International Journal of Surgery 8 (2010) 643–647

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.theijs.com

Distal gastrectomy via minilaparotomy for non-overweight patients with T1N0-1 gastric cancer: Initial experience of 30 cases

Hideyuki Ishida*, Toru Ishiguro, Tatsuya Miyazaki, Norimichi Okada, Kensuke Kumamoto, Keiichiro Ishibashi, Norihiro Haga

Department of Digestive Tract and General Surgery, Saitama Medical Center, Saitama Medical University, 1981 Kamoda, Kawagoe, Saitama 350-8550, Japan

ARTICLE INFO

Article history:
Received 29 May 2010
Received in revised form
13 July 2010
Accepted 25 July 2010
Available online 14 August 2010

Keywords:
Minilaparotomy
Gastric cancer
Distal gastrectomy
Laparoscopy

ABSTRACT

Minilaparotomy is considered to be a useful treatment alternative to laparoscopic-assisted surgery from the viewpoint of minimal invasiveness, although it has several limitations for the resection of malignant tumors. We evaluated the usefulness of distal gastrectomy via minilaparotomy for non-overweight patients with clinically diagnosed T1N0-1 gastric cancer. Clinicopathological and surgical data on 30 patients attempted to undergo distal gastrectomy via minilaparotomy (skin incision, ≤7 cm) without laparoscopic assistance were analyzed. Inclusion criteria were clinically (preoperatively) diagnosed T1N0-1 gastric cancer that was not suitable for endoscopic mucosal resection located in the middle- or lower-third of the stomach and the patient body mass index ≤ 25.0 kg/m^2. The minilaparotomy approach was successful in 27 patients (90%), while laparoscopic assistance was required to accomplish the procedures in three patients (10%). The type of lymph node dissection was D1 + α in 23 patients and D1 + β in 7 patients. The duration of surgery was 105–170 min (median, 143.5 min) and blood loss was 25–520 mL (median, 152.5 mL). Pathological stage was stage IA in 26 patients, IB in two patients, and stage II in two patients. Postoperative complications were wound infection in one patient, bleeding in one patient, and anastomotic ulcer in one patient. The length of postoperative stay was 7–41 (median, 11) days. With a median follow-up of 31 months, there was no recurrence. Distal gastrectomy via minilaparotomy seems feasible and safe in the majority of non-overweight patients with clinically diagnosed T1N0 gastric cancer.

1. Introduction

Laparoscopic-assisted distal gastrectomy (LADG) has come to be widely performed in the treatment of cancer located in the middle- and lower- third of the stomach. LADG usually requires a small incision (5–7 cm) for the retrieval of the specimen and performing anastomosis.[1–4] The use of a small incision, as opposed to a full laparotomy, is believed to be associated with the early recovery of patients undergoing laparoscopic-assisted colectomy.[5] Favorable outcomes of a minilaparotomy approach without laparoscopic assistance for the resection of colon cancer have been reported by several investigators.[6–10] In 2003, Onitsuka et al.[11] first reported their experience of distal gastrectomy via minilaparotomy for the resection of early gastric cancer. However, little is known about the usefulness of the minilaparotomy approach, despite some Japanese surgeons including ourselves meticulously documenting surgical techniques for performing distal gastrectomy,[12,13] pyloric-ring preserving gastrectomy,[14] or total gastrectomy[13] via minilaparotomy.

This study was performed to evaluate our initial experience of distal gastrectomy via minilaparotomy in non-overweight patients with clinically (preoperatively) diagnosed stage IA (T1N0) or IB (T1N1) gastric cancer,[15] in terms of the feasibility, safety, minimal invasiveness, and short-term oncological outcome.

2. Methodology

2.1. Definition of minilaparotomy

We defined a minilaparotomy approach as the distal gastrectomy through a skin incision with a maximum length of 7 cm.

2.2. Patients and indication of minilaparotomy

Between April 2005 and July 2008, curative distal gastrectomy using a minilaparotomy approach was scheduled for 30 patients with histologically proven gastric cancer who met the inclusion

* Corresponding author. Tel.: +81 49 228 3619; fax: +81 49 222 8865.
E-mail address: 05hishi@saitama-med.ac.jp (H. Ishida).

