Journal of Minimal Access Surgery

Home
Current issue
Instructions
Submit article

J Minim Access Surg. 2016 Jul-Sep; 12(3): 199–208. PMCID: PMC4916744
doi: 10.4103/0972-9941.181283

Oncologic value of laparoscopy-assisted distal gastrectomy for advanced gastric cancer: A systematic review and meta-analysis

Paolo Aurello, Andrea Sagnotta, Irene Terrenato,[1] Giammauro Berardi,Giuseppe Nigri, Francesco D'Angelo, and Giovanni Ramacciato

Author information ► Article notes ► Copyright and License information ►

INTRODUCTION

Go to:

Since being first reported by Kitano in 1994,[1] laparoscopic surgery has revolutionised the approach to gastric cancer. Laparascopy-assisted distal gastrectomy (LADG) is increasingly recognised as a viable alternative to conventional open distal gastrectomy (ODG). Various studies have highlighted its short- and long-term benefits in curing early gastric cancer (EGC), with recorded 5-year survival rates exceeding 95%.[2,3,4,5] Similar advantages have been observed with LADG performed for advanced gastric cancer (AGC), such as reduced intraoperative blood loss, fewer postoperative complications and a shorter recovery time.[6,7,8,9] However, LADG for AGC remains controversial because of its uncertain oncological efficacy and limited long-term results regarding the oncologic validity of the procedure as compared to open surgery.[6,9,10]

Therefore, the aim of this study was to evaluate the technical safety and oncological efficacy of LADG for AGC compared with open surgery. A systematic review and a meta-analysis of the most recent data regarding morbidity, mortality and intraoperative and long-terms outcomes were performed.

MATERIALS AND METHODS

Go to:

Search Strategy

The search dates ranged from January 2008 to December 2014 to restrict this review to current practice. The publications were identified by searching the major medical databases PubMed, Medline Ovid, EMBASE and Cochrane Library. The search terms were "gastric cancer OR advanced gastric cancer OR advanced gastric adenocarcinoma AND open distal gastrectomy AND laparoscopic distal gastrectomy OR laparoscopy-assisted distal gastrectomy." Article language was limited to English. The title and abstract of each identified publication were screened and only publications reporting clinical outcomes of interest (specified later) were further retrieved. References from relevant articles and reviews were manually searched.

Inclusion and Exclusion Criteria

Inclusion criteria were as follows:

1. Clinical studies published since 2008 comparing LADG versus ODG;
2. The study being limited to AGC, which was defined as pT ≥2 according to the 5th edition of the TNM Staging System of the American Joint Committee on Cancer (AJCC) and the Union for International Cancer Control (UICC);
3. A sample size of minimum 25 patients for each of the two groups referring only or predominantly to AGC;
4. The study had to contain long-term outcomes as defined later.

Exclusion criteria were as follows:

1. No ODG as a control group;
2. Robotic or robotic-assisted distal gastrectomy, laparoscopic total or proximal gastrectomy;
3. Distal gastrectomy for EGC, non-primary gastric cancer or benign gastric diseases.

Type of Surgery

LADG performed with a small incision to facilitate the procedure or to use a hand port, was included in the laparoscopic group. We considered as open gastrectomy all procedures described as "conventional" or "open" and performed through a standard upper abdominal laparotomy incision.

Measured Outcomes and Definitions

The measured outcomes of the eligible studies were defined as:

1. Postoperative morbidity and mortality;
2. Oncologic surgery-related outcomes: number of lymph nodes retrieved, proximal and distal tumour margins (cm), positive resection margin;
3. Long-term oncologic outcomes: tumour recurrence rate and site of recurrence, cancer-related mortality rate, overall survival (OS) and disease-free survival (DFS).

Quality of Literature

We used the Newcastle-Ottawa Quality Assessment Scale (NOS) for quality assessment of observational studies.[11] A threshold of 6 stars or above has been considered indicative of high quality.

Data Extraction and Collection

Two reviewers independently extracted and collected in an electronic database the following data from each study: author; country; year of publication; study type and period; patient's number and baseline characteristics [age, sex, body mass index (BMI), previous abdominal surgery]; tumour characteristics (location, size, histology, grade of differentiation, pTNM and/or Stage data); treatment factors (type of reconstruction, level of lymphadenectomy, use of adjuvant chemotherapy); length of follow-up and measured outcomes.

