Original Article

Comparison of efficacy and safety between endoscopic and laparoscopic resections in the treatment of gastric stromal tumors: a systematic review and meta-analysis

Yong-Qing Wang[1#], Long-Quan Li[2#], Guang-Ming Li[2]

[1]Day Diagnostic Center, Gansu Provincial Hospital, Lanzhou, China; [2]Hepatology Department, Lanzhou University Second Hospital, Lanzhou, China

Contributions: (I) Conception and design: LQ Li, YQ Wang; (II) Administrative support: GM Li; (III) Provision of study materials or patients: GM Li; (IV) Collection and assembly of data: LQ Li, YQ Wang; (V) Data analysis and interpretation: LQ Li, YQ Wang; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Guang-Ming Li. Hepatology Department, Lanzhou University Second Hospital, No. 82 Cuiyingmen, Lanzhou 730000, China. Email: liggming@163.com.

Background: There are still clinical controversy on the efficacy and safety of endoscopic resection (ER) and laparoscopic resection (LR) in the treatment of gastrointestinal stromal tumors (GISTs). The present study aimed to evaluate the safety and efficacy of ER in the treatment of GISTs by comparing the relative outcomes of ER to LR.

Methods: PubMed, Web of Science, Cochrane Library, and Embase were searched. Data were retrieved from January 2010 to January 2020 and subjected to a meta-analysis based on the intraoperative and postoperative outcomes of ER and LR. The intervention arm was treated by LR while the comparator arm was treated by ER. Relevant literature was selected based on the inclusion criteria, data was extracted, and quality evaluation of the included literature was carried out. The Newcastle-Ottawa Scale (NOS) was applied for assessing the quality of included studies. Heterogeneity between studies was assessed using the Cochrane χ^2 test and I^2 statistic, and Funnel plots and Egger's test were used to detect publication bias.

Results: The present analysis included 13 studies, comprising a total of 1,261 patients, (ER *vs.* LR: 543 *vs.* 718). The incidence rate of postoperative complications [odds ratio (OR), 0.400; P=0.001] was significantly lower in the ER group [3.3%; 95% confidence interval (CI), 0.015 to 0.055] than the LR group (8.9%; 95% CI, 0.03 to 0.17). The meta-analysis revealed that the recurrence rate following ER (1.7%; 95% CI, 0.005 to 0.033) was lower than that following LR (2.5%; 95% CI, 0.012 to 0.041). The R0 resection rate of ER (99%; 95% CI, 0.975 to 0.999) was similar to that of LR (100%; 95% CI, 0.995 to 1.000). No publication bias in this study (P>0.10), and the sensitivity analysis showed that the study was robust.

Conclusions: ER was safer and more efficient than LR in terms of all the outcomes, except the R0 resection rate. Thus, ER should be considered the treatment of choice. However, attention should be paid to the surgical margin status following ER.

Keywords: Gastrointestinal stromal tumor (GIST); endoscope; laparoscopic; meta-analysis

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Introduction

Gastrointestinal stromal tumors (GIST) are the most common mesenchymal-derived tumors of the digestive system, especially the stomach, and account for 50–60% of all tumors. The National Comprehensive Cancer Network (NCCN) guidelines (1) state that upon endoscopic ultrasonography (EUS), patients with small GISTs (<2 cm in diameter) and no risk factors require regular checkups, while those with positive symptoms or high-risk factors should undergo GIST excision (2).

GISTs have malignant potential, and their biological behavior is unpredictable (2). Thus, both the European Society of Medical Oncology and the NCCN guidelines recommend the complete resection of the lesion (3,4) without the removal of clinically negative lymph nodes as the standard treatment for GIST. Consequently, most patients undergo endoscopic resection (ER) of small GISTs at an early stage to decrease the economical and psychological burden of long-term follow-up.

Endoscopic treatment has a faster postoperative recovery time, is less invasive, and is cheaper than laparoscopic and traditional surgery. ER was first described as a treatment for early gastric neoplasms in 1988 (5). The use of endoscopic techniques for the treatment of GISTs is controversial. When applied improperly, endoscopic therapy leads to short-term complications (e.g., bleeding, perforation, and fistula), tumor recurrence, and local or widespread metastasis.

With the development of endoscopic techniques, the endoscopic treatment of GISTs has improved. In addition, the application of titanium clipping and nylon rope techniques has decreased the risk of intraoperative perforation (6,7). Many clinical reports have described ER treatment of GISTs of different sizes (8,9). Due to the lack of evidence-based clinical and long-term data on oncological safety, ER as a treatment for GIST has not been accepted fully. A meta-analysis in 2017 revealed that ER may be effective for GISTs with a diameter <2 cm (10), It is important that only 5/16 of all the studies included reported pathological R0 status of ER in the research, so the conclusions should be viewed cautiously. With the emergence of many new studies in the past 10 years, many data show different results. Considering the above factors, we did this meta-analysis.

ER technology is still in its early stages. Conversely, laparoscopic resection (LR) has a longer clinical application time than ER, and the technology is more mature. LR is also widely used to treat gastrointestinal tumors. However, there is still a lack of comparative studies on the efficacy and safety of LR and ER in the treatment of GISTs, and tumor size is the main factor affecting the efficacy and safety. Thus, it is important to identify the tumor size for which ER is a safe and effective treatment and to compare this with LR. To investigate this issue, a meta-analysis was performed on studies published over the past 10 years. We present the following article in accordance with the MOOSE reporting checklist (available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-1121/rc).

Highlight box

Key findings

- ER should be considered the treatment of choice. However, attention should be paid to the surgical margin status following ER.

What is known and what is new?

- ER or LR can be used for resection of gastric stromal tumors.
- ER was safer and more efficient than LR in terms of all the outcomes.

What is the implication, and what should change now?

- ER should be popularized in the treatment of gastric stromal tumors.

Methods

Literature search strategy

The PubMed (https://pubmed.ncbi.nlm.nih.gov/), Web of Science (http://isiknowledge.com), Cochrane Library (https://www.cochranelibrary.com/), and Embase (https://www.embase.com/) databases were searched to retrieve all observational studies including cohort, case-control and cross-sectional studies published between January 2010 and January 2020. The following keywords were used: gastric stromal tumors, GISTs, endoscopic submucosal dissection (ESD), endoscopic full-thickness resection (EFR), endoscopic submucosal excavation, endoscopic tunnel submucosal resection, endoscopic ligation, ER and LR. For a more comprehensive and accurate search, the references included in the articles were also reviewed.

