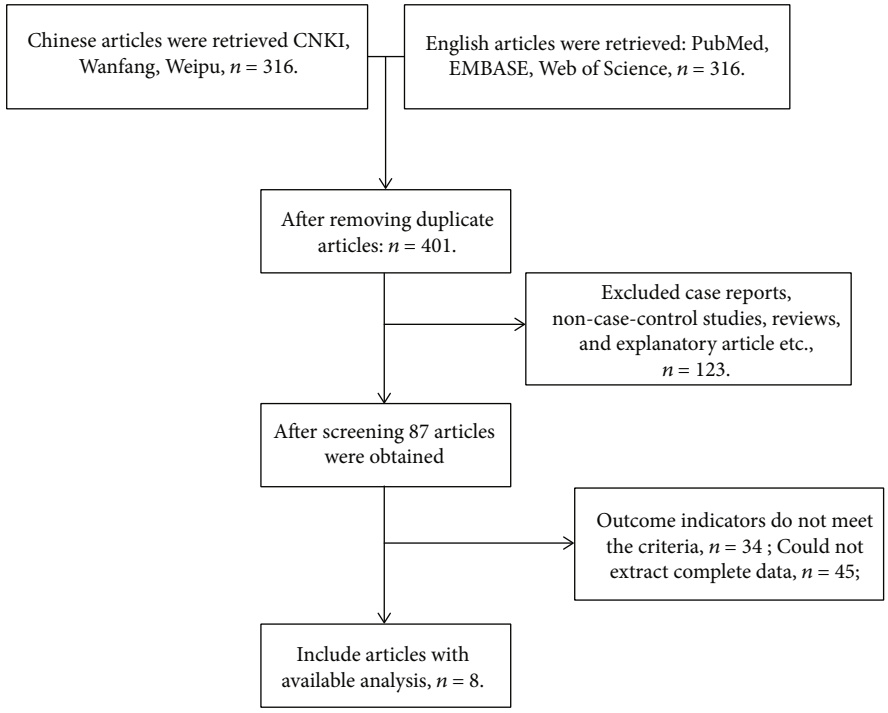

Figure 1: Flow diagram of the search, screening, and inclusion process.

funnel plot analysis bias on the research index of the included article amount to 5. For the sensitivity analysis of the included article, the changes in the combined effect were observed by excluding one article at a time during the meta-analysis process to illustrate the stability and accuracy of the results.

3. Results

3.1. Search Results and Study Characteristics. A total of 439 related articles were retrieved as required, and a total of 316 articles were retrieved through Chinese-related databases, including 127 on CNKI, 113 on Wanfang, and 76 on Weipu; a total of 123 articles were retrieved through English-related databases, including 78 on PubMed, 25 on EMBASE, and 20 on Web of Science; other search methods failed to obtain qualified articles. Then, the retrieved related literature was screened again, and based on the title and abstract content, noncase-control studies, incomplete content information, review, and explanatory literature were excluded, and finally, a total of 8 articles were included in this study, including 5 in Chinese and 3 in English. The literature screening process is shown in Figure 1.

After screening, a total of 8 articles, including Chinese and English articles, were included in 2836 patients, including 1254 cases in the laparoscopic group and 1582 cases in the traditional open laparotomy group. The study types are all case-control studies. Basic information such as authors, countries, and publication dates included in the literature are shown in Table 1.

Eight articles were finally included in quality assessment study, all of which were clinical case-control studies. According to the NOS evaluation criteria of case-control studies, the included literatures were evaluated objectively. The results showed that all the included literature scores were ≥7 points, and the literature quality was generally good.

3.2. Meta-Analysis Results

3.2.1. Incision Infection Rate. Seven of the included studies reported on the incidence of incision infections after laparoscopic surgery and open surgery. A total of 2769 patients participated, including 1217 patients in the laparoscopic group and 1552 patients in the open laparotomy group. The result of the heterogeneity test was calculated by RevMan 5.3 software $I^2 = 0\% < 50\%$, so the fixed effects model was adopted, RR = 0.29, 95% CI (0.20, 0.41), $P < 0.00001$, the comparison of the incidence of incision infection between the two groups is statistically significant, it showed that the incidence of incision infection is different between the laparoscopic surgery group and the open surgery group, and the risk of incision infection is lower in laparoscopic surgery than open surgery Figure 2.