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doi:10.1016/j.ijsu.2010.07.302

criteria described below at the Department of Digestive Tract and General Surgery, Saitama Medical Center, Saitama Medical University. The indications for the minilaparotomy approach were clinically diagnosed T1N0 (stage IA) cancer other than mucosal cancer that satisfied criteria of endoscopic mucosal resection (differentiated, 2 cm in diameter), or T1N1 (stage IB) cancer, determined according to the Guidelines of the Treatment of Gastric Cancer,[16] a tumor located in the middle- or lower- third of the stomach, and patient body mass index $\leq$ 25.0 kg/m^2. Informed consent was obtained from each patient.

The diagnosis of gastric cancer was made by histological examination of biopsy specimens obtained at endoscopic examination. The site of lesion and degree of invasion (T-category) were evaluated comprehensively on the basis of barium examination, and endoscopic and/or endoscopic ultrasonographic findings. All patients underwent abdominal computed tomography to determine the presence/absence of lymph node metastasis (N-category), liver metastasis, and distant metastasis.

2.3. Level of lymph node dissection

The type of lymph node dissection (D1 + α or D1 + β) for T1N0-1 cancer was selected in accordance with the Guidelines of the Treatment of Gastric Cancer.[16] Mucosal cancer not satisfying the criteria for EMR was treated by modified gastrectomy A with D1 + α lymph node dissection. Modified gastrectomy A was also indicated for differentiated submucosal cancer of less than 1.5 cm in diameter. D1 + α includes removal of lymph nodes classified as group 1 lymph nodes (No. 1, 3, 4sb, 4d, 5, and 6) + No. 7 (along the left gastric artery) lymph nodes. The submucosal cancer that did not meet the indications of modified gastrectomy A was treated by modified gastrectomy B with D1 + β lymph node dissection, which included removal of group 1 lymph nodes, No. 7, No. 8a (along the common hepatic artery), and No. 9 (around the celiac trunk) lymph nodes. D1-lymph node dissection included removal of all or part of the group 1 lymph nodes comprising right paracardial lymph nodes (No. 1), those along the lesser curvature (No. 3), those along the left gastroepiploic vessels (No. 4sb), those along the right gastroepiploic vessels (No. 4d), the suprapyloric lymph nodes (No. 5), and the infrapyloric lymph nodes (No. 6), which varied according to the site of primary tumor. In cases of lower-third cancer, modified gastrectomy A included dissection of the No. 8a lymph nodes.

2.4. Surgical procedures

Each patient was placed on the operating table in the supine position. In principle, all the surgical procedures were performed utilizing conventional surgical instruments through an upper median abdominal incision, with a maximum length of 7 cm. The first author (HI) oversaw the procedures as a surpervising assistant. The median duration of surgical training of operating surgeons (n = 11) was 7 years (range, 3–16 years). A wound retractor, Alexis™ (medium size; Applied Medical, CA, USA) was applied to the edge of the wound. An assistant slid the wound into position utilizing conventional retractors. When necessary for dissecting lymph nodes around the celiac artery, or dissecting the gastrosplenic ligament, a 6-cm-wide Kent retractor™ (Takasago, Tokyo, Japan), whose bar was placed beside the patient's left-sided axilla, was used to slide the wound cephalad or laterally (Fig. 1a). This movable wound allowed direct visualization of almost all the surgical field, enabling lymph node dissection.

The transverse colon and the greater omentum were gently pulled out of the wound, and the greater omentum was dissected about 4–5 cm away from the arcade of the gastroepiploic vessels