All the research results were evaluated in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension (11). Articles were included in the meta-analysis if they met the following inclusion criteria: (I) included patients who were confirmed or suspected to have

GISTs before surgery; (II) included patients who underwent ER *vs.* LR; (III) studies were designed: observational studies including cohort, case-control, and cross-sectional studies; outcomes measure: at least 1 major outcome indicator (i.e., the postoperative complications, R0 resection, or recurrence rate); (IV) in the included research, we also extracted other outcomes for comparison, we compared included postoperative complications, recurrence rate, R0 resection, length of hospital stay, operative time, intraoperative blood loss, postoperative diet recovery time were chosen. Articles were excluded from the meta-analysis if they met any of the following exclusion criteria: (I) concerned a case report, non-comparative study, conference paper, or comment; and/or (II) involved patients with certain risk factors, such as stroke and coronary heart disease, as such factors could have affected the accuracy of the findings of the present study.

Data collection and quality evaluation

The data collection and evaluation of the quality of the articles were independently performed by two investigators. Microsoft Excel 2010 software (Microsoft Corporation, USA) was used to record all the data, such as the primary outcomes (i.e., the postoperative complications, R0 resection, and recurrence rate), secondary outcomes (i.e., length of hospital stay, total hospital charges, operative time, intraoperative blood loss, and postoperative diet recovery time), and the baseline characteristics. In the included retrospective study, we will extract the adjusted OR values. For quality assessment of included studies, observational studies were assessed by the modified Newcastle-Ottawa Scale (NOS) (12,13), any disagreement was resolved by another investigator (LLQ).

Statistical analysis

The pooled odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for the dichotomous outcomes, and the pooled standardized mean differences (SMDs) or weighted mean differences (WMDs) and 95% CIs were calculated for the continuous outcomes. Heterogeneity between studies was assessed using the Cochrane χ^2 test and I^2 statistic. When the I^2 value was <50%, a fixed-effects model was used. Conversely, an I^2 value >50% indicated significant heterogeneity, and a random-effects model was used to pool the results. There is heterogeneity in the research, and the heterogeneity can be reduced by setting the subgroup analysis, and the combined effect value can be calculated. Funnel plots and Egger's test were used to detect publication bias (14). P value was used to detect the statistical difference, which was statistically significant when P<0.05. STATA version 15.0 (StataCorp LP, USA) was used to perform all the statistical analyses.

Risk of bias across studies

Funnel plot graphical expressions were chosen to search and identify publication bias.

Patient and public involvement

No patients or members of the public were directly involved in this study.

Results

Study collection and quality evaluation

Using the aforementioned search method, 627 articles were retrieved from the online databases between 1 January 2010 and 1 January 2020. A total of 286 articles remained after removing duplicates. Subsequently, 260 articles were excluded based on the aforementioned criteria. Of the remaining 26 articles, 13 were removed for various reasons (*Figure 1*). Ultimately, 13 articles with full-text (15-27) that met the inclusion and exclusion criteria (*Figure 1*) were included in the meta-analysis. The characteristics, demographics, and quality evaluations of the included studies are presented in *Tables 1,2*.

Postoperative complications

The meta-analysis revealed that the incidence rate of the postoperative complications of patients who underwent ER was significantly lower than that of patients who underwent LR (OR, 0.400; 95% CI, 0.228 to 0.702; P=0.001; *Figure 2A*) without heterogeneity (I^2=0; P=0.570) or publication bias (Figure S1A). The cumulative meta-analysis demonstrated that the 95% CI of ER narrowed, and the effect size became stable in the 9th study in 2019 (*Figure 2B*). According to the meta-analysis, which also showed no publication bias, the incidence rates of postoperative complications in patients who underwent ER and LR were 0.033 (95% CI, 0.015 to 0.055; *Figure 2C*) and 0.089 (95% CI, 0.03 to 0.17; *Figure 2D*), respectively (Figure S1B,S1C).

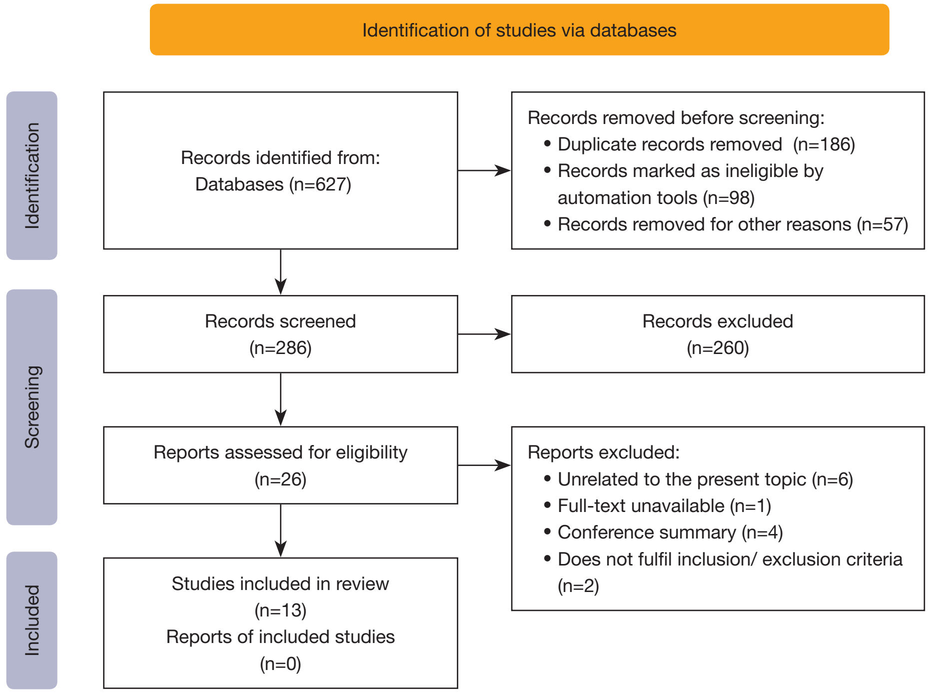

Figure 1 Selection process for the studies included in the meta-analysis.

