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**MINIMAL ACCESS SURGERY**


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## LAPAROSCOPIC GASTRIC RESECTION FOR BENIGN AND MALIGNANT CONDITIONS: LESSONS LEARNED FROM 35 CONSECUTIVE CASES

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**Introduction:** Despite significant advances in laparoscopy, gastric surgery is still generally carried out by conventional open techniques. The aim of the study was to report the short- and medium-term outcomes of gastric surgery when carried out laparoscopically for a variety of benign and malignant conditions.

**Methods:** A retrospective review was carried out for all patients who underwent a laparoscopic gastric resection between January 2000 and September 2006. Follow up was carried out at the private consulting rooms and by telephone interview.

**Results:** Thirty-five consecutive laparoscopic gastric resection were carried out in 31 patients for a variety of benign lesions, six early gastric cancer and 13 adenocarcinomas. The totally intracorporeal laparoscopic procedures included four total, eight distal and 21 partial gastrectomies. There were two open conversions (6%). There was one in-hospital mortality (3%) and one non-fatal anastomotic leak. Median operative duration and length of stay were 75, 205 and 252 min and 5, 6.5 and 8 days for laparoscopic partial, distal and total gastrectomy, respectively. After malignant resections, there were six recurrences; however, 15 patients remained disease-free at up to 60 months follow up.

**Conclusion:** Laparoscopic gastric resection is feasible with good short- and medium-term results and may be an appropriate treatment option in selected cases.

**Key words:** gastrectomy, gastric cancer, GIST, laparoscopy, laparoscopic gastric resection.

Abbreviations: BI, Billroth I; BII, Billroth II; EGC, early gastric cancer; GIST, gastrointestinal stromal tumour; LGR, laparoscopic gastric resection; PUD, peptic ulcer disease.

### INTRODUCTION

In recent years, the advantages of minimal access surgery have become more clearly defined over an increasing range of pathologies. Assisted by significant advances in laparoscopic technology, particularly endostaplers and ultrasonic shears, more demanding procedures such as gastric surgery are now feasible by laparoscopic means.

At the present time, laparoscopic gastric resection (LGR) for benign or malignant lesions has not been widely adopted in Australia or overseas. The reasons for this may include the relatively low caseload of gastric lesions that occurred per surgeon in western communities, perceived technical difficulties, longer operating time, the cost-effectiveness of laparoscopic surgery and concerns regarding oncology adequacy for malignancy. Encouraged by reports by Goh *et al.* and Huscher *et al.* supporting the feasibility, safety and oncological adequacy of LGR, we began offering a totally intracorporeal LGR in selected patients for both benign and malignant diseases.<sup>1,2</sup>

Goh *et al.* from Singapore reported the first case of a complete laparoscopic distal gastrectomy with Billroth II (BII) anastomosis in 1992 for a case of complicated peptic ulcer disease (PUD).<sup>3</sup> Kitano *et al.* from Japan was the first to perform laparoscopic-assisted radical subtotal gastrectomy plus local lymph node dissection with a Billroth I (BI) reconstruction by a small open incision for early gastric cancer (EGC) in 1991.<sup>4</sup> Fowler and White from the USA reported five cases of laparoscopic antrectomy and intracorporeal BII anastomosis, four cases of complicated PUD and one case for palliation of EGC in 1994.<sup>5</sup> Azagra *et al.* reported laparoscopic total gastrectomy with D2 lymph node dissection for proximal gastric cancer.<sup>6</sup>

Kim *et al.* was the first in Korea to report laparoscopic-assisted subtotal gastrectomy with lymph node dissection in 1999 and reported its safety and feasibility in 2003. This same group later described hand-assisted laparoscopic total gastrectomy with D1 lymphadenectomy in 2003 for a case of EGC.<sup>7</sup> Another group from Hong Kong also reported a case of hand-assisted laparoscopic D2 subtotal gastrectomy for advanced gastric cancer in 2002.<sup>8</sup>

This paper documents a single-unit experience of 35 cases of LGR and includes a discussion about the lessons learned.