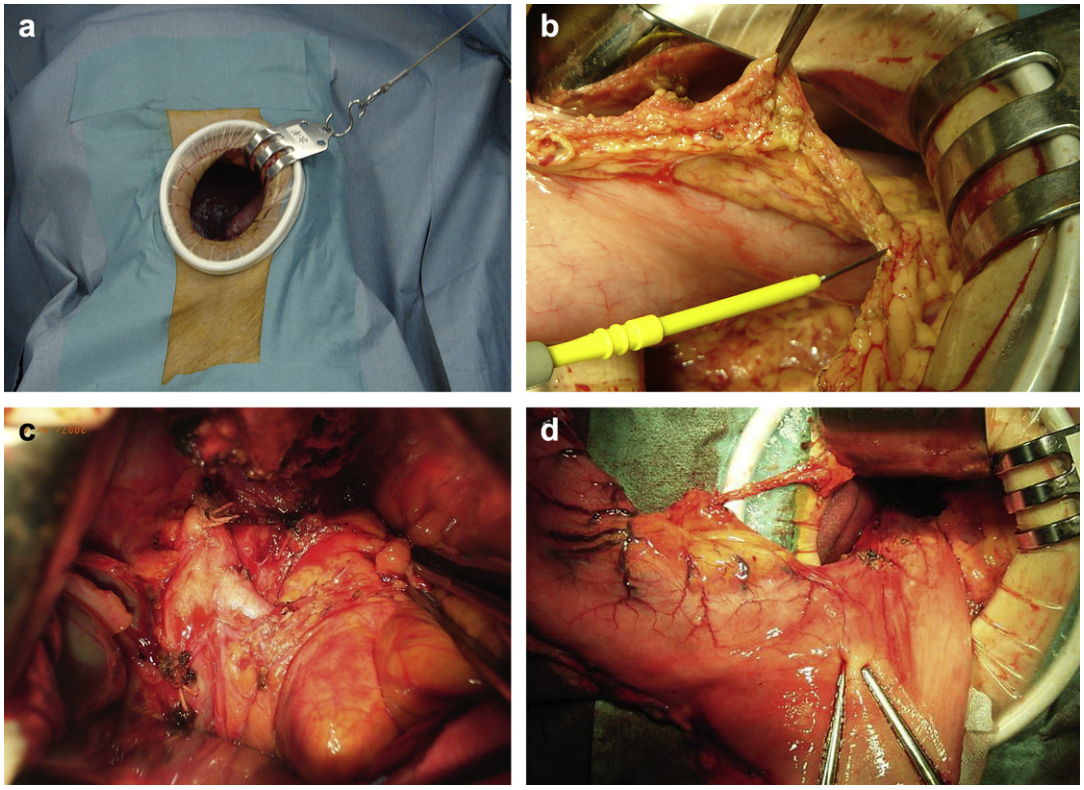

Fig. 1. a: The wound is slid cephalad, caudally, or laterally by the traction utilizing a Kent retractor system. b: The omentum dissected 4–5 cm away from the gastroepiploic vessels. c: Lymph node dissection around the celiac trunk completed via minilaparotomy. d: The lesser curvature of the stomach denuded after lymph node dissection around the common hepatic artery and/or celiac trunk.

(Fig. 1b). The gastroepiploic artery and vein were ligated and divided where appropriate according to the site of the primary tumor. The right gastroepiploic artery and vein were ligated and divided at their roots, and then the right gastric artery was ligated and divided. The duodenum was divided after the application of the purse-string instrument, the anvil head of PCEEA 25 mm (Covidien, Mansfield, MA, USA) or Proximate ILS (SDH25) (Ethicon Endo-Surgery, Cincinnati, OH, USA) was introduced to the lumen, and the purse-string suture was tightened. The other stump of the duodenum was closed by interrupted sutures to prevent the spillage of gastric juice. With the stomach reflected cranially in the surgical field, the lymph nodes and the surrounding fat tissue along the common hepatic artery were dissected. Lymph node dissection was progressed along the root of the splenic artery and celiac axis when necessary (Fig. 1c). The left gastric artery and vein were each divided at their roots. The lesser curvature was denuded (Fig. 1d), and the stomach was transected utilizing a linear stapler, Linear Cutter 100 (Ethicon Endo-Surgery, Cincinnati, OH, USA) or GIA80 (Covidien, Mansfield, MA, USA). The body of the circular stapler was introduced into the remnant stomach via the lower cut-end of the stomach. Stapled anastomosis was performed between the posterior side of the greater curvature of the remnant stomach and the duodenum. The site, through which the circular stapler was introduced, was finally closed using a linear stapler.

When surgeons experienced difficulty in dissecting lymph nodes around the common hepatic artery and/or celiac trunk, or the gastrosplenic ligament, or to perform lysis for significant adhesions safely, an ultrasonically activated device, Harmonic scalpel^{ITM} (Ethicon Endo-Surgery, Cincinnati, OH, USA) was used with the assistance of a laparoscope, which illuminated the deep surgical field through the wound.

2.5. Evaluated factors

The patient age, sex, history of prior abdominal surgery, body mass index (kg/m^2), American Society of Anesthesiologists (ASA) classification, location of tumor, type of lymph node dissection, pathological stage, number of harvested lymph nodes, duration of surgery, blood loss, postoperative complications, first passage of flatus, first time of oral intake, use of analgesic agents (pentazocine, 15 mg, intramuscularly), and length of postoperative hospital stay were prospectively recorded on the medical charts and analyzed retrospectively.

2.6. Statistical analysis

A statistical software package (Statview ver. 5.0; SAS Institute, Cary, NC, USA) running on a Windows personal computer was used to conduct the analysis. Continuous data were expressed as median and range.