3.2.2. Intestinal Injury Rate. Five of the included articles reported on the occurrence of intestinal injury in laparoscopic surgery and open surgery. A total of 2073 patients participated, including 1004 patients in the laparoscopic group and 1069 patients in the open group. The result of the heterogeneity test was calculated by RevMan 5.3 software $I^2 = 0\% < 50\%$, so the fixed effects model was adopted, RR = 0.08, 95% CI (0.04, 0.14), $P < 0.00001$, the incidence of intestinal injury between the two groups was statistically significant, indicating that for the incidence of intestinal injury,

Table 1: Basic characteristics of the study articles.

Author	Country	Year	Journal	Laparoscopic (*n*)	Open (*n*)
Carlson et al. [4]	Ohio	2021	J Minim Invasive Gynecol	133	234
Fan [15]	China	2012	Chongqing Medicine	111	101
Huang [16]	China	2010	Chinese Journal of Family Planning	37	30
Li et al. [17]	China	2020	Journal of Fujian Medical university	18	16
Shigemi et al. [18]	Japan	2019	Obstetrics & Gynecology	749	740
Yang et al. [19]	China	2002	J Am Assoc Gynecol Laparosc	19	37
Sun [5]	China	2018	China Medical University	102	382
Yang [20]	China	2019	Qingdao University	85	42

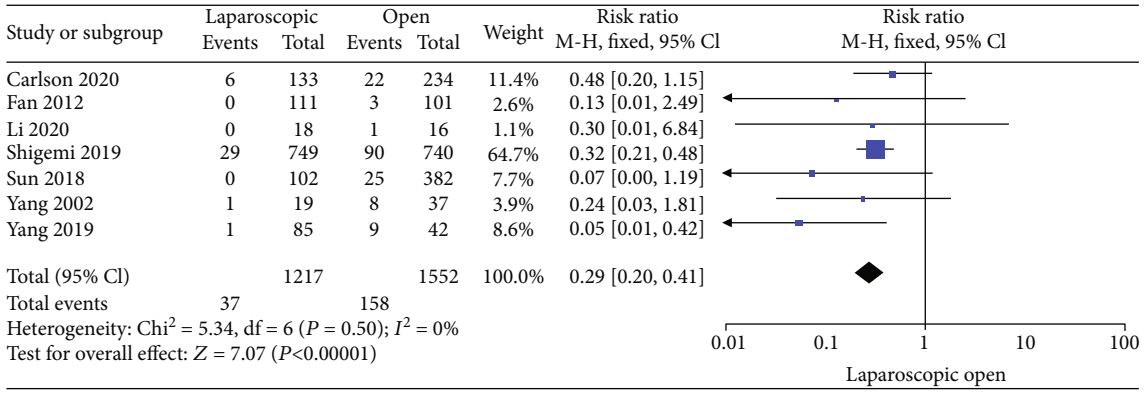

Figure 2: Forest plot of incision infection rate. Comparison of incision infection rate between the laparoscopic surgery group and the open laparotomy group. Statistical method: Mantel-Haenszel of fixed effects model (RR: relative risk; 95% CI: 95% confidence interval).

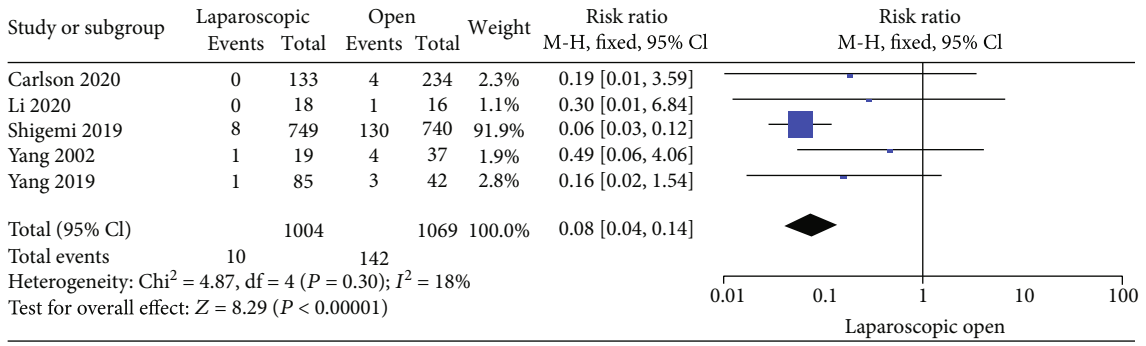

Figure 3: Forest plot of intestinal injury rate. Comparison of intestinal injury rate between the laparoscopic surgery group and the open laparotomy group. Statistical method: Mantel-Haenszel of the fixed effects model (RR: relative risk; 95% CI: 95% confidence interval).

laparoscopic surgery is different from open surgery, and laparoscopic surgery has a lower risk of intestinal injury than open surgery Figure 3.