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### METHODS

Between January 2000 and September 2006, 35 cases of LGR were carried out at The John Flynn Gold Coast Private Hospital, Tugun and The Tweed District Hospital, Tweed Heads Australia

by a single upper gastrointestinal surgical unit. Because of our limited experience, LGR was offered to patients with benign pathology and malignant disease in situations where an extensive lymphadenectomy was not felt to be necessary. This confined our application for malignant pathologies to gastrointestinal stromal tumours (GIST), EGC and either very early or palliative adenocarcinomas (treated with palliative intent on account of advanced age, metastases or poor health). Patients with potentially curative adenocarcinoma are at present treated by conventional open gastrectomy combined with a formal D2 lymphatic clearance, and they were not included in this series. All procedures were carried out using totally intracorporeal techniques. Details concerning patient characteristics, histology, operating time, length of stay, time to return to clear fluids, conversion and complication were collected by chart review. Cases of local recurrence and metastasis are tabulated. Patients treated for GIST, EGC and adenocarcinoma were closely followed postoperatively as well as recontacted by telephone during May 2006 to August 2006.

### Techniques

Three different extents of resection were carried out depending on the location and nature of the lesion and patient characteristics.

#### Laparoscopic partial gastrectomy

Small lesions located at the fundus or anterior wall of the stomach was isolated free with limited mobilization and resected with an endoscopic linear cutting stapler. When lesions involved the greater or lesser gastric curve, vascular arcades were divided with endoscopic ultrasonic shears before the application of a series of endoscopic linear staplers to excise the lesion parallel with the long axis of the stomach (in effect performing a limited sleeve gastrectomy and avoiding the need for anastomosis). Intraoperative endoscopy was carried out to document lesion clearance and ensure that the gastro-oesophageal junction and pyloric lumen were not compromised.

#### Laparoscopic distal/subtotal gastrectomy

For lesions situated in the lower half of the stomach, including gastric ulcers, gastric outlet obstruction or distal gastric neoplasia, a laparoscopic distal or subtotal gastrectomy was carried out. Reconstruction by Billroth-II loop gastrojejunostomy was carried out with endoscopic linear staplers, and the defect was closed by intracorporeal suture.

#### Laparoscopic total gastrectomy

For recurrent or proximal gastric malignancy, a total or completion gastrectomy was carried out. Lymphatic clearance included regional perigastric nodes, and the second tier nodes around the left gastric and coeliac axis were removed as well as the greater omentum. Oesophago-jejunostomy with Roux en Y reconstruction was carried out by totally intracorporeal technique using circular and linear endostaplers, reinforced by seromuscular sutures.

## RESULTS

### Patient data and operation

Thirty-five LGR were carried out between 2000 and 2006 in 31 patients. The median age was 75 years, with the oldest patient

being 90 years of age (Table 1). The indications for surgery and types of operation carried out were outlined in Table 2. Median operative duration was 75, 205 and 252 min for laparoscopic partial, distal and total gastrectomy, respectively (Table 3). Median length of hospital stay was between 5 and 8 days, depending on type of procedure. Overall duration of clinical follow up was 12 months (range 1–60 months). One patient (with benign leiomyoma) was lost to follow up.

### Conversions

There were two conversions to open surgery. A distal gastrectomy for GIST was converted after initial laparoscopy revealed extensive adhesions in the upper abdomen from previous open cholecystectomy and unrelated gastric surgery. The other patient with adenocarcinoma was converted to a laparoscopic-assisted procedure midway through the case because of difficulties created by a heavy load of food residue in a very distended stomach. A small midline incision was carried out to transect the stomach and complete the gastrojejunostomy to avoid spillage of gastric contents.

**Table 1.** Patient and operation data

Number of patients	31
Number of procedures	35
Men : women	13:18
Median age (range)	75 (46–90)
ASA 1–2	13
ASA 3–4	18

ASA, American Society of Anaesthesiologists.

**Table 2.** Gastric pathologies

Pathology	Number of cases ( <i>n</i> = 35)
Benign ( <i>n</i> = 18)	
Leiomyoma	2
Bleeding PUD	1
GOO/gastroparesis	2
Dysplastic polyps	2
Benign ulcer	3
Low-risk GIST	8
Malignant ( <i>n</i> = 17)	
High-grade GIST	1
EGC	6
Invasive adenocarcinoma	10

EGC, early gastric cancer; GIST, gastrointestinal stromal tumour; GOO, gastric outlet obstruction; PUD, peptic ulcer disease.

**Table 3.** Types of laparoscopic gastric resection

Surgical procedure	Number of cases ( <i>n</i> = 33)	Median operative duration (minutes)	Median length of stay (days)
Partial gastrectomy	21	75	5
Distal/subtotal gastrectomy	8	205	6.5
Total gastrectomy	4	252.5	8

The table includes three revisional procedures carried out laparoscopically for recurrent disease.

### Complications

There was one in-hospital mortality (3%). This patient had a duodenal stump leak after a laparoscopic subtotal gastrectomy. Despite multiple returns to theatre, she died from related septic complications 64 days later.