Table 1 Characteristics and quality evaluation of the included studies

Study	Year	Country	Study period	Study design	Quality score
Jeong *et al.* (15)	2012	South Korea	2002–2007	Retrospective	8
Zhang *et al.* (16)	2013	China	2008–2012	Retrospective	7
Huang *et al.* (17)	2014	China	2010–2013	Retrospective	7
Wang *et al.* (18)	2016	China	2011–2013	Retrospective	9
Meng *et al.* (19)	2016	China	1998–2012	Retrospective	6
Gluzman *et al.* (20)	2017	Russia	2010–2016	Retrospective	8
Meng *et al.* (21)	2017	China	2009–2016	Retrospective	7
Chen *et al.* (22)	2018	China	2009–2016	Retrospective	7
He *et al.* (23)	2018	China	2012–2016	Retrospective	8
Yin *et al.* (24)	2018	China	2007–2015	Retrospective	9
Zhao *et al.* (25)	2020	China	2009–2017	Retrospective	8
Dong *et al.* (26)	2020	China	2006–2017	Randomized	8
Chen *et al.* (27)	2019	China	2017–2018	Retrospective	7

Tumor recurrence rate

The forest plot showed that the tumor recurrence rates did not differ significantly (data not shown). The meta-analysis indicated that studies reporting a recurrence rate following ER of 0.017 (95% CI, 0.005 to 0.033; P<0.001; *Figure 2E*) exhibited moderate heterogeneity (I^2=49.98%; P=0.029) and no publication bias (Figure S1D). Moreover, studies

Table 2 Patient demographics

Study	Number of patients (ER *vs.* LR)	Average age, years (ER *vs.* LR)	Sex, % female (ER *vs.* LR)	Average follow-up period, months (ER *vs.* LR)	NIH grade			Tumor size, cm (ER *vs.* LR)
					Low	Medium	High	
Chen *et al.* (22)	30/30	60.35/60.43	46.66/40.00	6.00/6.00	91	9	1	6.44/6.54
Dong *et al.* (26)	45/164	56.30/54.80	46.70/48.50	6.00–108.00/ 6.00–124.00	168	29	13	2.60/3.60
Zhao *et al.* (25)	85/64	57.01/57.77	63.52/54.68	36.00/36.00	94	12	10	1.60/3.13
Yin *et al.* (24)	46/30	60.09/54.47	50.00/60.00	12.00–100.00	61	15	0	2.04/3.70
Gluzman *et al.* (20)	22/40	NA	NA	NA	NA	NA	NA	2.30/4.90
Meng *et al.* (19)	75/51	50.64/54.53	53.33/50.98	40.08/40.92	NA	NA	NA	1.44/1.46
Huang *et al.* (17)	32/30	NA	NA	NA	NA	NA	NA	3.70/3.90
Wang *et al.* (18)	35/33	55.00/56.00	28.50/39.40	1.00–72.00	68	0	0	1.30/1.60
Zhang *et al.* (16)	22/20	42.50/42.50	NA	NA	NA	NA	NA	3.50/3.70
Jeong *et al.* (15)	27/57	55.40/55.40	NA	49.30/37.00	67	10	7	3.10/3.10
Meng *et al.* (21)	27/48	49.15/53.17	59.26/60.42	3.00–24.00/ 3.00–59.00	NA	NA	NA	1.18/1.20
Chen *et al.* (27)	35/66	31.00–78.00/ 34.00–80.00	59.09/65.71	17.00–60.00/ 15.00–60.00	91	9	1	2.50/3.00
He *et al.* (23)	62/84	51.55/53.38	41.93/33.33	12.00/12.00	116	17	13	3.40/3.70

ER, endoscopic resection; LR, laparoscopic resection; NIH, National Institutes of Health; NA, not available.

that reported a post-LR recurrence rate of 0.025 (95% CI, 0.012 to 0.041; P<0.001; *Figure 2F*) exhibited heterogeneity (I^2=39.566%; P=0.085) and no publication bias (Figure S1E).

R0 resection rate

The forest plot of the R0 resection rates did not differ significantly (data not shown). The meta-analysis showed that ER had a R0 resection rate of 0.990 (95% CI, 0.975 to 0.999; P<0.001; *Figure 2G*) with mild heterogeneity (I^2=3.809%; P=0.405) and no publication bias (Figure S1F). LR had a R0 resection rate of 1.000 (95% CI, 0.995 to 1.000; P<0.001; *Figure 2H*) with low heterogeneity (I^2=4.519%; P=0.399) and no publication bias (Figure S1G).

Other outcomes

Due to the high heterogeneity, a random-effects model was used to study the secondary outcomes (i.e., length of hospital stay, total hospital charges, operative time, intraoperative blood loss, postoperative diet recovery time, and tumor size). All the secondary outcomes were lower for ER than for LR. The lengths of hospital stay for ER and LR were 6.938 (Figure S2A) and 8.888 days (Figure S2B), respectively (WMD: −1.718; 95% CI, −2.402 to −1.033; P<0.001; *Figure 3A*). As the hospitalization costs varied between different regions, the SMD was used. The total hospital charges for ER and LR were ¥21,843.469 (Figure S2C) and 32,302.498 (Figure S2D), respectively (SMD: −1.538; 95% CI, −1.844 to −1.232; P<0.001;

