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Who may benefit from robotic gastrectomy?: A subgroup analysis of multicenter prospective comparative study data on robotic versus laparoscopic gastrectomy

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Abstract

Aims: Robotic gastrectomy for gastric cancer has been proven to be a feasible and safe minimally invasive procedure. However, our previous multicenter prospective study indicated that robotic gastrectomy is not superior to laparoscopic gastrectomy. This study aimed to identify which subgroups of patients would benefit from robotic gastrectomy rather than from conventional laparoscopic gastrectomy.
Methods: A prospective multicenter comparative study comparing laparoscopic and robotic gastrectomy was previously conducted. We divided the patients into subgroups according to obesity, type of gastrectomy performed, and extent of lymph node dissection. Surgical outcomes were compared between the robotic and laparoscopic groups in each subgroup.
Results: A total of 434 patients were enrolled into the robotic (n = 223) and laparoscopic (n = 211) surgery groups. According to obesity and gastrectomy type, there was no difference in the estimated blood loss (EBL), number of retrieved lymph nodes, complication rate, open conversion rate, and the length of hospital stay between the robotic and laparoscopic groups. According to the extent of lymph node dissection, the robotic group showed a significantly lower EBL than did the laparoscopic group after D2 dissection ($P = 0.021$), while there was no difference in EBL in patients that did not undergo D2 dissection ($P = 0.365$).
Conclusion: Patients with gastric cancer undergoing D2 lymph node dissection can benefit from less blood loss when a robotic surgery system is used.

Keywords: Gastric cancer; Robotic surgery; Laparoscopy; Surgical outcome

Introduction

Laparoscopic gastrectomy has now gained worldwide acceptance for the treatment of early gastric cancer. A large

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number of non-randomized trials, randomized trials, and meta-analyses have confirmed that laparoscopic gastrectomy is safe and feasible, with advantages such as less pain, earlier recovery, and fewer postoperative complications compared to open gastrectomy.[1–4]

However, laparoscopic gastrectomy still has limitations such as the limited movement of the instrument, amplification of physiologic tremor, and unstable video images. A robotic system has been adopted to overcome these technical difficulties in conventional laparoscopic gastrectomy for gastric cancer, with three-dimensional high-definition visualization, a wristed instrument without tremor, more intuitive instrument control with increased dexterity, and better ergonomics.[5] Robotic gastrectomy has also been proven to be feasible and safe from the standpoint of short-term surgical outcomes.[6–9] However, the benefits of robotic gastrectomy have not been consistent across reports or even in meta-analysis.[10–13] Therefore, the benefits of robotic gastrectomy remain controversial. Moreover, a recent multicenter prospective study did not show any superiority of robotic gastrectomy in terms of short-term outcomes.[14]

Thus, we designed the present study as a subgroup analysis following a multicenter prospective study that did not show an advantage of robotic gastrectomy over conventional laparoscopic gastrectomy.[14] This study aimed to identify which subgroups of patients would benefit from robotic gastrectomy rather than from conventional laparoscopic gastrectomy.

Materials and methods

Patients

Between May 2011 and December 2012, we conducted a prospective multicenter study comparing robotic gastrectomy with laparoscopic gastrectomy performed on patients with gastric cancer at 11 hospitals by 17 surgeons. The inclusion criteria and matching method have been described previously.[14] The patients selected the type of surgery after they received a comprehensive explanation of each procedure. The patients were matched according to surgeon, extent of gastric resection, and sex. After an enrolled patient underwent robotic gastrectomy, screening was carried out to identify a patient of the same sex who was expected to undergo the same extent of resection among the patients who were scheduled to undergo laparoscopic gastrectomy by the same surgeon. Candidate patients identified for matching were asked to participate in the study. All patients provided a written informed consent, and the study was approved by the Institutional Review Boards of all participating institutions.

Subgroup analysis

Surgery for obese patients, extended (D2) lymph node dissection, and total gastrectomy were considered factors contributing to more complications and greater technical difficulty during laparoscopic gastrectomy. For these reasons, we divided the patients into subgroups according to obesity, extent of gastric resection, and extent of lymph node dissection.

Obesity status was classified using the body mass index (BMI). Patients were categorized to the non-obese group if they had BMIs within the normal range or were underweight (<25 kg/m^2) and into the obese group if they had BMIs above the normal range (≥ 25 kg/m^2) according to the World Health Organization definition of obesity in the Asia–Pacific region. Patients were divided into a total gastrectomy group and partial gastrectomy group, which included distal subtotal gastrectomy, proximal gastrectomy, and pylorus-preserving gastrectomy. They were also categorized into a D2 group and non-D2 group including D1 or D1+ lymphadenectomy. We utilized the Japanese gastric cancer treatment guidelines 2010 to define the extent of lymph node dissection.[15] In each subgroup, surgical outcomes, including the operative time, complication rate, estimated blood loss (EBL), open conversion rate, number of retrieved lymph nodes (RLN), and length of hospital stay, were compared between the robotic and laparoscopic groups as parameters representing the benefits of robotic gastrectomy.

Statistical analysis

All subgroup outcomes underwent intention-to-treat analysis. Categorical variables were compared using the chi-square test, while continuous variables were compared with the independent sample *t*-test. Two-sided p-values were calculated for all tests. A *P*-value of less than 0.05 was considered statistically significant. All analyses were performed using SPSS version 18.0 (SPSS Inc., Chicago, IL, USA).

Results

Overall results

A total of 434 patients (223 robotic and 211 laparoscopic gastrectomies) were enrolled.

The overall analysis of the enrolled patients has been described previously.[14] In summary, the characteristics of the two groups were similar with the exception of age, medical comorbidity, and disease stage. Patients in the robotic group were younger ($P = 0.024$) and had fewer medical comorbidities ($P = 0.025$) than those in the laparoscopic group. The tumors in the robotic group had more advanced T and N stages ($P = 0.013$, $P = 0.012$). The operative time was significantly longer for the patients in the robotic group ($P < 0.001$). There was no difference in the complication rate ($P = 0.619$), EBL ($P = 0.296$), RLN number ($P = 0.514$), length of the hospital stay

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