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Original research

Laparoscopic distal gastrectomy reduced surgical site infection as compared with open distal gastrectomy for gastric cancer in a meta-analysis of both randomized controlled and case-controlled studies

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HIGHLIGHTS

- This meta-analysis focused on the specific postoperative complications.
- Surgical site infection was significantly less in LDG than in ODG.
- Especially, wound infection was significantly less in LDG than in ODG.

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ABSTRACT

Background: In some meta-analyses of randomized controlled trials (RCTs), laparoscopic or laparoscopy-assisted distal gastrectomy (LDG) had several short-term advantages. However, several specific postoperative complications (PCs) were not analyzed sufficiently.
Methods: RCTs and case-controlled studies (CCSs) comparing postoperative complications between LDG and open distal gastrectomy (ODG) were identified in PubMed and Embase. Studies in which patients' status, extent of lymph-node dissection, or reconstruction procedures were matched between the groups were included in a meta-analysis. Postoperative complications such as surgical-site infection (SSI; which included wound infection and intra-abdominal abscess), leakage, anastomotic stenosis, bleeding, ileus, delayed gastric emptying, pneumonia were evaluated in a meta-analysis performed using Review Manager version 5.2 software.
Result: This meta-analysis included a total of 2144 patients (1065 underwent LDG and 1079 underwent ODG) from 5 RCTs and 13 CCSs. SSI and wound infections were reported in 14 studies, and the incidences were significantly lower in LDG than in ODG (n = 1737; odds ratio [OR] 0.50, 95% confidence interval [CI] 0.29–0.85, P = 0.01, I^2 = 0%, and OR 0.46, 95% CI 0.24–0.88, P = 0.02; I^2 = 0%). There were no significant differences in intra-abdominal abscess or other specific complications between the procedures.
Conclusion: LDG was associated with a lower incidence of SSI, especially wound infection, as compared with ODG in a meta-analysis of both RCTs and CCSs.

1. Introduction

Laparoscopic or laparoscopy-assisted distal gastrectomy (LDG) is an established minimally invasive procedure for the treatment of gastric cancer, especially in Eastern Asia. However, treatment guidelines in Japan have not yet designated LDG as a standard procedure. Five meta-analyses of randomized controlled trials (RCTs) comparing LDG with conventional open distal gastrectomy (ODG) showed several short-term advantages of LDG, such as less pain and lower operative bleeding [1–5]. The incidences of overall postoperative complications (PCs) were significantly lower in LDG than in ODG in 4 of the meta-analyses [2–5], excluding the oldest study, which included the fewest patients [1]. However, the

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definition of "overall PCs" was unclear in some of the studies. One study included minor complications such as pleural effusion, atelectasis, hepatic or renal complications, and urinary tract infections in the category of "overall PCs," while another included only abdominal complications. Therefore, a comparison of "overall PCs" might be not reliable. Specific PCs such as surgical-site infection (SSI), leakage, or ileus should be evaluated in a meta-analysis. In addition, several RCTs included D1 lymph-node dissection, which is indicated only for limited early cancer according to the Japanese gastric cancer treatment (JGCT) guidelines 2010 [6]. Moreover, meta-analyses of small RCTs are of controversial quality and may be unreliable and underpowered to compare different surgical treatments.

Two meta-analyses including both RCTs and case-controlled studies (CCSs) that compared LDG with ODG have been reported by other investigators. In an analysis of patients with early gastric cancer, LDG was associated with significantly less overall PCs than ODG [7]. In another meta-analysis, the incidences of medical PCs (cardiovascular, respiratory, or metabolic events) and minor surgical PCs (wound complications, bleeding, ileus, delayed gastric emptying, and anastomotic stenosis) were significantly lower in LDG than in ODG, although the incidence of major surgical PCs (anastomotic leakage, intra-abdominal abscess) did not differ significantly between the groups [8]. However, these meta-analyses had several critical flaws in the comparison of PCs. The extent of lymph-node dissection or the reconstruction procedure was mismatched in some of the studies included in meta-analysis, although both of these factors can be associated with PCs. In addition, specific PCs were not evaluated.