Statistics

A formal systematic review and a meta-analysis were performed in line with recommendations from the Cochrane Collaboration. Statistical analysis was perfomred using the Review Manage version 5.2 (RevMan 5.2) software downloaded from Cochrane Library. Meta-analysis of continuous variables was conducted with the generic inverse-variance method by using mean difference (MD), whereas dichotomous variables were estimated with the Mantel-Haenszel method using odds ratio (OR) as the summary statistic. If the study provided medians and ranges, we estimated the means and standard deviations (SDs) as described by Hozo *et al*.[12] Each estimate was reported with its relative 95% confidence intervals (CI) and was considered statistically significant at the level of P value <0.05. Data were pooled using the fixed-effects model. Heterogeneity, which refers to diversity in a sense that is relevant for a clinical situation, was assessed across studies using the I^2 statistic and we considered as statistically significant a $P < 0.10$. If there was evidence of substantial heterogeneity, greater emphasis was placed on the random-effects model.

RESULTS

Go to:

Eligible Studies

According to the search strategy, the literature review yielded a total of 278 potential studies that matched the predetermined criteria. After the titles and abstracts had been reviewed, 261 papers were excluded. The main causes of exclusion were as follows: absence of comparative ODG group, inclusion of total gastrectomy, inclusion of EGC, and no long-term outcomes. Seventeen studies[13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29] were retrieved for a full-text evaluation and eight of these (six comparative and two case-control studies published between 2008 and 2013) finally matched the inclusion criteria and were considered suitable for our analysis.[22,23,24,25,26,27,28,29] They included data from four different countries (three from China, three from South Korea, one from Italy and one from Japan). According to the NOS, two of the eight observational studies got 6 stars, two articles got 7 stars, three articles got 8 stars and one article got 9 stars. The general characteristics and the quality assessment score of the eligible studies are summarised in Table 1.

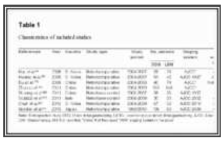


Table 1
Charateristics of included studies

Clinicopathological Characteristics

A total of 1456 patients were enrolled, of whom 678 underwent LADG and 778 underwent ODG, and were included in our meta-analysis. None of the studies demonstrated a statistically significant difference between the two groups in terms of age, sex distribution or BMI.

Regarding the preoperative clinical criteria used to select patients for LADG, all but one[23] reported such information. Three studies[22,25,26] confined indication to cT2N0-1 patients, while the last four studies extended indication to cT3 tumours[24,27,28,29] [Table 1]. All studies reported detailed staging information, using the AJCC/UICC staging system. Two studies[22,25] exclusively included patients with T2 tumours, three studies[24,27,28] included pT ≥ 2a patients, and three studies[23,26,29] included some pT1 patients, too. In most studies the staging distribution in the LADG and ODG groups was comparable. However, Gordon *et al*.[24] report a higher proportion of advanced stage in the ODG group compared to LADG (not tested statistically). All but one study[29] included descriptions on cancer location within the stomach. Gordon*et al*. and Hur *et al*. reported a statistically significant difference in tumour location between LADG and ODG.[24,25]

All but two studies[24,28] reported information about tumour size, and Hur *et al*. and Hwang *et al*.[25,26] reported a statistically significant difference between the two groups (P = 0.005 and P<0.001, respectively).

Finally, three studies[25,26,29] included information about the use of adjuvant chemotherapy without any statistically significant difference between the two groups [Table 1].

Morbidity and Mortality

All studies reported data on postoperative morbidity.[22,23,24,25,26,27,28,29] The median (range) morbidity rate was 8.5% (5.7-15.5%) and 12.5% (8.5-26.6%) in LADG and ODG groups respectively. Three studies[24,27,29] showed a statistically significant difference between the two groups and the meta-analysis of the included studies confirmed this difference (OR 0.59; 95% CI = 0.42-0.83; P < 0.002; Figure 1].