3.2.3. Intestinal Obstruction Rate. Three of the included articles reported on the occurrence of intestinal obstruction in laparoscopic surgery and open surgery. A total of 359 patients participated, including 205 patients in the laparoscopic group and 154 patients in the open group. The result of the heterogeneity test is calculated by RevMan5.3 software $I^2 = 0\% < 50\%$, so the fixed effects model is adopted, RR = 0.26, 95% Cl (0.08, 0.90), $P = 0.03 < 0.05$, and the comparison of the occurrence of intestinal obstruction between the two groups is statistically significant, indicating that the occurrence of intestinal obstruction is different between laparoscopic surgery and open surgery. Laparoscopic surgery has a lower risk of intestinal obstruction than open surgery Figure 4.

3.2.4. Pelvic Abscess. Three of the included articles reported on the occurrence of pelvic abscess recurrence in both laparoscopic surgery and open surgery. A total of 678 patients participated, including 224 patients in the laparoscopic group and 454 patients in the open group. The result of

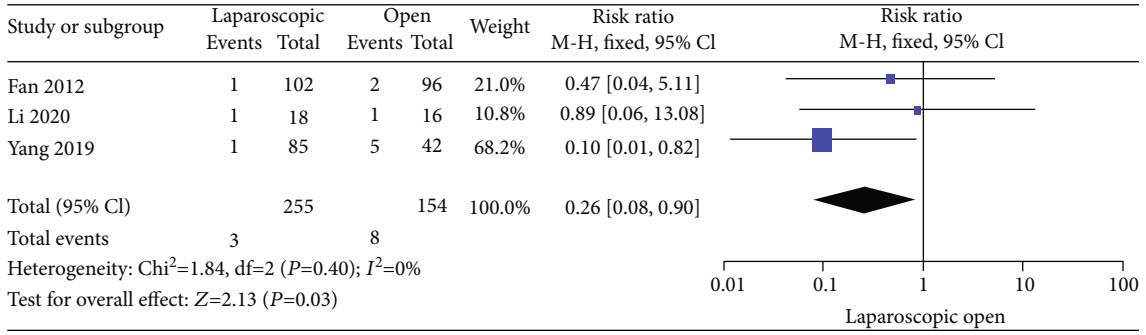

Figure 4: Forest plot of intestinal obstruction rate. Comparison of intestinal obstruction rate between the laparoscopic surgery group and the open laparotomy group. Statistical method: Mantel-Haenszel of the fixed effects model (RR: relative risk; 95% CI: 95% confidence interval).

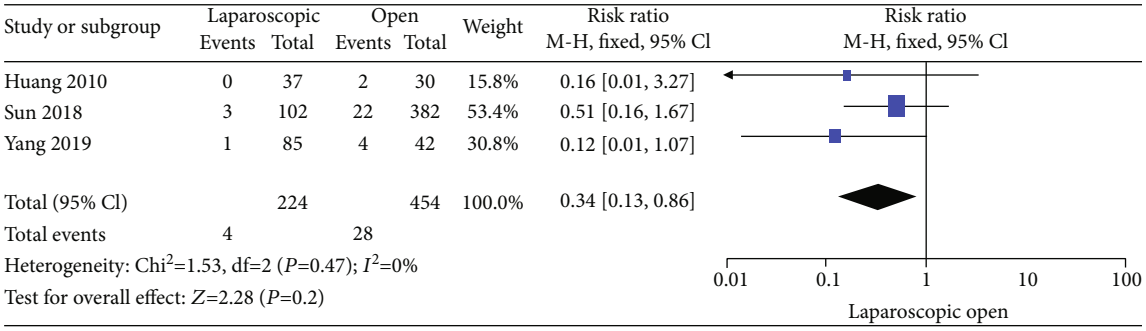

Figure 5: Forest plot of pelvic abscess rate. Comparison of pelvic abscess rate between the laparoscopic surgery group and the open laparotomy group. Statistical method: Mantel-Haenszel of the fixed effects model (RR: relative risk and 95% CI: 95% confidence interval).

