Comparison of laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours: A meta-analysis

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Abstract

Background and Objectives: The aim of the study was to assess the efficacy and safety in treating gastric stromal tumours by laparoscopy combined with gastroscopy positioning surgery.

Methods: I searched the randomized controlled trials (RCTs) about the efficacy and safety of laparoscopy combined with gastroscopy positioning surgery in treating gastric stromal tumours from the PubMed (1998 ~ 2018.06), Wanfang Data (1990 ~ 2018.06), China National Knowledge Infrastructure (1979 ~ 2018.06) and International Statistical Institute (1998 ~ 2018.06). I extracted the data from these trials, and I got the meta-analysis from RevMan 5.3 software.

Results: Twenty-six RCTs involving 1710 patients were included (870 patients in the laparoscopy combined with gastroscopy positioning group and 840 patients in open resection group). Compared with open resection group, this meta-analysis showed that laparoscopy combined with gastroscopy positioning group could reduce the intraoperative blood (P < 0.05), shorten the post-operative time of recovery of intestinal peristalsis (P < 0.05), shorten the diet recovery time (P < 0.05), reduce the incidence of the incision infection, intestinal obstruction and pneumonia and also shorten the post-operation hospital stay (P < 0.05). However, there was no significant difference in the operation time (P > 0.05).

Conclusion: Compared with open resection group, the total effect of laparoscopy combined with gastroscopy positioning group in the treatment of gastric stromal tumours is better. Laparoscopy combined with gastroscopy positioning group for the gastric stromal tumours is acceptable.

Keywords: Efficacy, gastric stromal tumours, gastroscopy, laparoscopy, meta-analysis, open resection, safety

INTRODUCTION

Gastrointestinal stromal tumour (GIST) is the most common mesenchymal neoplasm of the alimentary tract, and the stomach is the most frequently affected site, accounting for roughly 60% ~ 70% of all patients with a GIST. It is known that gastric GIST rarely metastasises to perigastric lymph nodes, in particular, the diameter of...
the tumour was <5 cm; gastric local resection without lymphadenectomy as a standard treatment is acceptable. Minimally invasive surgery has the characteristics of less trauma, less post-operative complications and quick recovery. It is widely used in the clinic. At present, the minimally invasive methods for the treatment of gastric stromal tumours include endoscopic therapy, laparoscopy and combined endoscopic and laparoscopic resection, among which endoscopy is mainly aimed at small diameter and limited growth tumours; the first choice of surgical intervention is needed for patients with larger diameter and malignant potential. Clinical practice shows that compared with open surgery, laparoscopic surgery has the advantages of minimal invasion and quick post-operative recovery, but it has its limitations. We can easily use laparoscopic wedge resection with adequate margins to treat extragastric type submucosal tumours. Due to the difficulty of accurately judging the tumour’s location under laparoscopic examination, it is more problematic for the resection of intragastric type submucosal tumours. Moreover, it results to remove the tumour by removing relatively large sections of the stomach, and it could lead to the post-operative deformity of the stomach. In 2008, it was first reported about the laparoscopic endoscopic cooperative surgery by Hiki et al. and it was designed to resect submucosal tumours originating by a minimally invasive surgical technique. Now, various surgical operations have carried out both in China and abroad; colour Doppler ultrasound, computed tomography, gastroscopy and other related examinations should be used to determine the location, diameter and risk grade of the lesion to provide a basis for the formulation of the surgical plan before the surgery. Conventional endoscopy to the small gastric stromal tumour location is poorer and easy misdiagnosis, and gastroscopy can accurately judge the location of tumour, positioning is easier and can provides a theoretical basis for the minimally invasive treatment of gastric stromal tumour.

Laparoscopy combined with gastroscopy positioning has been gradually matured for the patients with gastric stromal tumours, but compared with the open resection group, it is more controversial that whether the efficacy and safety of laparoscopy combined with gastroscopy positioning for gastric stromal tumours has the existence of the treatment, prognosis, recurrence and follow-up.

In this research, we could provide the reliable evidence for the gastric stromal tumours by the efficacy and safety of patients between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours.

METHODS
In this study, 26 randomized controlled trials (RCTs) were retained for the systematic review and meta-analysis. The object of the research was patients with gastric stromal tumours who were pre-operative ultrasonography and gastroscopy performed and were confirmed by the first biopsy. The articles were all related to laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The observed indexes include the operation time, the intraoperative blood, the post-operative time of recovery of intestinal peristalsis, the post-operation hospital stay and the total hospital stay.