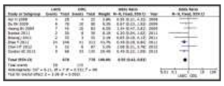


Figure 1
Meta-analysis of the pooled data: Overall morbidity

Six studies[22,24,27,28,29] reported postoperative mortality rates. The majority of the studies defined mortality as in-hospital mortality, while Gordon *et al*.[24] specified a 30-day mortality rate. In our study rates were 0-2.2% for LADG and from 0-1.2% for ODG respectively, and no significant differences were found (OR 1.22; 95% CI = 0.28-5.29, P = 0.79) between the two groups [Figure 2].

Figure 2
Meta-analysis of the pooled data: Postoperative mortality

Oncologic Surgical-related Parameters

All studies reported details of their operative technique.[22,23,24,25,26,27,28,29] The most common steps of operation performed extracorporeally were transection and reconstruction. The type of reconstruction (Billroth I or II, Roux-en-Y) varied, as did the type of mini-laparotomy. All studies reported details on level of lymphadenectomy. [22,23,24,25,26,27,28,29] Five studies included exclusively D2 lymphadenectomy.

[22,23,25,27,28] Three studies[24,26,29] described a D1 resection in a total of 16 cases (1%) and a D1+ resection (D1+a: D1+ N°7; D1+b: D1+N°7, 8a and 9) in 162 cases (11.1%), including 67 cases (9.88%) in the LADG group and 95 cases (12.2%) in the ODG group. Gordon *et al.*[24] reported three cases of D0 resection in the ODG group [Table 2]. Therefore, a formal D2 lymphadenectomy was performed in 605 patients (89.23%) and 667 patients (85.73%) in LADG and ODG groups respectively without statistical differences (P = 0.72).

Table 2

Summary of laparoscopic technique

No significant difference was found between the two groups regarding the number of harvested lymph nodes (MD 0.60; 95% CI = −0.67-1.86, P = 0.35; Figure 3). The mean number of retrieved lymph nodes was greater than 23 and 21 nodes in the LADG and ODG groups respectively.[22,23,24,25,26,27,28,29]

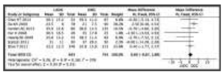


Figure 3

Meta-analysis of the pooled data: Number of harvested lymph nodes

Seven studies reported data on surgical resection margins.[22,23,25,26,27,28,29] Four studies[23,26,27,28] specified that all resections were with free tumour margin in both LADG and ODG groups [Table 2]. Proximal (MD: −0.28; 95% CI = −0.72-0.16, P = 0.22) and distal resection margins (MD: 0.08; 95% CI: −0.16-0.33,P = 0.51) were not significantly different between the two groups (P= 0.22 and P = 0.51 respectively).[22,25,26,29]

Long-term Parameters

Recurrence rate Six studies reported data about tumour recurrence rates ranging 7.7-42.5% for LADG and 10.4-45% for ODG.[22,23,24,25,26,29] Meta-analysis found no significant differences between the two groups (OR: 0.85, 95% CI, 0.66-1.09, P = 0.20) [Figure 4]. In the studies reporting site of recurrence, lymph nodes were the most frequent in both groups (four in LADG and 10 in ODG respectively).[22,25] Hwang *et al.*[26] reported a port-site recurrence 10 months after LADG. Zhao *et al.*[29] reported a case of port-site recurrence 13 months after LADG in that group; a case of incision metastasis and a case of metastasis in the orifice of the abdominal drain tube 27 months and 9 months, respectively, after ODG in that group. The available data about specific recurrent sites are summarised in Table 3.

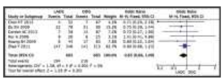
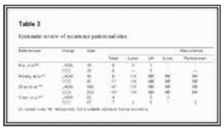


Figure 4

Meta-analysis of the pooled data: Recurrences

Table 3

Systematic review of recurrence pattern and sites



Cancer-related mortality Four studies[24,25,26,29] analysed the cancer-related mortality and the meta-analysis showed no significant difference between LADG and ODG (OR 0.79; 95% CI = 0.60-1.05, *P* = 0.11) [Figure 5a].

