



# Laparoscopic surgery versus open resection in patients with gastrointestinal stromal tumors: An updated systematic review and meta-analysis



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## ABSTRACT

**Purposes:** The contemporary surgery has reported the safety of laparoscopic surgery (LAP) for patients with gastrointestinal stromal tumors (GISTs). However, its use is still debated due to suspicion of the oncologic equivalence to open surgery (OPEN). We conducted a systematic review and meta-analysis of updated original articles to investigate the short- and long-term clinical outcomes of LAP compared with OPEN for GISTs.

**Methods:** A systematic search was performed in PubMed, Embase, Web of Science, Cochrane Library and CNKI. Comparative studies of laparoscopic and open surgery for GISTs were published before November 2016. The Newcastle-Ottawa scale was utilized to conduct quality assessment. The Review Manager (RevMan) software version 5.0 was used for meta-analysis.

**Results:** Twenty-four studies involving 2140 patients were included for the meta-analysis. The meta-analysis results showed that, compared with OPEN, LAP indicated potentially favorable outcomes in terms of operative time (WMD, −30.71; 95% CI, −58.48 to −2.95;  $P = 0.03$ ); intraoperative blood loss (WMD, −60.90; 95% CI, −91.53 to −30.28;  $P < 0.0001$ ); time to flatus (WMD, −1.10; 95% CI, −1.41 to −0.79;  $P < 0.00001$ ); time to oral intake (WMD, −1.25; 95% CI, −1.64 to −0.86;  $P < 0.00001$ ); length of hospital stay (WMD, −3.42; 95% CI, −4.37 to −2.46;  $P < 0.00001$ ); overall complications (OR, 0.38; 95% CI, 0.27 to 0.54;  $P < 0.00001$ ); and recurrence (OR, 0.45; 95% CI, 0.30 to 0.66;  $P < 0.0001$ ).

**Conclusions:** Laparoscopic surgery is safe and feasible for the treatment of GISTs including less operative time and intraoperative blood loss, earlier postoperative recovery, shorter hospital stay, and lower rate of overall complications and recurrence.

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## 1. Introduction

Gastrointestinal stromal tumor (GIST) is the most common mesenchymal tumor of the gastrointestinal tract, mesentery or omentum.<sup>1,2</sup> It is the designation for the specific KIT (CD117) and

CD34 expression, and many of GIST patients have KIT-activating mutations.<sup>3,4</sup> Although pathogenesis-targeted treatment with tyrosine kinase inhibitor (imatinib) has become more common,<sup>5</sup> surgical therapy remains the mainstay of therapy for primary GIST with no evidence of metastasis extension.<sup>6,7</sup> Meanwhile, except for gastric cancer, splenic diseases and gallstone, laparoscopic surgery is increasingly being recognized as a feasible approach for GIST, and operation results are quite satisfactory.<sup>8–10</sup> However, several controversial studies have reported that tumors in large size and in difficult location are tend to rupture via the laparoscopic approach, leading to higher risk of planted recurrence.<sup>11,12</sup> Therefore, it is necessary to conduct the meta-analysis to

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examine the efficacy and safety of laparoscopic surgery (LAP) versus the traditional open surgery (OPEN). In comparison with relatively short follow-up time and small sample size of previous meta-analyses, the advantage of our current study is that the median follow-up time is up to 4 years and the number of participants is 2140, it is also the first meta-analysis with data updating to November 2016. The aim of the present study is to draw objective conclusions of the short- and long-term outcomes of LAP for GIST, thus providing clinicians valid information for clinical decision-makings.

## 2. Methods

### 2.1. Search strategy

A systematic search was performed in PubMed, Embase, Web of Science, Cochrane Library and CNKI to identify articles published from January 1997 to November 2016. We used the following terms: [gastrointestinal stromal tumor (MeSH) OR GIST] AND [laparoscopy (MeSH) OR laparoscopic resection OR minimal invasive surgery] AND [gastrectomy (MeSH) OR gastric resection OR open resection OR conventional resection]. Search strategy was slightly adjusted according to the requirement of different databases. The language of the articles was limited to English and Chinese according to the reviewers' language competence. Chinese terms were used when searching the Chinese database (CNKI).

### 2.2. Study selection

This selection was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.<sup>13</sup> Two authors reviewed titles, abstracts and full text articles, any discrepancies about study inclusion were resolved by discussions among all authors. Inclusion of this paper was based on the following criteria: (1) the article should include comparative studies of both LAP and OPEN for patients with GIST; (2) the article should be published as full-text article; (3) the study type of the article should be either randomized controlled trials (RCTs) or observational studies. Studies were excluded from the analysis if (1) studies were abstracts, case reports, reviews, letters, editorials, expert opinions, and technical notes; (2) studies included either other types of gastrointestinal tumors or other types of surgical approaches; (3) it was impossible to extract the complete and appropriate data used for meta-analysis from the published articles.