After a laparoscopic total gastrectomy for linitus plastica in another patient, it was found that she had a radiological leak around the oesophageal anastomosis site. The area was immediately inspected by laparoscopy; however, no defect was detected and she was managed conservatively without further intervention.

There was one case of non-ST elevation myocardial infarct after laparoscopic-assisted distal gastrectomy. The stay in hospital was extended to 13 days for supplementary medical care, and the patient was discharged home without further complications.

Minor bleeding from the staple line after a partial tube gastrectomy occurred in one case. This patient received two units of blood transfusion, did not require a return trip to theatre and was discharged 1 week later.

Two patients developed anastomotic stricture after total gastrectomy and oesophagojejunostomy with a 21 mm circular staple. Endoscopic dilatation were carried out successfully, both at 10 months after the initial operation.

### Results for malignant disease

Twenty-one patients underwent resection of malignant pathologies (Table 2). There were eight GIST, five EGC and eight advanced gastric cancers. Seven reoperations (three carried out laparoscopically) were carried out in six patients for the resection of recurrent disease (Table 4).

#### *Gastrointestinal stromal tumours*

Laparoscopic partial gastric resection of the greater curve was carried out for a high-grade 45 mm GIST with >10/50 mitosis per high-power field. He developed a solitary 3-cm local recurrence 34 months later between the stomach and the spleen, which was again resected laparoscopically. Despite maximal imatinib therapy, he developed further local and regional recurrence (liver metastases, anterior abdominal wall) and survived for another 5 months after a third debulking procedure. Another patient had

severe ischaemic cardiomyopathy with an ejection fraction of 20%. She underwent a successful emergency laparoscopic partial gastrectomy of the greater curve for an acutely bleeding GIST without complication and was discharged on day 5. The remaining six patients had low-grade GIST tumours and have done well after laparoscopic partial resections.

#### *Early gastric cancer*

All patients underwent laparoscopic partial gastrectomy after localization of the lesion by preoperative endoscopy and Indian ink tattoo. Three patients developed additional lesion after initial partial resections, requiring further surgery. One patient with a 4-mm EGC on the lesser curve (resected with histologically clear margins) developed another EGC on surveillance gastroscopy 6 months later. A completion total gastrectomy was carried out laparoscopically without complication. The second patient had a laparoscopic long wedge excision of the lesser curve for a small EGC, where the tumour extended close to the proximal margin but was reported to be clear. On surveillance endoscopy, she was found to have another adjacent EGC and underwent an uneventful open subtotal gastrectomy 5 months later. The third case had a wedge excision of the lesser curve, again for EGC extending to the stapled margin, and she had a salvage open subtotal gastrectomy 5 months later with good results. All patients were still alive and disease-free at a median follow up of 7 months (range 5–46 months).

#### *Advanced gastric cancer*

Non-radical LGR were carried out for linitus plastica (2) or metastatic disease (1) or because of advanced age (over 75 years) and/or life-threatening coorbidities (ASA 3–4) (Table 5). A laparoscopic subtotal gastrectomy followed by adjuvant chemotherapy was carried out in one patient with adenocarcinoma with associated lung metastasis. She later developed liver metastasis as well, but is still alive at 21 months follow up. Of two patients with linitus plastica, one survived for 17 months and the other for 18 months after laparoscopic total gastrectomy.

A positive microscopic proximal margin was reported after laparoscopic distal gastrectomy for adenocarcinoma in an elderly patient. She underwent a successful salvage open subtotal

**Table 4.** Recurrent disease ( $n = 6$ )

Pathology	Initial management	Recurrence	Time to recurrence (months)	Subsequent management	Outcome
High-grade GIST	Laparoscopic partial gastrectomy	3 cm solitary lesion between stomach and spleen	34	Laparoscopic resection recurrent mass	
		Further lesion in splenic hilum, liver metastasis	42	Open splenectomy and hepatectomy	Died after 47 months
EGC	Laparoscopic partial gastrectomy	Further EGC on endoscopy	6	Laparoscopic total gastrectomy	Alive at 11 months
EGC	Laparoscopic partial gastrectomy	Further EGC on endoscopy	5	Open subtotal gastrectomy	Alive at 12 months
EGC	Laparoscopic partial gastrectomy	Further EGC on endoscopy	5	Open subtotal gastrectomy	Alive at 8 months
Advanced carcinoma	Laparoscopic distal gastrectomy	Microscopically involved margins	2	Open subtotal gastrectomy	Alive at 8 months
Advanced carcinoma	Laparoscopic partial gastrectomy	Local recurrence	28	Laparoscopic total gastrectomy	Alive at 34 months

EGC, early gastric cancer; GIST, gastrointestinal stromal tumour.