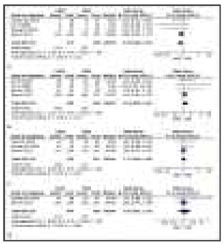


Figure 5
Meta-analysis of the pooled data: long term-outcomes: (a) Cancer-related mortality (b) 3-year OS (c) 5-year OS (d) 5-year DFS

Survival rates Follow-up ranged widely between 1 month and 146 months. Seven studies reported postoperative survival rates and demonstrated no statistically significant difference between the two groups.[22,23,24,25,27,28,29] Shuang *et al.*[28] did not report specific survival rates but they also found no significant difference in the survival rates between the two groups after 50 months of follow-up (*P* = 0.316). Meta-analysis of available data demonstrated that OS was not significantly different between LADG and ODG groups (3-year: OR 1.24, 95% CI: 0.95-1.63, *P* = 0.11; 5-year: OR 1.11, 95% CI: 0.84-1.46, *P* = 0.47) and nor was the 5-year DFS (OR: 1.07; 95% CI 0.81-1.43, *P* = 0.62). The systematic review and meta-analysis of long-term outcomes are summarised in Table 4 and Figure 5b–d.

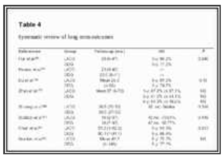


Table 4
Systematic review of long-term outcomes

Publication Bias

Funnel plots were constructed for each outcome and these showed symmetry, suggesting that publication bias was not substantial and was unlikely to drive any conclusions made [Figure 6].

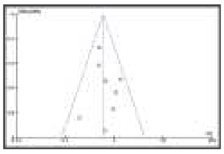


Figure 6
Funnel plot of the overall postoperative complications

DISCUSSION

Go to:

Several reports and meta-analyses, especially from Eastern countries, revealed the efficacy and compatibility of laparoscopic gastrectomy in managing EGC.[2,3,4,5,30,31,32] Reduced trauma, quick recovery, limited analgesic requirement and shorter hospital stay are some of the well-known benefits of this procedure.[2,3,4,5] Focusing attention on AGC, many surgeons are still reluctant to use laparoscopy, mainly because of its technical difficulty and oncologic inadequacy. Nevertheless, cumulative data have emerged on the safety of LADG when compared with ODG for AGC, but adequacy of lymphadenectomy, surgical margins and long-term results are not well investigated.[6,7,8] We therefore decided to perform a systematic review of the literature in order to analyse evidences available in the literature; together with the finally included articles, two recent systematic reviews and meta-analyses were retrieved concerning the topic of interest.[33,34] Despite this, we believe that these publications have some limitations that allowed us to perform the present study: in 2013, Chen *et al.*[34] performed a meta-analysis evaluating the outcomes of LADG and ODG for AGC, but they included in their analysis total and proximal gastrectomies, influencing perioperative outcomes that are therefore biased by a non-selected subgroup of patients according to the procedure; furthermore, the survival analysis is biased by the inclusion of the total and proximal gastrectomy patients. In 2014, Cheng *et al.*[33] performed a study that could be similar to the one herein presented; this study is biased by the inclusion of articles reporting outcomes of EGCs in patients, as is well known from the literature, who have a very good prognosis compared to the AGC patients. Therefore, we decided that it was timely and appropriate to perform a systematic review and meta-analysis concerning only distal gastrectomies for exclusively AGC patients.

Our study synthesised the existing non-randomised control trial (RCT) studies with strictly inclusion and exclusion criteria to investigate the oncologic value of LADG for the treatment of AGC. We identified six comparative and two case-control, recently published studies that have compared LADG versus ODG for AGC patients.[22,23,24,25,26,27,28,29] These studies were published within the last few years (2008-2013) and these got 6 or more stars according to the NOS quality score. Therefore, the systematic review and meta-analysis of morbidity, mortality, relevant features of surgery, recurrence and survival rates will produce a more comprehensive and objective evaluation of the current status of LADG in treating AGC.

A significantly different postoperative morbidity rate and a higher non-significant postoperative mortality rate had been reported in patients undergoing ODG compared to LADG. These results are consistent with the well-known short-term advantages of LADG and are similar to those of some recent meta-analyses.[9,33,34,35]