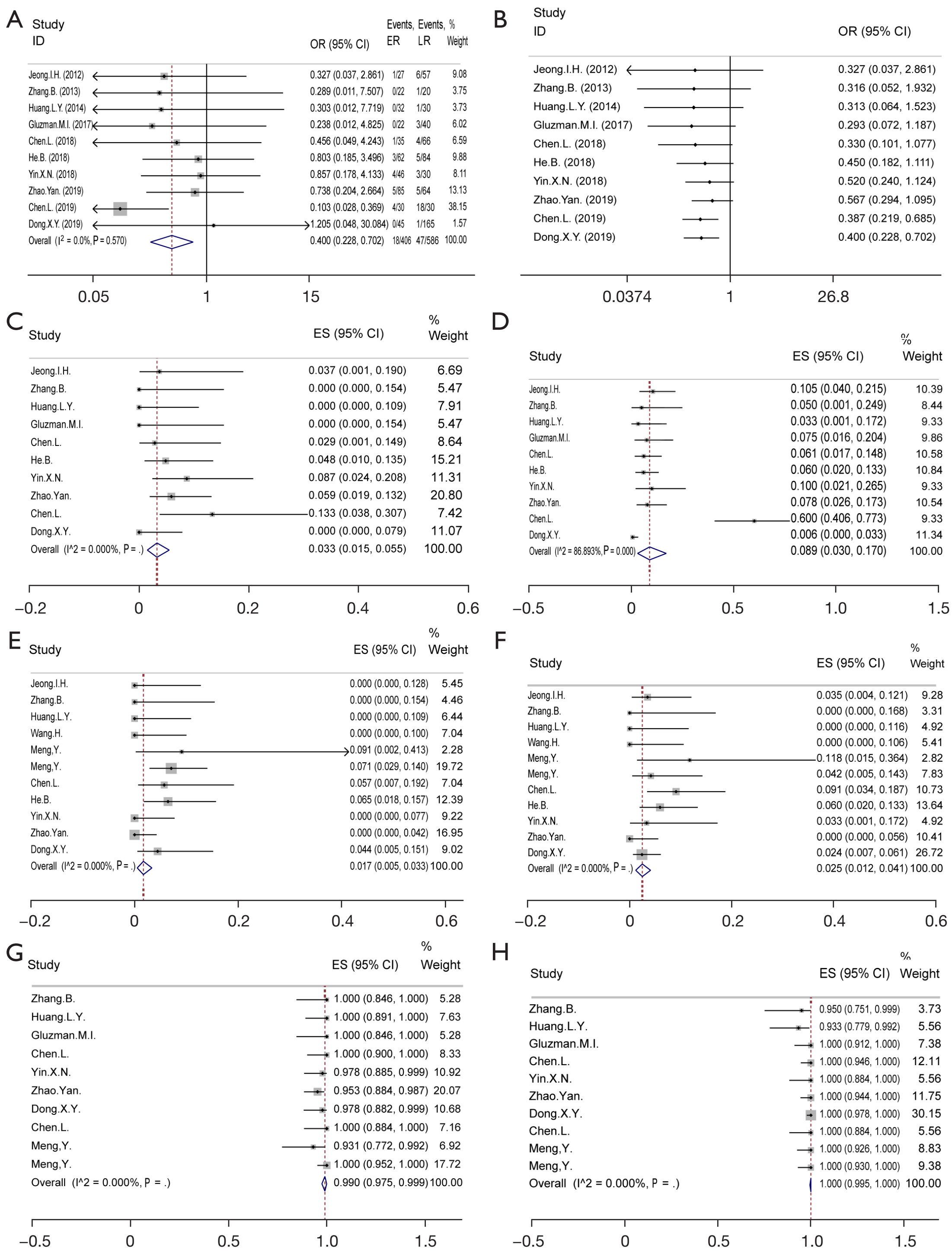

Figure 2 Forest plots of the primary outcomes and the meta-analysis. (A) OR and (B) cumulative meta-analysis of the postoperative complications. Meta-analysis of the postoperative complications in the patients who underwent (C) ER and (D) LR. Meta-analysis of the recurrence rates in the patients who underwent (E) ER and (F) LR. Meta-analysis of the R0 resection rates in the patients who underwent (G) ER and (H) LR. OR, odds ratio; CI, confidence interval; ER, endoscopic resection; LR, laparoscopic resection; ES, effect size.

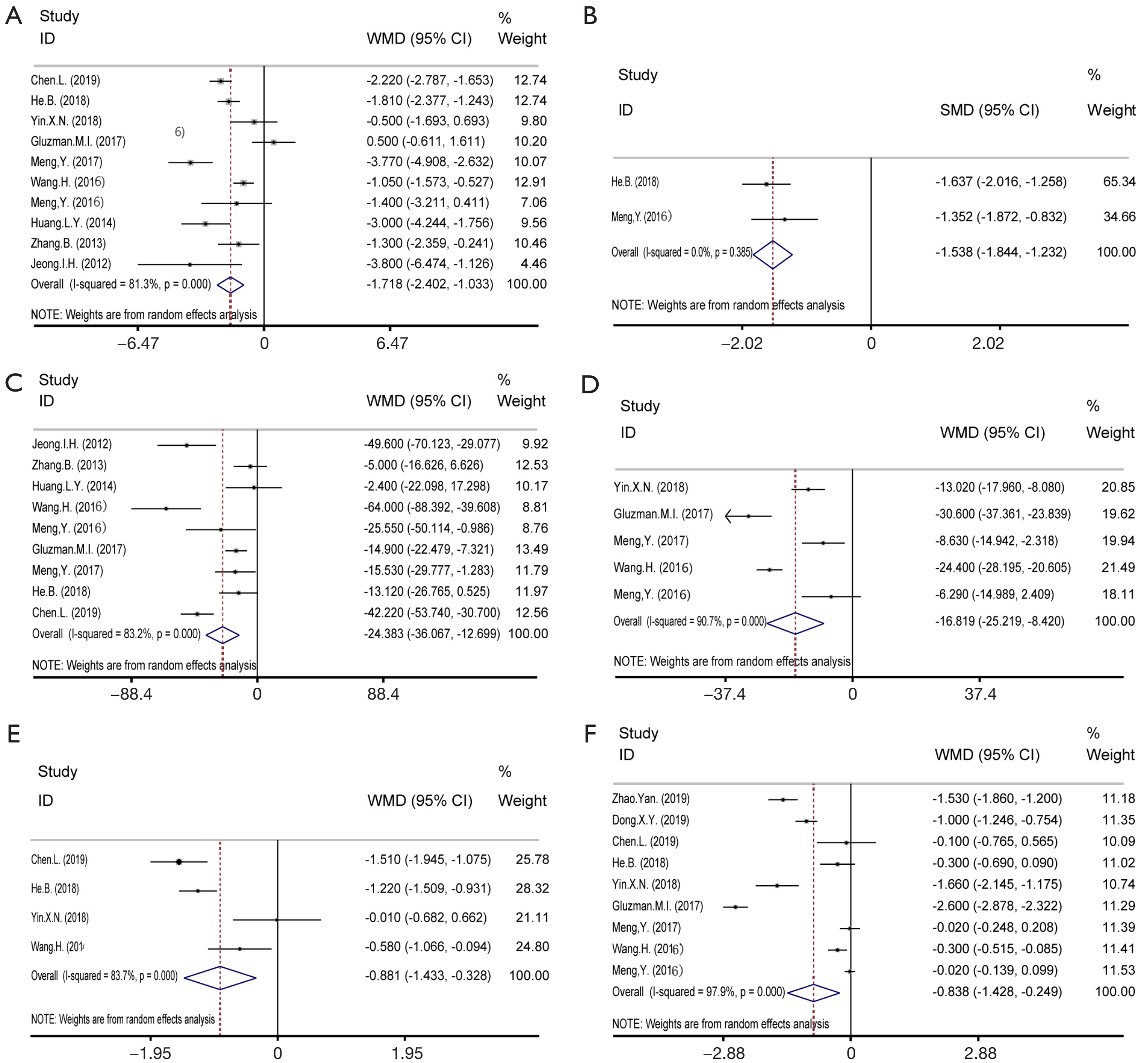

Figure 3 Forest plots of the ORs of the meta-analysis of other outcomes. (A) Length of hospital stay. (B) Total hospital charges. (C) Operative time. (D) Intraoperative blood loss. (E) Postoperative dietary recovery time. (F) Tumor size. WMD, weighted mean difference; CI, confidence interval; SMD, standardized mean difference.