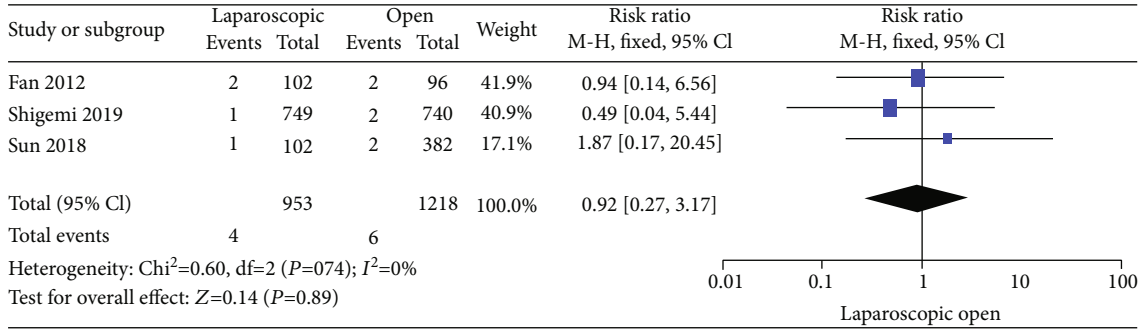

Figure 6: Forest plot of urinary system damage rate. Comparison of urinary system damage rate between the laparoscopic surgery group and the open laparotomy group. Statistical method: Mantel-Haenszel of the fixed effects model (RR: relative risk; 95% CI: 95% confidence interval).

the heterogeneity test is calculated by RevMan 5.3 software $I^2 = 0\% < 50\%$, so the fixed effects model is adopted, RR = 0.12, 95% CI (0.13, 0.86), $P = 0.02 < 0.05$, and the incidence of pelvic abscess recurrence between the two groups was statistically significant, indicating that for the incidence of pelvic abscess recurrence, laparoscopic surgery is different from open surgery. Laparoscopic surgery has a lower risk of pelvic abscess recurrence than open surgery Figure 5.

3.2.5. Urinary System Damage. The study indicators involved a total of 3 included articles and a total of 2171 patients participated, including 953 patients in the laparoscopic group and 1218 patients in the open laparotomy group. The result of the heterogeneity test was calculated by RevMan 5.3 software $I^2 = 0\% < 50\%$, so the fixed effects model was adopted, RR = 0.92, 95% CI (0.27, 3.17), and $P = 0.89 > 0.05$. The comparison of the occurrence of urinary tract injury between the two groups was not statistically significant, indicating that there was no significant difference in the risk of urinary tract injury between laparoscopic surgery and open surgery Figure 6.

3.2.6. Publication Bias. As the number of articles used to analyze the rate of incision infection and intestinal injury

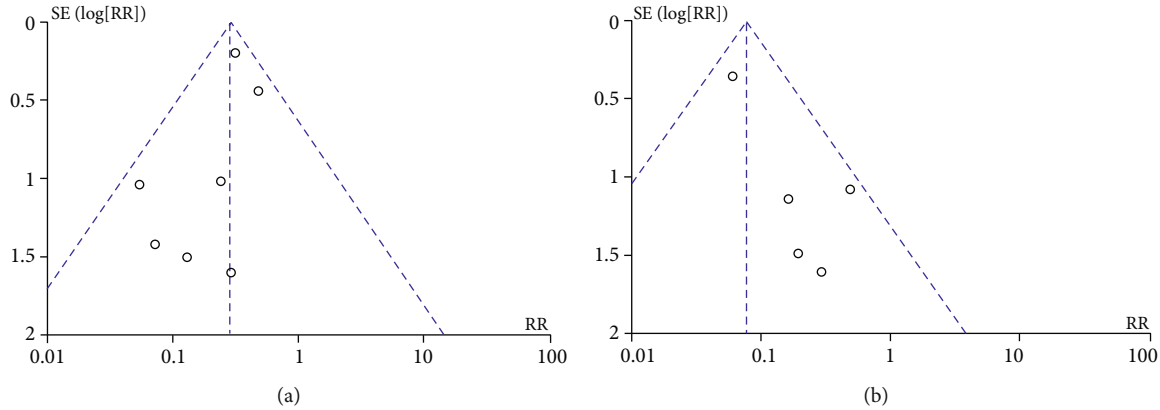

Figure 7: Publication bias is analyzed by funnel plot. Comparison of (a) incision infection rate and (b) intestinal injury rate. RR: relative risk; SE: standard error of the mean.

after laparoscopic surgery and open surgery for the treatment of pelvic abscess has reached 5, the funnel chart of these two indicators is used to analyze the publication bias, and both funnel charts are asymmetry, so there is publication bias. The articles with other indicators included in the study were all below the publication bias requirement (<5), so no publication bias analysis was performed Figure 7.