**Table 5.** Reasons for non-radical management of gastric adenocarcinoma

Rationale	Number of cases
Metastatic disease	1
Linnitus plastica	2
Age >75 years and frailty	2
Significant comorbidities (ASA 3–4)	3

ASA, American Society of Anaesthesiologists.

gastrectomy 2 months later. Another patient developed a local recurrence at 28 months after a laparoscopic partial gastrectomy with clear margins was carried out and underwent a completion laparoscopic total gastrectomy followed by adjuvant chemotherapy. She is still alive at 6 months after the second operation. There were two patients, one aged 70 years and the other 82 years, with severe chronic obstructive airway disease who had a successful laparoscopic distal gastrectomy for invasive adenocarcinoma without any complications. Their length of stay in hospital was 4 and 7 days, respectively.

Overall five of eight patients remain alive after a median follow up of 18 months, range 7–38 months (Fig. 1). Incidentally, a median of 11 lymph nodes were harvested during distal or total gastrectomy (range 8–34).

## DISCUSSION

Huscher *et al.* recently published their 5-year result of a randomized prospective trial on laparoscopic versus open subtotal gastrectomy and D1 lymphadenectomy in 59 patients with distal gastric cancer. There was a statistically significant result in favour of the laparoscopic group in terms of estimated blood loss, earlier resumption of food and discharge home. More importantly, there was no statistically significant difference in postoperative morbidity, mortality, 5 year recurrence rates and disease-free interval, with the two groups being similar in histology types, pTNM staging or number of lymph nodes dissected.<sup>9</sup>

Kitano *et al.* also recently published favourable long-term results of 116 patients who underwent laparoscopic-assisted BI gastrectomy plus D1 node resection. Their mean operative time

was 234 min, and they had blood loss of 139 mL.<sup>10</sup> Unlike the Huscher study, this is an exclusive group of EGC in which laparoscopic surgery was successfully carried out with good prognosis – all were alive with no recurrence or port-site metastasis, with a median follow up period of 53 months (range 2–120 months). Other studies from this same pioneer group also showed that laparoscopic surgery was superior to open gastrectomy in terms of less surgical trauma, rapid return gut function, shorter hospital stay, less impaired nutrition, significant improvement in quality of life and less problems with postoperative weight loss, difficulty in swallowing, heart burn or belching or early dumping syndrome.<sup>11,12</sup> Another group from Japan also reported that there were no statistically significant differences in operation time, complication rate and 5 year survival, with significant favourable results in the laparoscopic group in terms of operative blood loss, duration of epidural use and hospital stay.<sup>13</sup>

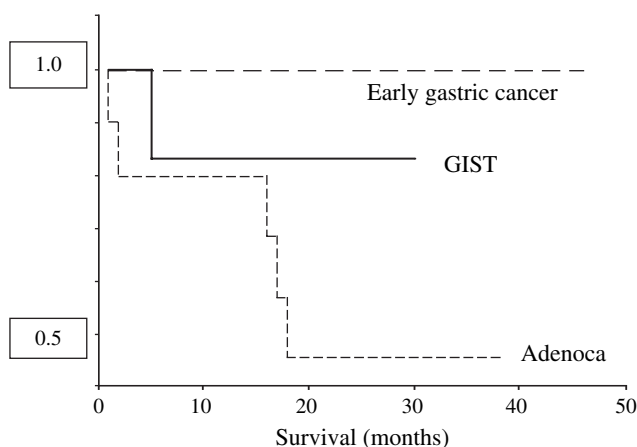
Early gastric cancer represents up to 70 and 30% of gastric cancers in Japan and Korea, respectively. The relative low risk of lymph node metastasis (up to 5% for mucosal lesions and up to 15–20% for submucosal lesions) may justify a less radical approach to lymph node clearance. With the cure rate for EGC approaching over 90%, laparoscopic-assisted gastrectomy for EGC has been proven to be safe, feasible and gaining popularity in Japan.<sup>5</sup> A survey of 16 surgeons in 12 countries who collectively carried out a total of 118 cases of laparoscopic gastrectomies for both benign and malignant cases found that laparoscopic surgery was considered superior by most because it was associated with less pain, faster recovery and better cosmesis.<sup>14</sup>

The role of LGR in EGC outside the specialized units in Japan is still unclear. Appropriate management of these lesions must be considered in the context of the patients' age, comorbidities, remaining lifespan, as well as the size and location of the tumour. The concept of field change needs to be appreciated particularly in younger patients. Many authors prefer D1 subtotal gastrectomy as a minimum treatment for these lesions. Because three of our five patients with EGC developed local recurrence and required further unplanned surgery, our results do not support laparoscopic partial gastrectomy for EGC.