Figure 3B). The operative times for ER and LR were 79.135 (Figure S2E) and 105.115 min (Figure S2F), respectively (WMD: −24.383; 95% CI, −36.067 to −12.699; P<0.001; *Figure 3C*). The intraoperative blood loss in ER and LR was 11.889 (Figure S2G) and 28.880 mL (Figure S2H), respectively (WMD: −16.819; 95% CI, 25.219 to −8.420; P<0.001; *Figure 3D*). The postoperative dietary recovery times following ER and LR were 2.855 (Figure S2I) and 3.700 days (Figure S2J), respectively (WMD: −0.88; 95% CI, −1.43 to −0.33; P<0.001; *Figure 3E*). The mean tumor size for ER was 2.449 cm (Figure S2K) and that for LR was 3.304 cm (Figure S2L; WMD: −0.838; 95% CI, −1.428 to 0.249; P<0.001; *Figure 3F*).

Publication bias and sensitivity analysis

The funnel plots of all the studies showed a symmetrical distribution (Figure S3). The Egger test results demonstrated no publication bias (Figure S4). The robustness of the results was confirmed by a sensitivity analysis (Figure S5).

Discussion

The studies included in the present analysis were published over a 10-year period [2010–2020] and compared the safety and efficacy of ER and LR in the treatment of GISTs. Most of the studies were retrospective; however, they were of relatively high quality according to the quality evaluation. Moreover, Abraham *et al.* (28) indicated that a meta-analysis of randomized controlled trials was not necessarily superior to that of non-randomized controlled studies. Zhang *et al.* (10) analyzed 11 articles with a total of 1,383 patients to assess the safety and efficacy of ER and LR for the treatment of GISTs <2 cm in diameter. Their results showed that there were no significant differences in the primary outcomes (i.e., the postoperative complications, R0 resection rate, and recurrence rate), and no definite conclusion was reached.

In the present study, ER primarily included EFR and ESD. Different surgical methods have different definitions of postoperative complications. In ESD, postoperative complications include intraoperative manual perforation. Conversely, in EFR, perforation is considered an intraoperative complication, not a postoperative complication. With the development of endoscopic and ligation technology and the application of titanium clips, intraoperative perforation is no longer the primary problem in the ER of small GISTs (29). The study found that there was no statistically significant difference in the prognosis between patients under endoscopic perforation and closure surgery and those without endoscopic perforation (30).

Unlike the studies of Zhang *et al.* (10) and Wang *et al.* (31), the present study included some more recent articles and compared the primary and secondary outcomes of ER and LR in the treatment of GISTs. In the present study, postoperative complications included delayed perforation rather than perforations formed intraoperatively and treated perfectly. A meta-analysis was conducted to calculate the pooled absolute values of every outcome. The incidence rate of postoperative complications was significantly lower in the patients who underwent ER than those who underwent LR (3.3% *vs.* 8.9%; OR, 0.400; P=0.001). The operative time, length of hospital stay, postoperative diet recovery time, intraoperative blood loss, and total hospital charges for ER were all lower than those for LR.

Both clinicians and patients have concerns regarding the recurrence rate and R0 resection in tumor therapy; thus, a comparison of these indicators between ER and LR was necessary. No statistically significant difference in the recurrence rate was found between ER and LR; however, the meta-analysis revealed a low recurrence rate for both techniques (1.7% *vs.* 2.5%; OR, 1.02; P=0.964). No significant difference in the R0 resection rate was found between ER and LR, and both remained high (99.0% *vs.* 100.0%; OR, 0.51; P=0.156); thus, this range was considered acceptable. These results can be partly explained by the fact that compared to GISTs treated with LR, most of those treated with ER were small in size and low risk (83.8%) as indicated by the National Institutes of Health (NIH) risk assessment. With the inclusion of more studies, the effect value will stabilize, and the 95% CI will narrow.

Hospitalization costs may have affected the choices of patients. The difference between countries and regional expenses is notable; thus, the SMD was used in the calculation of hospitalization costs instead of the WMD. The results suggested that hospitalization costs for ER was significantly lower than those for LR, which indicated that ER has a lower financial burden.

Day surgery is a globally popular treatment mode between emergency and hospitalization, and is a supplement of the traditional medical mode. Day surgery is associated with a short operative time, less trauma, short average hospital stay, and reduced hospitalization expenses, which meet the needs of patients for fast medical services (32). In the present study, ER caused little trauma, had a quick recovery period, and required only 1-day postoperative observation of patients. These factors are compatible with the day diagnosis and treatment mode. Thus, digestive endoscopy can be recommended as day surgery for the resection of gastric stromal tumors in the future.

A subgroup analysis of different ER methods revealed no significant differences between patients who underwent EFR and ESD. Compared to ESD, EFR comprises more steps for the formation and closure of intraoperative "manual perforations". Thus, the size and invasion depth of GISTs should be considered when choosing between ESD and EFR.