To clarify differences in specific PCs between LDG and ODG, we conducted the present meta-analysis. We included RCTs as well as CCSs in which age, gender, physical status, tumor stage, extent of lymph-node dissection, and reconstruction procedure were all matched. In addition, we included studies of D1+ or D2 lymph-node dissection in accordance with the JGCT guidelines 2010 [6], because these procedures involve a more difficult technique than D1 dissection and are essential for accreditation as a certificated surgeon for LDG in Japan. The most important endpoint of meta-analyses is overall or disease-free survival. In the most previous RCTs and CCSs, however, survival curves were based on the outcomes of patients with various tumor stages [9–19]. Therefore, comparing survival among meta-analyses may have poor quality. We therefore focused our meta-analysis on only PCs and not other problems.

2. Materials and methods

2.1. Study selection

A publication search was carried out in the PubMed and Embase database to identify studies published from 1994 through 2013. Search terms included "laparoscopic," "gastrectomy," and "gastric cancer." Studies were excluded if they were (a) written in a language besides English, (b) were a review or meta-analysis, (c) did not include a control group, (d) did not report the numbers of PCs, (e) focused on a specific population, such as elderly or obese patients or patients with some comorbidity, or (f) included patients with other diseases, such as lymphoma and gastrointestinal stromal tumor. When overlapping data appeared to be included in several reports from the same institution, the RCT or CCS of higher quality was selected.

2.2. Inclusion criteria

This meta-analysis included studies that met the following criteria: (a) the study was an RCT or CCS comparing LDG with ODG only in patients with gastric cancer; (b) all patients underwent D1+ or D2 lymph-node dissection in accordance with the JGCT guidelines 2010 [6]; (c) the numbers of individual PCs were separately reported in each group; and (d) LDG and ODG were matched for pathological tumor stage, extent of lymph-node dissection, reconstructive method, gender, age, body mass index (BMI), and the rate of comorbidity or the American Society of Anesthesiologists physical status (ASA-PS).

2.3. Quality assessment

The quality of RCTs was assessed using the Cochrane risk of bias tool [20]. The Newcastle–Ottawa scoring system (NOS) was used to assess the quality of CCSs [21]. In the NOS, the maximum evaluation was four stars for selection, two for comparability, and three for outcome assessment.

2.4. Outcomes of interest

LDG and ODG were compared with regard to the following individual postoperative complications: (a) SSI, which included wound infection and intra-abdominal abscess in accordance with the definition of the Centers for Disease Control and Prevention (CDC) guidelines [22], (b) leakage (both anastomotic and stump leakage), (c) anastomotic stenosis, (d) delayed gastric emptying, (e) Ileus (including internal hernia), (f) bleeding (intra-abdominal or intra-luminal bleeding), and (g) pneumonia.

2.5. Statistical analysis

Review Manager version 5.2 (Cochrane Collaboration, Oxford, UK) was used to perform this meta-analysis. For discontinuous variables, each postoperative complication was extracted from the trial report; odds ratios (OR) were calculated from the total number of patients and the observed number of events of interest in all groups, using a random-effect model. In the tables of our results, the squares indicate point estimates of OR, with 95% confidential intervals (CI) indicated by horizontal bars. The diamond represents the summary OR with the 95% CI from the included studies. P values of <0.05 were considered to indicate statistical significance.

The I^2 statistic was used to quantitatively assess heterogeneity. Graphical exploration with funnel plots of the included studies was used to evaluate publication bias.

3. Results

3.1. Selected studies

A flow chart of study selection is shown in Fig. 1. Among 1394 publications identified by searching the database, 1283 were excluded because of the title or because the report was not written in English. The abstracts of 111 studies were reviewed. Seventy of these studies did not meet our inclusion criteria and were excluded after screening the abstract. The full texts of the remaining 41 articles were reviewed. Two RCTs that included patients who underwent D1 lymphadenectomy and 21 CCSs that did not meet the inclusion criteria were excluded. Finally, 5 RCTs [23–27] and 13 CCSs [14–19,28–34] were eligible for inclusion in meta-analysis; all of these studies were published between 2005 and 2013. The results of quality assessment of the RCTs and CCSs are shown in Table 1 and Table 2, respectively. The results of assessment indicated that all studies were of high quality.

A summary of the included studies is shown in Table 3. This meta-analysis included a total of 2144 patients, among whom 1065