Exclusion criteria
Exclusion criteria were combination of other malignant tumours and organ metastases. The research included patients with non-perforated gastric stromal tumours. No comparison of the two surgical methods between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumors in randomized controlled studies. Specific retrieval methods: we searched from the PubMed (1998 ~ 2018.06), Wanfang Data (1990 ~ 2018.06), China National Knowledge Infrastructure (1979 ~ 2018.06), International Statistical Institute (1998 ~ 2018.06), Chinese keywords of ‘gastric stromal tumors; laparoscopy; gastroscopy : open resection; randomized controlled trials’ and English keywords of ‘gastric stromal tumors; laparoscopy, laparoscopic; open resection; randomized controlled trials’.

Quality assessment of selected literature
The quality assessment used the description of the concealment and blinding from RCT quality standards of Cochrane Reviewers’ Handbook 5.3.

Data extraction and statistical processing
The basic data included the first author, the year of publication, the operation mode and the number of cases. The observation index included the operate time, intraoperative blood, post-operative time of recovery of intestinal peristalsis, the post-operation hospital stay and the total hospital stay. The statistical data were extracted by RevMan 5.3 software package (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). The relative risk (RR) and
95% confidence intervals (CIs) are used to the binary data, and the standardized mean difference (MD) and 95% CI are used to continuous data; the test level was $\alpha = 0.05$. We used the funnel plots to assess whether there is the publication bias.

**RESULTS**

According to the pre-defined retrieval strategy, there were 26 randomized controlled studies\(^{9-34}\) with 1710 cases. Figure 1 and 2 show the risk of bias summary across the included studies. The test group was treated with laparoscopy combined with gastroscopy positioning for gastric stromal tumours with 870 cases, and the control group was treated with open resection for gastric stromal tumours with 840 cases.

**Comparison of the efficacy and safety**

**The operative time**

In this research, 25 studies had the comparison of the operation time between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was statistically significant in the difference test for heterogeneity between studies ($P < 0.00001, I^2 = 98\%$), so we analysed it by a random effects model. It is showed that the difference was not statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (MD = $-2.82$, 95% CI $[-13.15, 7.51], P = 0.59$) [Figure 3].

**The intraoperative blood**

In this research, 26 studies had the comparison of the intraoperative blood between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was statistically significant in the difference test for heterogeneity between studies ($P < 0.00001, I^2 = 95\%$), so we analysed it by a random effects model. It was showed that the difference was statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (MD = $-2.82$, 95% CI $[-13.15, 7.51], P = 0.59$) [Figure 4].

**The post-operative time of recovery of intestinal peristalsis**

In this research, 18 studies had the comparison of the post-operative time of recovery of intestinal peristalsis between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was statistically significant in the difference test for heterogeneity between studies ($P < 0.00001, I^2 = 98\%$), so we analysed it by a random effects model. It is showed that the difference was statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (standardized MD [SMD] = $-2.22$, 95% CI $(-3.29, -1.14), P < 0.05$) [Figure 5].

**Diet recovery time**

In this research, 14 studies had the comparison of the diet recovery time between laparoscopy combined
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Figure 2: Risk of bias graph

Figure 3: The operate time between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours

Figure 4: The intraoperative blood between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours with gastroscopy positioning and open resection for gastric stromal tumours. The difference was statistically significant in the difference test for heterogeneity between studies ($P < 0.00001$, $I^2 = 96\%$), so we analysed it by a
random effects model. It is showed that the difference was statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (SMD = −1.96, 95% CI [−2.76, −1.16], P < 0.05) [Figure 6].

**Incision infection**

In this research, 18 studies had the comparison of the incision infection between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was not statistically significant in the difference test for heterogeneity between studies (P = 1, F = 0), so we analysed it by a fixed-effect model. It is showed that the difference was statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (RR = 0.20, 95% CI [0.11, 0.38], P < 0.05) [Figure 7].

**Intestinal obstruction**

In this research, 7 studies had the comparison of the intestinal obstruction between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was not statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (RR = 0.25, 95% CI [0.09, 0.69], P < 0.05) [Figure 8].

**Pneumonia**

In this research, 10 studies had the comparison of the pneumonia between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was not statistically significant in the difference test for heterogeneity between studies (P = 0.99, F = 0), so we analysed it by a fixed-effect model. It is showed that the difference was statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (RR = 0.31, 95% CI [0.14, 0.70], P < 0.05) [Figure 9].