The present study had some limitations. The eligible studies were all from East Asia, and most of the studies were from China; this may be due to the higher incidence rate of GISTs in East Asia than in Europe and America (1,33-35). There are fewer cases of ER used to treat GISTs in Europe and America, which indicates that the preferred treatment methods for stromal tumors differ in different regions. The present study is only representative of GIST treatment in East Asian populations, not European and American populations. ESD and EFR were compared in the present study; however, other ER methods were not compared due to the small number of cases. Thus, it is still unclear whether endoscopic surgery is an optimal method and this issue requires further investigation. The studies included in this meta-analysis lacked long-term follow-up results, which prevented the assessment of the long-term outcomes of ER and LR; these should be investigated in future studies. Because the tumor size varied in each study, we used the meta-analysis to define the standard resection diameter of ER, which was <2.45 cm. ER may be used to treat to a larger size range of GISTs, but more clinical data are needed to support this finding. Based on the data from 13 studies and the present NIH risk assessment, 83.8% of patients were at low risk, 11.2% were at medium risk, and 5.0% were at high risk. Both the preoperative risk assessment and tumor size were considered to decide which surgical method would be more effective for the treatment of the disease. Finally, while no heterogeneity was found in the postoperative complications, other outcome indicators (including total hospital charges, length of hospital stay, operative time, and intraoperative blood loss) showed heterogeneity; these outcomes were primarily associated with the experience of the surgeon and the baseline characteristics of the patients. The funnel plots and Egger tests yielded robust and reliable results.

The present study showed that for the treatment of GIST, ER was safer and more efficient than LR in terms of all the outcomes, except the R0 resection rate. Thus, ER should be considered the treatment of choice. However, attention should be paid to the surgical margin status following ER.

Conclusions

ER was safer and more efficient than LR in terms of all the outcomes, except the R0 resection rate. Thus, ER should be considered the treatment of choice. However, attention should be paid to the surgical margin status following ER.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jgo.amegroups.com/article/view/10.21037/jgo-22-1121/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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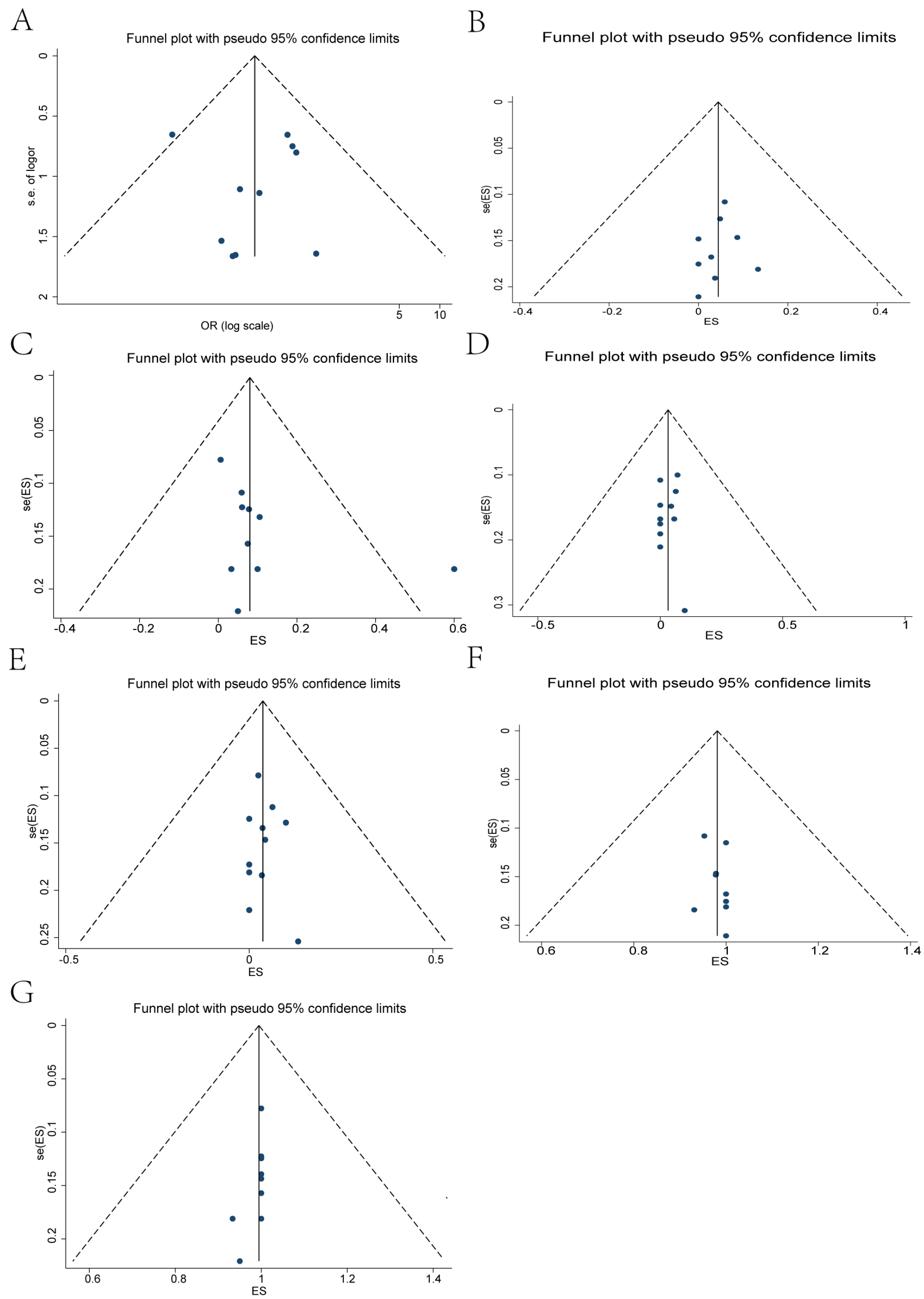

Figure S1 Funnel plot of the postoperative complications, tumor recurrence, and R0 resection rates. (A) Funnel plot of postoperative complications. meta-analysis of postoperative complications in the patients who underwent (B) ER and (C) LR. meta-analysis of the tumor recurrence rate in the patients who underwent (D) ER and (E) LR. (F) meta-analysis of the R0 resection rates in patients who underwent (F) ER and (G) LR. SE, standard error; OR, odds ratio; ES, effect size; ER, endoscopic resection; LR, laparoscopic resection.