### 2.3. Data extraction and quality assessment

We extracted basic data from the articles including the first author, geographical region, publication date, study period, number of patients, patient demographics and tumor characteristics. We also extracted important indicators, e.g., tumor size, operation time, blood loss, time to flatus, time to oral intake, length of hospital stay, and long-term outcomes. Data extraction was performed by two independent reviewers. Disagreements were resolved through discussions by the two reviewers, and when this did not resolve the differences, a third person made the final decision.

Methodological quality of case-control study or cohort study was evaluated by using the Newcastle–Ottawa scale (NOS).<sup>14</sup> It used a “star” rating system to judge quality on the basis of three aspects of the study: selection of study groups, comparability of study groups, and assessment of the exposure. The maximum number of stars a study might receive in each of these three categories is 4, 2, and 3.

### 2.4. Outcome definition and statistical analysis

Postoperative complications were classified as systematic complications (cardiovascular, respiratory events, deep venous thrombosis, and nonsurgical infections) or surgical complications (wound complications, bleeding events, ileus, delayed gastric emptying, and anastomotic stricture). This classification system was based on the Memorial Sloan-Kettering Cancer Center complication reporting system.<sup>15</sup>

Statistical differences between groups were assessed by means of Fisher's exact test for categorical data and by Student's *t*-test for continuous data. For continuous outcomes, we expressed the results using the weighted mean differences (WMDs) with 95% confidence intervals (95% CIs). For dichotomous outcomes, we planned to report results as odds ratios (ORs) with 95% CIs. We assessed the statistical heterogeneity between studies by using the  $\chi^2$  test and evaluated the extent of inconsistency by using the  $I^2$  statistic. If heterogeneity existed, data were analyzed using a random effects model. If heterogeneity did not exist, a fixed effects model was used.  $P < 0.05$  was considered statistically significant. The funnel plot method was used to assess the possible presence of publication bias.<sup>16</sup> Review Manager (RevMan) software version 5.0 (The Nordic Cochrane Center, The Cochrane Collaboration, Copenhagen, 2008) was used for data entry and statistical analysis.

## 3. Results

### 3.1. Studies selected

The initial search yielded 425 potentially relevant articles, of

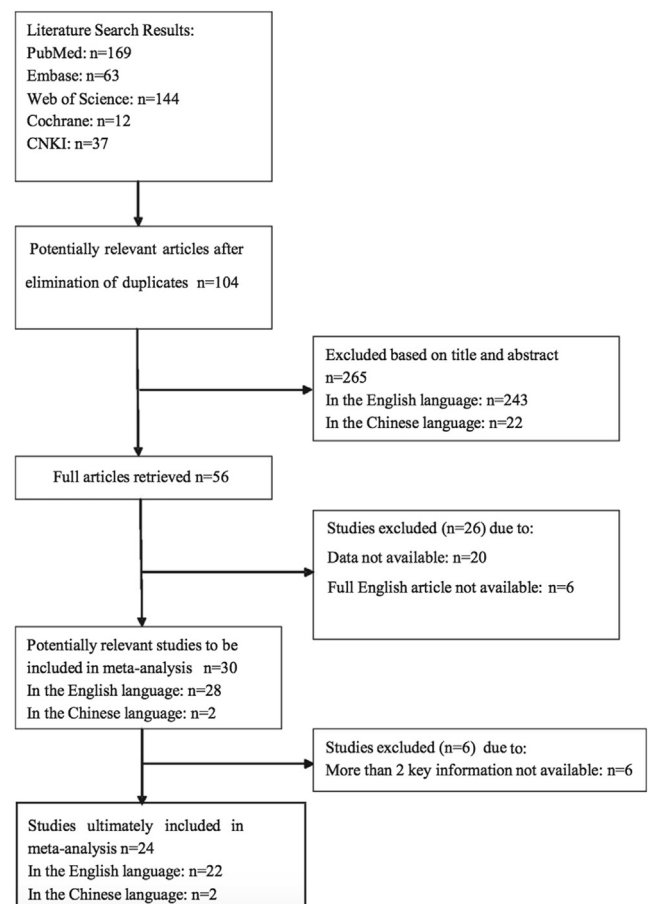


Fig. 1. Flow diagram for search strategy and study selection in the meta-analysis.

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