**The post-operation hospital stay**

In this research, 26 studies had the comparison of the post-operation hospital stay between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was statistically significant in the difference test for heterogeneity between studies (P = 0.99, F = 0), so we analysed it by a fixed-effect model. It is showed that the difference was statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (SMD = −1.96, 95% CI [−2.76, −1.16], P < 0.05) [Figure 10].
combined with gastroscopy positioning and open resection for gastric stromal tumours. The difference was statistically significant in the difference test for heterogeneity between studies ($P < 0.00001, I^2 = 87\%$), so we analysed it by a random effects model. It is showed that the difference was statistically significant between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours (SMD = −1.78, 95% CI [−2.11, −1.45], $P < 0.05$) [Figure 10].

**Figure 7:** Incision infection between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours

**Figure 8:** Intestinal obstruction between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours

**Figure 9:** Pneumonia between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours

**DISCUSSION**

In recent years, minimally invasive treatment has become a major mean for gastric stromal tumours, mainly including gastroscopy treatment, laparoscopic surgery and laparoscopy combined with gastroscopy.
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| Study or Subgroup | Experimental | Control | Std. Mean Difference | Std. Mean Difference |
|-------------------|--------------|---------|----------------------|----------------------|
|                  | N | Mean | SD | Total | Mean | SD | Total | Weight | N | Mean | SD | Total | Mean | SD | Total | Weight |
| Bai et al 2015    | 1 | 4.89 | 0.75 | 6 | 7.93 | 2.04 | 3 | 53 | 4.6% | -0.08 | 0.07 | -0.20 | 1.00 |
| Bhat et al 2015   | 2 | 4.89 | 1.23 | 3 | 1.09 | 2.05 | 26 | 29 | 2.9% | 2.94 | 2.60 | 2.20 | 2.00 |
| Chang et al 2018  | 3 | 8.5 | 2.1 | 8 | 7.9 | 2.5 | 10 | 4.1% | -3.59 | 1.78 | 0.08 | 0.00 |
| Ding et al 2018   | 4 | 9.44 | 1.8 | 9 | 11.9 | 2.6 | 49 | 4.5% | -1.81 | 0.04 | 1.11 | 0.00 |
| Guo et al 2018    | 5 | 6.22 | 2.47 | 27 | 13.1 | 4.79 | 21 | 4.1% | 1.69 | 1.26 | 0.06 | 0.00 |
| Huajing et al. 2018 | 6 | 5.94 | 0.21 | 26 | 6.83 | 0.72 | 26 | 4.2% | 1.65 | 2.26 | 1.82 | 0.00 |
| Hu et al 2017     | 7 | 8.4 | 1.3 | 10 | 11.3 | 3.4 | 13 | 3.0% | -1.91 | 0.75 | 0.00 | 0.00 |
| Jiang et al 2017  | 8 | 4.4 | 1.5 | 5 | 6.3 | 1.6 | 45 | 4.7% | -1.77 | 0.87 | 0.00 | 0.00 |
| Jin et al 2018    | 9 | 6.5 | 1.2 | 8 | 9.8 | 2.1 | 16 | 3.9% | -1.93 | 0.67 | 0.00 | 0.00 |
| Jun et al 2017    | 10 | 4.74 | 1.12 | 21 | 13.6 | 2.4 | 24 | 3.0% | 2.97 | 3.77 | 2.81 | 0.00 |
| Peng et al 2017   | 11 | 6.4 | 1.5 | 37 | 10.2 | 3.1 | 37 | 4.4% | -1.54 | 0.67 | 1.60 | 0.00 |
| Qiu et al 2018    | 12 | 6.5 | 1.19 | 30 | 10.5 | 2.6 | 43 | 4.7% | -1.93 | 2.46 | 0.30 | 0.00 |
| Shao et al 2018   | 13 | 5.5 | 1.7 | 28 | 11.2 | 2.4 | 24 | 4.0% | -2.60 | 3.37 | 1.94 | 0.00 |
| Guo et al 2019    | 14 | 6.89 | 1.25 | 36 | 14.1 | 2.58 | 38 | 4.3% | -4.22 | 3.17 | 0.26 | 0.00 |
| Shi et al 2017    | 15 | 6.14 | 1.22 | 26 | 11.2 | 3.1 | 24 | 3.1% | 2.23 | 3.81 | 1.88 | 0.00 |
| Xu et al 2015     | 16 | 7.9 | 2.4 | 41 | 10.2 | 2.7 | 52 | 4.9% | -2.56 | 2.06 | 0.42 | 0.00 |
| Xue et al 2018    | 17 | 7.28 | 1.86 | 10 | 13.2 | 3.77 | 40 | 4.6% | -1.06 | 1.53 | 0.59 | 0.00 |
| Yu et al 2019     | 18 | 8.26 | 1.42 | 25 | 11.7 | 2.16 | 25 | 4.1% | -1.65 | 1.32 | 0.11 | 0.00 |
| Xue et al 2017    | 19 | 6.19 | 0.70 | 36 | 8.0 | 0.76 | 71 | 4.1% | -1.56 | 0.46 | 0.00 | 0.00 |
| Yang et al 2015   | 20 | 5.12 | 0.96 | 75 | 11.06 | 3.06 | 25 | 4.7% | -2.35 | 1.56 | 1.93 | 0.00 |
| Cheng et al 2016  | 21 | 5.52 | 1.92 | 15 | 6.3 | 2.57 | 15 | 2.9% | -0.75 | 1.48 | 0.00 | 0.00 |
| Xue et al 2015    | 22 | 4.98 | 1.27 | 35 | 10.6 | 2.48 | 30 | 4.0% | -2.77 | 2.17 | 0.12 | 0.00 |
| Zhe et al 2018    | 23 | 7.9 | 0.58 | 30 | 13.4 | 1.2 | 10 | 3.9% | 2.23 | 15.15 | 4.26 | 0.00 |
| Zhu & Huang 2014  | 24 | 6.04 | 1.78 | 24 | 10.1 | 3.2 | 22 | 4.1% | -1.55 | 2.22 | 0.00 | 0.00 |