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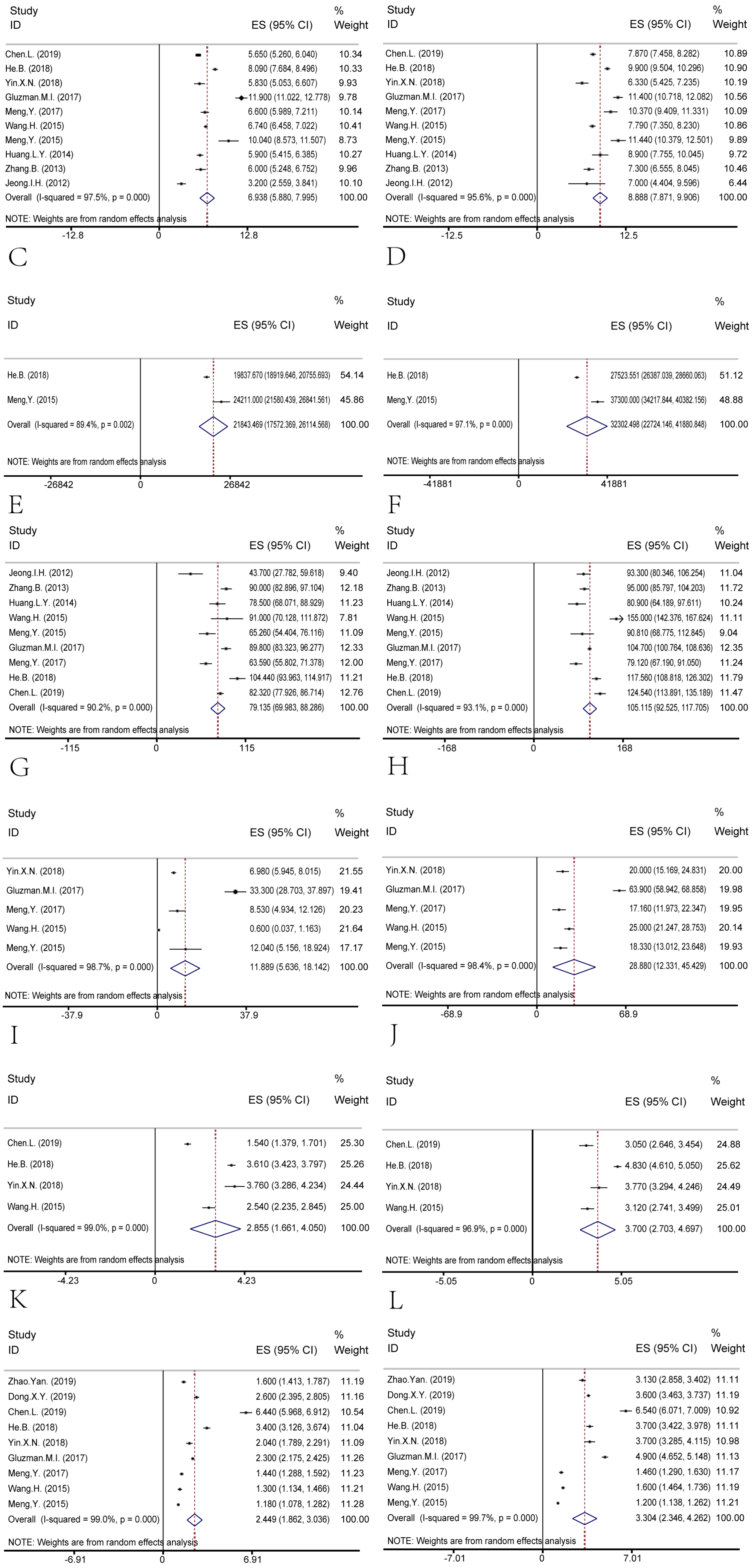

Figure S2 Forest plots of the meta-analysis of other outcomes. Length of hospital stay for the patients who underwent (A) ER and (B) LR. Total hospital charges for the patients who underwent (C) ER and (D) LR. Operative time for the patients who underwent (E) ER and (F) LR. Intraoperative blood loss for the patients who underwent (G) ER and (H) LR. Postoperative dietary recovery time for the patients who underwent (I) ER and (J) LR. Tumor size for the patients who underwent (K) ER and (L) LR. ES, effect size; CI, confidence interval; ER, endoscopic resection; LR, laparoscopic resection.