The key point and major challenge for a LADG is a systematic lymphadenectomy. Some controversies still exist about the oncologic superiority of D2 to D1 lymphadenectomy.[36,37] Western and Asian scholars have different views on D2 radical surgery: in the Western world, the real benefit of a D2 lymphadenectomy is not well recognised, while Asian countries, represented primarily by Japan, present radical resection with the clearance of D2 lymphadenectomy and a tumour-free margin at least 5 cm as the standard treatment for gastric cancer.[36,37,38,39,40] In our study, the D2 lymphadenectomy was performed in a total 87.3% of patients. Hwang *et al.*,[26] Zhao *et al.*[29] and Gordon *et al.*[24] performed D1, D1+a (D1+ N°7) or D1+b (D1+N°7, 8a and 9) in older and high-risk patients. Moreover, Gordon *et al.*[24] described three cases of a D0 resection in the ODG group. These differences in surgical extent, although not statistically significant, make it problematic to compare the quality of surgical treatment in these groups. Therefore, the number of retrieved lymph nodes is an objective indicator for evaluating lymphadenectomy in gastric cancer. Some authors reported that conventional open surgery is superior to laparoscopic surgery[10,31,41] in extraperigastric lymphadenectomy, especially in station N° 7, 8, 9 and 11. However, Song *et al.*[42] have reported a similar number of retrieved lymph nodes in station N° 7, 8a, 9, 11p, 12a and 14v. In recent years, with improved equipment and increased surgeon experience, the number of lymph nodes dissected by laparoscopic gastrectomy has gradually increased. Our work shows no study with a mean number of dissected lymph nodes of less than 23 and 21 nodes in the LADG and ODG groups respectively, and meta-analysis revealed that there was no evident difference in the number of lymph nodes dissected between two groups. This analysis suggests that pathological staging is not compromised. These results are different from the data of some previous meta-analyses.[9,30,31,32,43] The reasonable explanation for this is that we included studies with a minimum of 25 LADGs performed in specialised centres after their initial learning curve of LADG. Therefore, we believe that the lymph node dissection was adequate for AGC and our results are not influenced by the learning curve issue. Another concern regarding oncological efficacy relates to the surgical margin. Our results suggest similar proximal and distal margins between LADG and ODG groups.

The long-term results were similar in the LADG and ODG groups. Gastric cancer-related mortality, recurrence and survival rates (OS and DFS) are key factors for evaluating the oncological benefit of surgical intervention. Our systematic review and meta-analysis of the selected studies showed no significant differences in OS and DFS rates between the LADG and ODG groups, nor was any significant difference found in terms of gastric cancer-related mortality or recurrence. These findings are consistent with data reported from a previous meta-analysis with a larger-population study but including total and proximal gastrectomies.[34] The concern about dissemination of gastric cancer due to pneumoperitoneum and port site metastases, although that is quite rare, was seen in two of the included studies;[26,29] however, there were also two cases of wound metastasis in the OG group.[29]

However, several limitations must be taken into account. First, the enrolled studies are non-randomised retrospective trials, with various degrees of inter- and intra-study heterogeneity. To decrease this bias effect on outcomes, we used a random- or fixed-effects model as appropriate, and the heterogeneity test showed substantial homogeneity between the groups. Moreover, visual inspection of the constructed funnel plots revealed substantial symmetry, indicating no serious publication bias.

The studies mainly varied in terms of patient selection, staging and indication to LADG. All studies but one[27] were from Asian countries because of their high incidence of gastric cancer. Patient characteristics such as BMI and comorbidities are different between Western and Eastern countries. This fact may distort the results, above all for lymph node retrieval and morbidity rate. Tumour depth and nodal status are the main prognostic factors influencing long-term outcomes. Two of the analysed studies[22,25,26] reported the data of exclusively T2 patients, while Du *et al.*[23] and Hwang *et al.*[26] reported a total of 11 and 9 T1 patients in LADG and ODG, respectively. Patients with nodal involvement, such as stage III-IV, were mainly represented in the ODG group, although Gordon *et al.*[24] excluded stage IIIb or IIIc tumours in the survival analysis. Hence, this staging distribution could represent a bias, and analysis of the long-terms outcomes must be interpreted carefully. In addition, postoperative adjuvant chemotherapy has demonstrated a survival benefit when compared to treatment with surgery alone.[44,45] However, only three of the included studies report such information,[25,26,29] which might have affected the results.