3. Results

The extension of minilaparotomy wound was not necessary in any patients. The length of incision was 6 cm in 14 patients and 7 cm in 16 patients. The minilaparotomy approach was successful in 27 patients (90%), while in the remaining three patients (10%) laparoscopic assistance was needed to perform lymph node dissection in the deep field safely ($n = 2$) or to perform adhesiolysis ($n = 1$).

The patient age ranged from 49 to 86 years (median, 66.5 years). The male:female ratio was 18:12. The patient body mass index ranged from 16.6 to 25.0 kg/m^2 (median, 21.2 kg/m^2). The ASA classification was class I in 8 patients, class II in 12 patients, and class III in 10 patients. There were no patients with a history of prior upper abdominal surgery, although one patient had undergone anterior resection for rectal cancer. The location of the primary tumor was the middle-third of the stomach in 12 patients and the lower-third of the stomach in 18 patients. The type of lymph node dissection was D1 + α in 23 patients and D1 + β in 7 patients. Duration of surgery ranged from 105 to 170 min (median, 143.5 min) and the blood loss ranged from 25 to 520 mL (median, 152.5 mL). The number of harvested lymph nodes was 12–51 (median, 23). The pathological stage was stage IA in 26 patients, stage IB in two patients, and stage II in two patients (Table 1).

Table 1
Demographic, clinicopathological, and surgical factors.

	Median (range)
Age (years)	66.5 (49–86)
Sex (male:female)	18:12
Body mass index (kg/m^2)	21.2 (16.6–25.0)
ASA classification (I:II:III)	8:12:10
Tumor location (middle-third:lower-third)	12:18
Lymph node dissection (D1 + α:D1 + β)	23:7
Number of lymph nodes harvested	23 (12–51)
Pathological stage (IA:IB:II)	26:2:2
Duration of surgery (minutes)	143.5 (105–170)
Blood loss (mL)	152.5 (825–520)

The duration to first flatus was 1–4 days (median, 1 day) and that to first oral intake was 3–5 days (median, 3 days). The number of times analgesic was used (pentazocine, 15 mg, intramuscularly) was 0–9 (median, 1). Three patients developed postoperative complications. One patient each developed wound infection and anastomotic ulcer, both of which improved conservatively. The remaining one patient, in whom laparoscopic assistance was needed for lysis of adhesions between the greater omentum and the parietal peritoneum, underwent re-operation through the minilaparotomy wound the day after surgery. At re-laparotomy, although hemostasis was confirmed, the capsule of the spleen was found to have been torn. The postoperative length of hospital stay ranged from 8 to 42 days (median, 9 days) (Table 2). There was no recurrence with a median follow-up period of 31 months (range, 21–60 months).

4. Discussion

The underlying concept of the minilaparotomy approach is to utilize as small an incision as necessary to extract the specimen right from the beginning of the surgical procedure, enabling division of the stomach and the duodenum, lymph node dissection, and anastomosis under direct view without any laparoscopic assistance.

The definition of 'minilaparotomy' appears to be a matter of personal opinion. Some Japanese surgeons[11,12,14] including ourselves[13] considered the maximal incision length used for distal gastrectomy via minilaparotomy as 6–7 cm. In addition, Hyodo et al.[17] defined 'minilaparotomy' as 5–6 cm through which gasless laparoscopy-assisted distal gastrectomy was performed using an abdominal wall lift. Practically, 6–7 cm is the shortest incision that allows the surgeon to insert his or her hand into the operative field to provide prompt control for unexpected bleeding. In addition, Rino et al.[18] reported that an incision of 3 cm or longer was needed to

Table 2
Postoperative recovery and analgesic use.

	Median (range)
First pass of flatus (days)	1 (1–4)
Start of oral intake (days)	3 (3–5)
Number of analgesic use	1 (0–9)
Postoperative complications	3 (10%)
Postoperative hospital stay (days)	9 (8–42)

perform stapled gastroenterostomy safely in laparoscopic-assisted distal gastrectomy for early gastric cancer. Importantly, surgeons should note that most distal gastrectomies with D1 + α or D1 + β can be accomplished through shorter incisions than generally believed.