Total (95% CI) 818 789 100.6% 1.78 (1.21, 1.45)

Heterogeneity test: $I^2 = 55.6\%$; $Q = 23$ (df = 80); $p = 0.00001$;

**Figure 10:** The post-operation hospital stay between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours

**Figure 11:** Funnel plot of the operate time between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours

**Figure 12:** Funnel plot of the intraoperative blood between laparoscopy combined with gastroscopy positioning and open resection for gastric stromal tumours

positioning, such as endoscopic therapy can be used for smaller diameter, growth limited tumours, but compared with laparoscopy combined with gastroscopy positioning, gastroscopy therapy has obvious deficiencies. Intraoperative blood loss, integrity of surgical resection and tumour recurrence rate are not as good as laparoscopic surgery. Laparoscopic surgery is characterized by small trauma and rapid post-operative recovery. Successful laparoscopic wedge resection has been reported for 2–5 cm gastric GISTs and confirmed by studies examining long-term surgical outcomes.\[35-37\] However, it has certain limitations in the treatment of gastric stromal tumours. When tumours are located intragastrically, it is hard to decide the appropriate resection line from the outside of the stomach. Laparoscopic vision is limited, and complete tumour resection cannot be guaranteed. Tumours near the cardiac and pylorus are treated with simple laparoscopic surgery, which is easy to cause cardiac stenosis or pyloric stenosis.\[38\]

With the continuous development of endoscopic and laparoscopic technique, laparoscopic combined endoscopic treatment of gastric stromal tumour is increasing, so we can effectively play the advantages of laparoscopic and endoscopic and make up for the inadequacy of pure laparoscopic surgery.

Laparoscopy combined with gastroscopy positioning has become a major mean for gastric stromal tumours.\[6,39,40\] Laparoscopy combined with gastroscopy positioning for gastric stromal tumours, accurate endoscopic localization, reduces the time for finding the gastric stromal tumours and marks the tumour under gastroscopy. In addition, tumour resection is more complete with double lens combined therapy.
In this study, meta-analysis showed that compared with laparoscopic surgery group, laparoscopy combined with gastroscopy positioning group could reduce the intraoperative blood, shorten the post-operative time of recovery of intestinal peristalsis, shorten the diet recovery time, reduce the incidence of the incision infection, intestinal obstruction and pneumonia and also shorten the post-operation hospital stay. However, there was no...
significant difference in the operation time. Moreover, pure open resection for gastric stromal tumours is difficult, and much tissue which was near the stomach has been removed, and at the same time, the wedge resection of the stomach is overmuch.

Since the inclusion of this study is affected by time and the number of cases, the long-term effect analysis has not been conducted from the follow-up of patients.

With the leap development of the modern technology, full-thickness local excision using laparoscopy combined with gastroscopy positioning in treating gastric stromal tumours is a promising procedure for these cases. Our experience with laparoscopy combined with gastroscopy positioning surgery has confirmed that this procedure is safe and feasible.

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Conflicts of interest There are no conflicts of interest.

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