CONCLUSION

Go to:

The current study supports that LADG for ADG is a safe procedure with lower postoperative morbidity. Moreover, adequate lymphadenectomy, long-term outcomes such as cancer-related mortality, recurrence and survival rates appear equivalent to ODG. These results should be verified by well-designed, large-sample randomised clinical trials. It is important to note that LADG is a complex procedure and we believe that, for assisted distal gastrectomy, it should be offered only in specialised centres, especially in Western countries where patients have higher BMI and associated comorbidities.

Financial Support and Sponsorship

Nil.

Conflicts of Interest

There are no conflicts of interest.

REFERENCES

Go to:

1. Kitano S, Iso Y, Moriyama M, Sugimachi K. Laparoscopy-assisted Billroth I gastrectomy. Surg Laparosc Endosc. 1994;4:146–8. [PubMed]

2. Lee JH, Han HS, Lee JH. A prospective randomized study comparing open vs laparoscopy-assisted distal gastrectomy in early gastric cancer: Early results. Surg Endosc. 2005;19:168–73.[PubMed]

3. Kim HH, Hyung WJ, Cho GS, Kim MC, Han SU, Kim W, et al. Morbidity and mortality of laparoscopic gastrectomy versus open gastrectomy for gastric cancer: An interim report: A phase III multicenter, prospective, randomized Trial (KLASS Trial) Ann Surg. 2010;251:417–20. [PubMed]

4. Kim YW, Baik YH, Yun YH, Nam BH, Kim DH, Choi IJ, et al. Improved quality of life outcomes after laparoscopy-assisted distal gastrectomy for early gastric cancer: Results of a prospective randomized clinical trial. Ann Surg. 2008;248:721–7. [PubMed]

5. Lee JH, Yom CK, Han HS. Comparison of long-term outcomes of laparoscopy-assisted and open distal gastrectomy for early gastric cancer. Surg Endosc. 2009;23:1759–63. [PubMed]

6. Huscher CG, Mingoli A, Sgarzini G, Sansonetti A, Di Paola M, Recher A, et al. Laparoscopic versus open subtotal gastrectomy for distal gastric cancer: Five-year results of a randomized prospective trial. Ann Surg. 2005;241:232–7. [PMC free article] [PubMed]

7. Cai J, Wei D, Gao CF, Zhang CS, Zhang H, Zhao T. A prospective randomized study comparing open versus laparoscopy-assisted D2 radical gastrectomy in advanced gastric cancer. Dig Surg. 2011;28:331–7. [PubMed]

8. Moisan F, Norero E, Slako M, Varas J, Palominos G, Crovari F, et al. Completely laparoscopic versus open gastrectomy for early and advanced gastric cancer: A matched cohort study. Surg Endosc.2012;26:661–72. [PubMed]

9. Vinuela EF, Gonen M, Brennan MF, Coit DG, Strong VE. Laparoscopic versus open distal gastrectomy for gastric cancer: A meta-analysis of randomized controlled trials and high-quality nonrandomized studies. Ann Surg. 2012;255:446–56. [PubMed]

10. Miura S, Kodera Y, Fujiwara M, Ito S, Mochizuki Y, Yamamura Y, et al. Laparoscopy-assisted distal gastrectomy with systemic lymph node dissection: A critical reappraisal from the viewpoint of lymph node retrieval. J Am Coll Surg. 2004;198:933–8. [PubMed]

11. Athanasiou T, Al-Ruzzeh S, Kumar P, Crossman MC, Amrani M, Pepper JR, et al. Off-pump myocardial revascularization is associated with less incidence of stroke in elderly patients. Ann Thorac Surg. 2004;77:745–53. [PubMed]

12. Hozo SP, Djulbegovic B, Hozo I. Estimating the mean and variance from the median, range, and the size of a sample. BMC Med Res Methodol. 2005;5:13. [PMC free article] [PubMed]

13. Kim HH, Han SU, Kim MC, Hyung WJ, Kim W, Lee HJ, et al. Korean Laparoscopic Gastrointestinal Surgery Study (KLASS) Group. Prospective randomized controlled trial (phase III) to comparing laparoscopic distal gastrectomy with open distal gastrectomy for gastric adenocarcinoma (KLASS 01) J Korean Surg Soc. 2013;84:123–30. [PMC free article] [PubMed]

14. Lee JH, Lee CM, Son SY, Ahn SH, Park do J, Kim HH. Laparoscopic versus open gastrectomy for gastric cancer: Long-term oncologic results. Surgery. 2014;155:154–64. [PubMed]