In 2003, Onitsuka et al.[11] first reported the experience of minilaparotomy (7 cm) in 10 cases of early gastric cancer. They reported on 5 distal gastrectomies and 5 pyloric-ring preserving gastrectomies, one of which required the extension of the incision to accomplish the procedures. In their series, the mean operation time was 175 min, although the blood loss was not documented. Thereafter, some Japanese surgeons[12–14] reported their experience of minilaparotomy approach for the resection of gastric cancer, focusing on the surgical techniques. To the best of our knowledge, this is the first report documenting minutely the feasibility, safety, and minimal invasiveness of distal gastrectomy via minilaparotomy for non-overweight patients with clinically (preoperatively) diagnosed stage IA or IB gastric cancer.

In this series, minilaparotomy approach without any laparoscopic assistance was not successful in 10% of the patients. Thus, in some circumstances, minilaparotomy approach may not be possible. If the surgeon experiences difficulty in performing any procedures via minilaparotomy, he or she should never hesitate to extend the wound, converting to standard open surgery. Alternatively, as performed in this series, laparoscopic assistance would be a better choice for enabling dissection of the lymph nodes and/or vessels more easily and safely. The postoperative bleeding presumably occurring from the tear of the spleen in one case may have been avoided if the dissection of vessels near the spleen was performed carefully with laparoscopic assistance.

Morbid obesity is generally considered to be a relative contraindication to LADG. Noshiro et al.[1] reported that LADG for early gastric cancer in patients with BMI > 24.2 kg/m^2 resulted in significantly more technical difficulties, longer operating time, and delayed recovery of bowel activity than in those with lower BMI. For obese patients, even conventional open gastrectomy may be more difficult to perform than the equivalent procedure in slender patients. Bearing this and our experience of minilaparotomy approach to curative colectomy[9] in mind, we tentatively excluded patients with a BMI greater than 25.0 kg/m^2, which is the cut-off value of 'overweight'.[19] Further studies are needed to determine whether the indication of a minilaparotomy approach could be expanded to more obese patients.

In institutions where specialized laparoscopic gastric surgeons are available, LADG has been performed with wider acceptance and is considered to be the most useful treatment alternative to minimally invasive modalities for early gastric cancer. However, even now, we are not ready for the wide expansion of LADG to all institutions. Unlike a laparoscopic-assisted approach, a minilaparotomy approach does not have a high cost. In this series, we used multiple staplers for resection and anastomosis, since the cost for using multiple staplers is partly (70–90%) reimbursed by the Japanese health insurance system regardless of the procedures (laparoscopic-assisted or conventional open). Of course, we consider that hand-sewn anastomosis would be feasible even in our minilaparotomy, leading to lower cost than that of this series. Also, our minilaparotomy approach does not require a long operating time or highly trained surgeons. There may be arguments whether one can teach our method to non- experienced surgeons since the operative view is more limited than the laparoscopic-assited procedure. As mentioned in our surgical technique, our "movable wound" technique allowed direct visualization of almost all the surgical field, enabling identification and dividing vessels, and lymph node dissection as in almost similar manner as in conventional open surgery without taking longer operating time. In fact, in this series, the median duration of surgical training of operating surgeons was 7 years (range, 3–16 years). Considering the aforementioned issues, we believe that the minilaparotomy approach to curative distal gastrectomy should continue to be used as a treatment alternative to LADG depending on surgeon's preference and subsequent patients' selection.

In this series, we could not compare minilaparotomy and conventional open or laparoscopic-assisted surgery. In the treatment of colon cancer, a minilaparotomy approach has been reported to be identical to a laparoscopic approach[20] in terms of minimal invasiveness. In addition, compared with conventional open surgery, a minilaparotomy approach has been shown to be less invasive in terms of postoperative recovery and various laboratory parameters.[21,22] The length of our minilaparotomy ($\leq$7 cm) is considered not longer than the total length of incisions used for LADG when multiple trocar sites are added to the main incision length. Since the minilaparotomy is not any longer than the length performed in LADG, it will certainly be less painful than a conventional open gastrectomy incision and comparable to a laparoscopic surgical incision, although such comparisons were not performed in our series and deserve further investigations.

In conclusion, this study demonstrated that distal gastrectomy via minilaparotomy seems feasible, safe, and favorable in early oncological outcome in the majority of non-overweight patients with clinically (preoperatively) diagnosed stage IA or IB gastric cancer. To validate the usefulness of this approach, a prospective randomized trial comparing this approach with the conventional open or laparoscopic-assisted procedure, in terms of minimal invasiveness, cosmetic results, cost, and long-term oncological outcome, is needed.

Conflict of interest

None declared.

Funding

None.

Ethical approval

None.

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