Currently, an open curative gastric resection with D2 lymphatic clearance is still the gold standard for the management of invasive adenocarcinoma. The role of laparoscopic surgery for invasive adenocarcinoma is controversial, especially in regards to oncological adequacy of the dissection. It will probably remain so until a universal standard lymph node dissection is established. In our series, laparoscopic surgery for invasive adenocarcinoma is only carried out for the elderly, the medically unfit and the palliative resection group. At the present time, despite the excellent results by Huscher and others, we do not feel comfortable offering laparoscopic gastrectomy to fit young patients with potentially curable advanced gastric cancer.

In our series, previous upper abdominal laparotomy or previous laparoscopic partial gastric resection are not necessarily contraindications to further laparoscopic procedures. In comparison, laparoscopic division of adhesions around the stomach and left lobe of the liver may not be as difficult as division of adhesions around small bowel loops in the pelvis. After the gastrocolic omentum is divided, entry into the lesser sac will often expose the virgin posterior surface of the stomach, and the anatomy will be clearer. On identification of the posterior gastric and left gastric vessels in this plane, the rest of the dissection can proceed safely.

In contrast to open gastric surgery, laparoscopic surgery allows visualization from almost the same coronal plane as the stomach.



**Fig. 1.** Survival curves for early gastric cancer (EGC), gastrointestinal stromal tumours (GIST) and adenocarcinoma.

After entry into the lesser sac, dissection commences behind the first part of the duodenum and stomach, achieving good exposure to visualize the common hepatic and left gastric artery, pancreas and splenic artery. Modern laparoscopic ultrasonic dissecting or vessel-sealing instruments are invaluable for surgeons to perform lymph node clearance with precision and better haemostasis. A significant difficulty we came across during laparoscopic surgery was managing the distended stomach, often filled with food residue from an obstructing distal lesion. In contrast to open surgery, retraction, exposure, gastric transection and control of spillage may be very difficult in these situations.

Gastrointestinal stromal tumours are often palpable and visible externally. When laparoscopic partial gastric resection is being carried out, the resection margin is easier to judge because of the protruding and the relatively well-demarcated nature of this tumour, and in most cases, local recurrences are uncommon. In contrast, small EGC or adenocarcinoma are often not palpable and may not be visible even when the laparoscopic resection is carried out with prior tattoo or intraoperative endoscopy. This accounted for a number of immediate reoperative cases for positive margins and delayed reoperative cases for local recurrences in our series. To avoid close or positive margins or missed satellite lesions in these situations, we now prefer to perform either a generous partial or a subtotal gastrectomy.

Other less mentioned advantages of laparoscopic gastrectomy include excellent visualization for staging of any intraperitoneal and visceral metastasis. Tissue trauma from vigorous retraction, excessive small bowel manipulation and rough handling of tissues during an open operation is avoided. The anastomosis is carried out under magnified direct laparoscopic vision, and any areas of concern may be appropriately addressed. Other theatre staff and surgical trainees will be able to follow the operation on a high-definition wide-screen monitor, with everyone in the room allowed the same view. The ability to record the procedure on a DVD as part of digital record keeping that may be retrieved for future audit and peer review purposes will be invaluable. Trainees will be able to download the information onto a DVD or other storage devices to watch the operation again at home.

The authors acknowledge the prohibitive cost for LGR especially in regards to disposable instruments and stapling devices for enteric anastomosis in a public hospital setting. At our institution, we foster a teaching environment with support for both trainees and consultants to perform laparoscopic surgery (for elective or emergency appendicectomy, cholecystectomy with or without the investigation of bile duct, inguinal hernia and small and large bowel surgery) at his or her discretion. Theatre staffs are generally well trained, are very familiar with the equipments and expect laparoscopic procedures as the norm.

## CONCLUSIONS

At present, laparoscopic gastric surgery remains an alternative treatment option but not intended to replace a curative open gastric operation. Its role in the surgical management of gastric neoplasm is still evolving. As the findings supporting the adequacy of laparoscopic nodal dissection remain in their infancy, the most appropriate indication for laparoscopic gastric surgery at the present time is for situations in which radical surgery is not warranted. This may best apply to benign lesions, in particular GIST or malignant diseases such as EGC and adenocarcinoma in the elderly and medically unfit group who are not able to undergo an open procedure.

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