15. Lee JH, Son SY, Lee CM, Ahn SH, Park do J, Kim HH. Morbidity and mortality after laparoscopic gastrectomy for advanced gastric cancer: Results of a phase II clinical trial. Surg Endosc.2013;27:2877–85. [PubMed]

16. Nam BH, Kim YW, Reim D, Eom BW, Yu WS, Park YK, et al. Laparoscopy assisted versus open distal gastrectomy with d2 lymph node dissection for advanced gastric cancer: Design and rationale of a phase II randomized controlled multicenter trial (COACT 1001) J Gastric Cancer. 2013;13:164–71. [PMC free article] [PubMed]

17. Takiguchi S, Fujiwara Y, Yamasaki M, Miyata H, Nakajima K, Sekimoto M, et al. Laparoscopy-assisted distal gastrectomy versus open distal gastrectomy. A prospective randomized single-blind study. World J Surg. 2013;37:2379–86. [PubMed]

18. Wang W, Chen K, Xu XW, Pan Y, Mou YP. Case-matched comparison of laparoscopy-assisted and open distal gastrectomy for gastric cancer. World J Gastroenterol. 2013;19:3672–7.[PMC free article] [PubMed]

19. Zhao XF, Jeong O, Jung MR, Ryu SY, Park YK. A propensity score-matched case-control comparative study of laparoscopic and open extended (D2) lymph node dissection for distal gastric carcinoma. Surg Endosc. 2013;27:2792–800. [PubMed]

20. Chen QY, Huang CM, Lin JX, Zheng CH, Li P, Xie JW, et al. Laparoscopy-assisted versus open D2 radical gastrectomy for advanced gastric cancer without serosal invasion: A case control study. World J Surg Oncol. 2012;10:248. [PMC free article][PubMed]

21. Huang JL, Wei HB, Zheng ZH, Wei B, Chen TF, Huang Y, et al. Laparoscopy-assisted D2 radical distal gastrectomy for advanced gastric cancer. Dig Surg. 2010;27:291–6. [PubMed]

22. Chun HT, Kim KH, Kim MC, Jung GJ. Comparative study of laparoscopy-assisted versus open subtotal gastrectomy for pT2 gastric cancer. Yonsei Med J. 2012;53:952–9. [PMC free article][PubMed]

23. Du XH, Li R, Chen L, Shen D, Li SY, Guo Q. Laparoscopy-assisted D2 radical distal gastrectomy for advanced gastric cancer: Initial experience. Chin Med J (Engl) 2009;122:1404–7. [PubMed]

24. Gordon AC, Kojima K, Inokuchi M, Kato K, Sugihara K. Long-term comparison of laparoscopy-assisted distal gastrectomy and open distal gastrectomy in advanced gastric cancer. Surg Endosc. 2013;27:462–70. [PubMed]

25. Hur H, Jeon HM, Kim W. Laparoscopy-assisted distal gastrectomy with D2 lymphadenectomy for T2b advanced gastric cancers: Three years' experience. J Surg Oncol. 2008;98:515–9.[PubMed]

26. Hwang SI, Kim HO, Yoo CH, Shin JH, Son BH. Laparoscopic-assisted distal gastrectomy versus open distal gastrectomy for advanced gastric cancer. Surg Endosc. 2009;23:1252–8. [PubMed]

27. Scatizzi M, Kroning KC, Lenzi E, Moraldi L, Cantafio S, Feroci F. Laparoscopic versus open distal gastrectomy for locally advanced gastric cancer: A case-control study. Updates Surg. 2011;63:17–23.[PubMed]

28. Shuang J, Qi S, Zheng J, Zhao Q, Li J, Kang Z, et al. A case-control study of laparoscopy-assisted and open distal gastrectomy for advanced gastric cancer. J Gastrointest Surg. 2011;15:57–62.[PubMed]

29. Zhao Y, Yu P, Hao Y, Qian F, Tang B, Shi Y, et al. Comparison of outcomes for laparoscopically assisted and open radical distal gastrectomy with lymphadenectomy for advanced gastric cancer. Surg Endosc. 2011;25:2960–6. [PubMed]