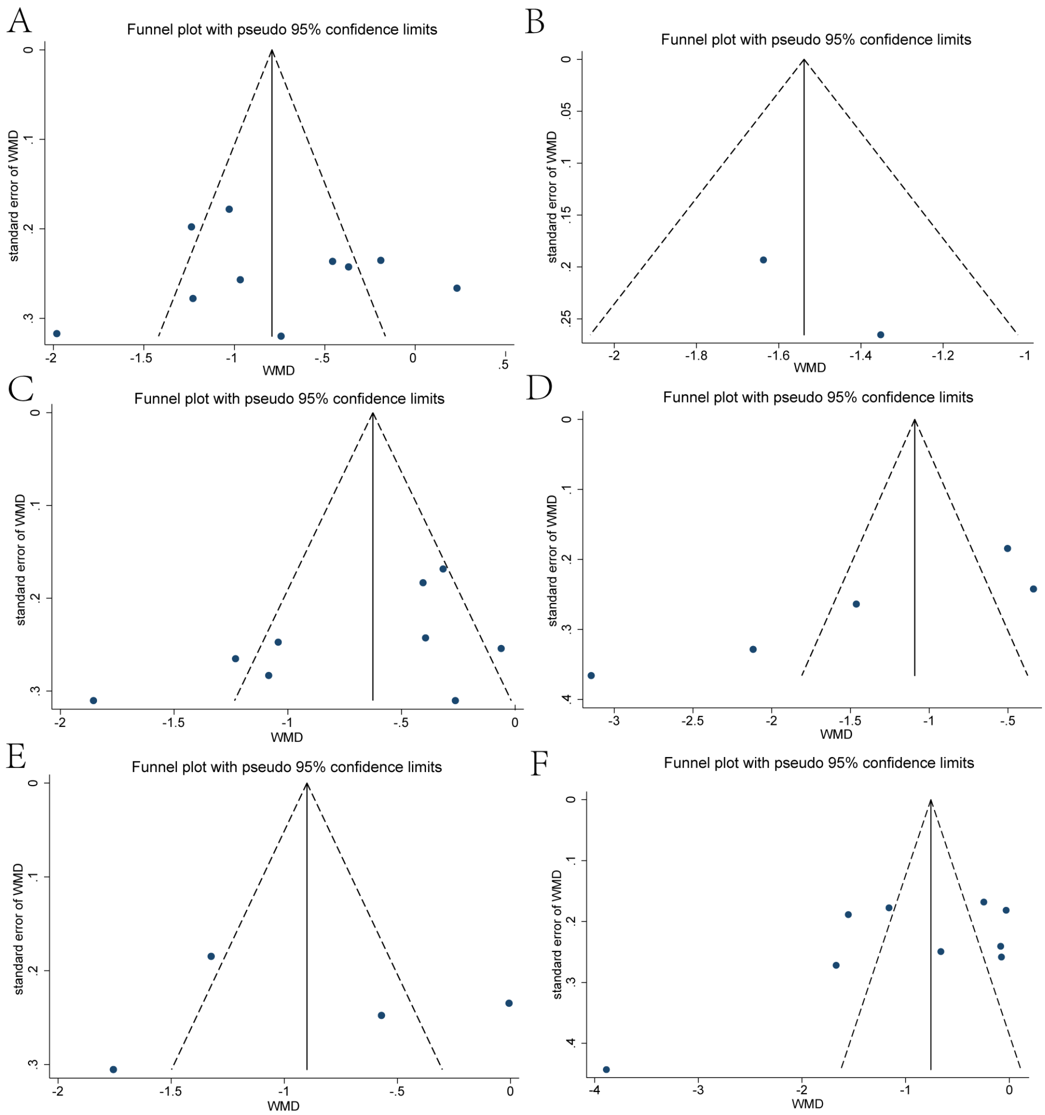

Figure S3 Funnel plot of the patients undergoing endoscopy and laparoscopy. (A) Length of hospital stay. (B) Total hospital charges. (C) Operative time. (D) Intraoperative blood loss. (E) Postoperative dietary recovery time. (F) Tumor size. WMD, weighted mean difference.

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Quantitative Assessment for Publication Bias

	postoperative complications	Operative time	Hospital stay	Tumor size	Diet recovery	Intraoperative blood loss	Hospitalization cost
Number of studies	10	9	10	9	4	5	2
P value for Egger tests	0.908	0.124	0.927	0.173	0.978	0.037	-

Egger's test for Single arm meta-analysis

Table1. Endoscopic resection

	postoperative complications	Tumor recurrence rate	R0 resection rate
Number of studies	10	11	10
P value	0.412	0.605	0.408

Table2. Laparoscopic resection

	postoperative complications	Tumor recurrence rate	R0 resection rate
Number of studies	10	11	10
P value	0.162	0.791	0.130

Figure S4 Publication bias and Egger's test results.

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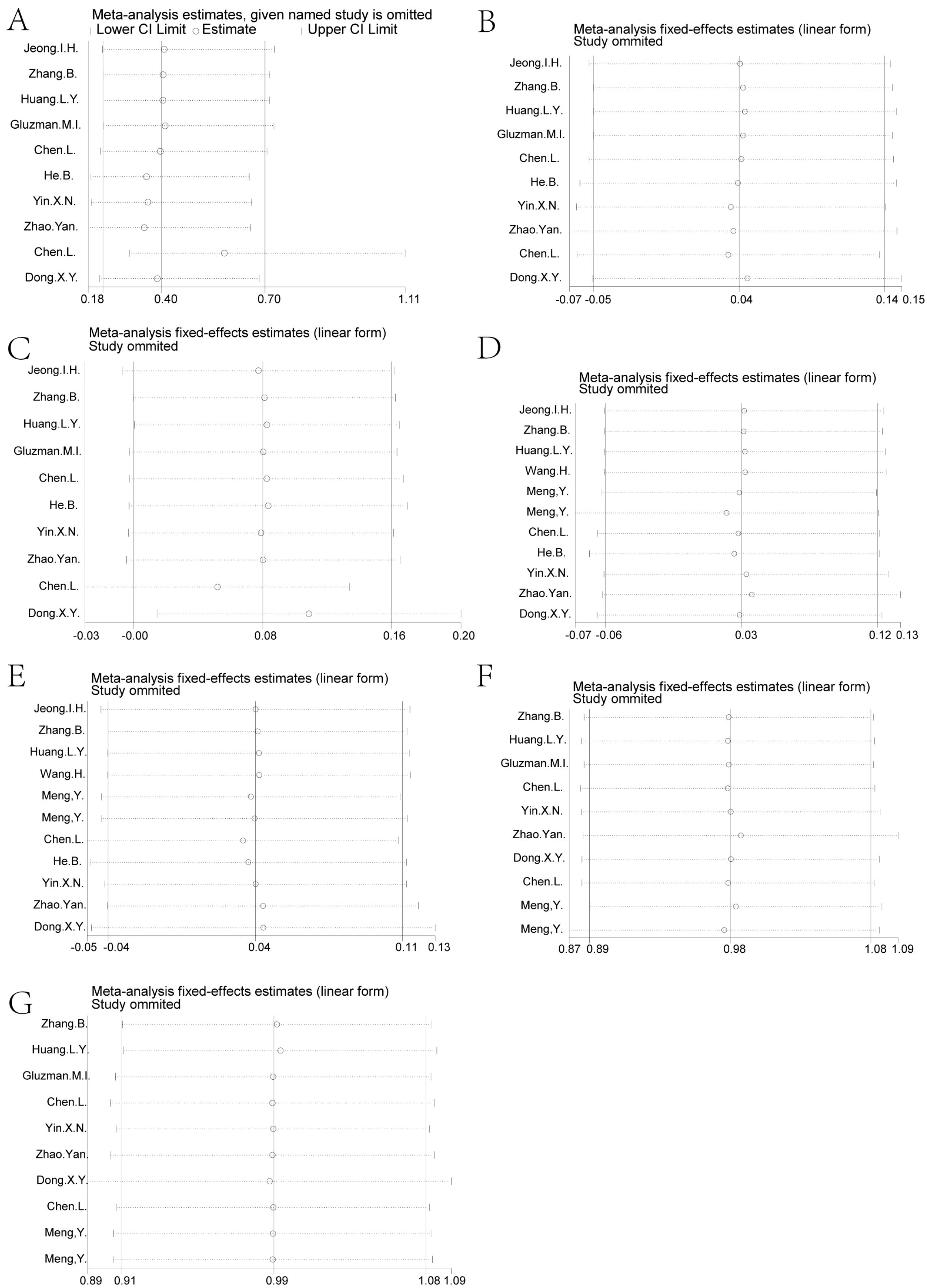

Figure S5 Sensitivity analysis of postoperative complications. (A) Sensitivity analysis of postoperative complications. Meta-analysis of the patients who underwent (B) ER and (C) LR. Meta-analysis of tumor recurrence following (D) ER and (E) LR. Meta-analysis of the R0 resection rates following (F) ER and (G) LR. CI, confidence interval; ER, endoscopic resection; LR, laparoscopic resection.

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