3.2.7. Risk of Bias. According to the evaluation tool of risk of bias in the Cochrane Collaboration, the low risk of random sequence generation was described in 7 articles [4, 5, 15–19], and the remaining 1 study did not specify the risk of bias [20]. The 8 articles all describe the implicit bias of allocation (low risk = 5 [4, 17–20] and risk = 3 [5, 15, 16]), and the risk of bias for blinding subjects and researchers (low risk = 6 [4, 5, 16–19] and high risk = 2 [15, 20]). Six articles describe the risk of bias in blinded result evaluation (low risk = 4 [4, 15–17] and high risk = 2 [19, 20]). All articles are low risk for incomplete result data, selective reporting domains, and other risks of bias.

4. Discussion

Common pathogens of pelvic inflammatory diseases include Streptococcus, Staphylococcus aureus, Neisseria gonorrhoeae, Chlamydia trachomatis, Mycoplasma, and viruses [4, 7, 10, 14]. If acute pelvic inflammatory disease is not treated in time, it can evolve into pelvic abscess as the disease progresses. Adhesion of tissues in the pelvic cavity has a serious impact on fertility [3]. In addition, diffuse peritonitis caused by the rupture of a pelvic abscess can cause toxic shock to the patient, and the life of the patient is seriously threatened. Therefore, early diagnosis and treatment can not only reduce complications but also preserve the patient's fertility and save the patient's life.

Because there is an abscess wall in a pelvic abscess, antibiotics cannot enter the abscess and cannot play a therapeutic role. The posterior fornix incision and drainage can achieve a certain therapeutic effect, but the effect is not ideal for patients with pelvic abscess and intestinal tube adhesion and tubal empyema and may cause injury [19, 21]. The puncture effect under ultrasound is better, but the puncture site has limitations. Traditional open laparotomy can drain the abscess, but the surgical trauma is large, the incision is easy to split or heal poorly, and there are many adverse reactions after the operation [22, 23]. In the past, the surgical treatment of pelvic abscess was mainly traditional open surgery, while laparoscopic surgery has always been regarded as a relatively taboo. With the popularity of laparoscopic surgery and the advancement of the technical level of the surgeon, laparoscopic surgery has gradually become the first choice for the diagnosis and treatment of pelvic abscess. Studies have shown that laparoscopic surgery has the advantages of less trauma and faster recovery, and there are fewer adverse reactions after surgery [24, 25].

This study compared the efficacy of laparoscopic exploratory surgery and laparotomy in the treatment of conservatively treated pelvic abscesses. The results showed that the laparoscopic group's incision infection rate, intraoperative intestinal injury rate, intestinal obstruction rate, and postoperative pelvic abscess recurrence rates were better than those in the open surgery group, but there was no significant difference in the urinary system injury rate between the laparoscopic group and the open surgery group. Laparoscopic surgery can reduce complications such as organ damage during the treatment of pelvic abscess, and patients can benefit more.

There may be several reasons why laparoscopic surgery has a better therapeutic effect. Laparoscopy is a minimally invasive surgery, with a small incision and less damage to the operation area. Patients can get out of bed earlier after surgery. Therefore, intestinal function recovers better and faster, and the risk of intestinal obstruction is lower. Laparoscopy has a magnifying effect, can clearly display the operation field, can observe the lesion from multiple angles, and find the hidden lesion, which can remove the lesion and surrounding necrotic tissue more thoroughly and can completely separate the adhesions, reducing the probability of readhesion and recurrence after surgery [9, 21, 26]. During the operation, the normal saline is repeatedly flushed, and the drainage tube after the operation can reduce the inflammatory exudation, which is safer and more effective.

This study only retrieved Chinese and English articles, which would have a certain degree of influence on the results of the study. The total number of articles included in this study is 8 with 2836 subjects. Because the sample size of the included study is not large enough, and the articles included in this study are heterogeneous in samples and methods, a multicenter and large sample size study is needed to further confirm the difference between laparoscopic and open surgery. In addition, due to publication bias, it affects the veracity and validity of the conclusions to a certain extent.

5. Conclusion

Laparoscopic surgery for patients with pelvic abscess has a lower risk of incision infection, intestinal injury, intestinal obstruction, and recurrence of pelvic abscess than open surgery, but there is no significant difference in the risk of urinary tract injury. In summary, laparoscopic surgery has more advantages than open surgery in the treatment of pelvic abscess.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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