30. Chen XZ, Hu JK, Yang K, Wang L, Lu QC. Short-term evaluation of laparoscopy-assisted distal gastrectomy for predictive early gastric cancer: A meta-analysis of randomized controlled trials.Surg Laparosc Endosc Percutan Tech. 2009;19:277–84. [PubMed]

31. Hosono S, Arimoto Y, Ohtani H, Kanamiya Y. Meta-analysis of short-term outcomes after laparoscopy-assisted distal gastrectomy.World J Gastroenterol. 2006;12:7676–83. [PMC free article][PubMed]

32. Ohtani H, Tamamori Y, Noguchi K, Azuma T, Fujimoto S, Oba H, et al. A meta-analysis of randomized controlled trials that compared laparoscopy-assisted and open distal

gastrectomy for early gastric cancer. J Gastrointest Surg. 2010;14:958–64. [PubMed]

33. Cheng Q, Pang TC, Hollands MJ, Richardson AJ, Pleass H, Johnston ES, et al. Systematic review and meta-analysis of laparoscopic versus open distal gastrectomy. J Gastrointest Surg.2014;18:1087–99. [PubMed]

34. Chen K, Xu XW, Mou YP, Pan Y, Zhou YC, Zhang RC, et al. Systematic review and meta-analysis of laparoscopic and open gastrectomy for advanced gastric cancer. World J Surg Oncol.2013;11:182. [PMC free article] [PubMed]

35. Ding J, Liao GQ, Liu HL, Liu S, Tang J. Meta-analysis of laparoscopy-assisted distal gastrectomy with D2 lymph node dissection for gastric cancer. J Surg Oncol. 2012;105:297–303.[PubMed]

36. Bonenkamp JJ, Hermans J, Sasako M, van de Velde CJ, Welvaart K, Songun I, et al. Extended lymph-node dissection for gastric cancer. N Engl J Med. 1999;340:908–14. [PubMed]

37. Bonenkamp JJ, Songun I, Hermans J, Sasako M, Welvaart K, Plukker JT, et al. Randomised comparison of morbidity after D1 and D2 dissection for gastric cancer in 996 Dutch patients. Lancet.1995;345:745–8. [PubMed]

38. Cuschieri A, Fayers P, Fielding J, Craven J, Bancewicz J, Joypaul V, et al. Postoperative morbidity and mortality after D1 and D2 resections for gastric cancer: Preliminary results of the MRC randomised controlled surgical trial. The Surgical Cooperative Group. Lancet. 1996;347:995–9. [PubMed]

39. Songun I, Putter H, Kranenbarg EM, Sasako M, van de Velde CJ. Surgical treatment of gastric cancer: 15-year follow-up results of the randomised nationwide Dutch D1D2 trial. Lancet Oncol.2010;11:439–49. [PubMed]

40. Nakajima T. Gastric cancer treatment guidelines in Japan.Gastric Cancer. 2002;5:1–5. [PubMed]

41. Liang Y, Li G, Chen P, Yu JZhang C. Laparoscopic versus open gastrectomy for early distal gastric cancer: A meta-analysis.ANZ J Surg. 2011;81:673–80. [PubMed]

42. Song KY, Kim SN, Park CH. Laparoscopy-assisted distal gastrectomy with D2 lymph node dissection for gastric cancer: Technical and oncologic aspects. Surg Endosc. 2008;22:655–9.[PubMed]

43. Kodera Y, Fujiwara M, Ohashi N, Nakayama G, Koike M, Morita S, et al. Laparoscopic surgery for gastric cancer: A collective review with meta-analysis of randomized trials. J Am Coll Surg.2010;211:677–86. [PubMed]

44. Sakuramoto S, Sasako M, Yamaguchi T, Kinoshita T, Fujii M, Nashimoto A, et al. Adjuvant chemotherapy for gastric cancer with S-1, an oral fluoropyrimidine. N Engl J Med. 2007;357:1810–20.[PubMed]

45. Bang YJ, Kim YW, Yang HK, Chung HC, Park YK, Lee KH, et al. CLASSIC trial investigators. Adjuvant capecitabine and oxaliplatin for gastric cancer after D2 gastrectomy

(CLASSIC): A phase 3 open-label, randomised controlled trial. Lancet.2012;379:315–21. [PubMed]