

Minimal invasive gastric surgery: A systematic review

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Abstract

Background: As an alternate to open surgery, laparoscopic gastrectomy (LG) is currently being performed in many centers, and has gained a wide clinical acceptance. The aim of this review article is to compare oncologic adequacy and safety of LG with open surgery for gastric adenocarcinomas with respect to lymphadenectomy, short-term outcomes (postoperative morbidity and mortality) and long-term outcome (5 years overall survival and disease-free survival). **Materials and Methods:** PubMed was searched using query "LG" for literature published in English from January 2000 to April 2014. A total of 875 entries were retrieved. These articles were screened and 59 manuscripts ultimately formed the basis of current review. **Results:** There is high-quality evidence to support short-term efficacy, safety and feasibility of LG for gastric adenocarcinomas, although accounts on long-term survivals are still infrequent.

Key words: Gastric adenocarcinoma, laparoscopic gastrectomy, lymphadenectomy

Introduction

Gastric cancer (GC) is the fourth most common cancer and second leading cause of cancer death in the world accounting for >10% of cancer deaths worldwide.^[1] Radical gastrectomy (RG) with regional lymph node dissection (LND) still remains the gold standard and potentially curative treatment available for gastric adenocarcinoma. As an alternate to open surgery, laparoscopic gastrectomy (LG) has gained a wide clinical acceptance. According to the 10th national survey in 2010 by Japanese Society of Endoscopic Surgery (JSES), approximately 25% of gastrectomies for GCs are done laparoscopically reflecting a tenfold increase over last 10 years.^[2] According to Korean Laparoendoscopic Gastrointestinal Surgery Study Group (KLASS) survey, about 25.8% of gastrectomies in Korea were performed laparoscopically in 2009 (which is 5 times the number performed in 2004) and the numbers are on increase.^[3] There are attempts to expand the indications of LG from early distal cancers to proximal and advanced GCs (AGC) and considerable success has been achieved. LG for early GC (EGC) and AGC has now emerged in the west with progressive acceptance among various groups.^[4]

The aim of this review article to understand and establish the literary evidence regarding oncologic safety of LG when compared with open group (OG) with respect to lymphadenectomy, short-term outcomes (lymphadenectomy, postoperative mortality and morbidity) and long-term outcome (overall survival and disease free survival).

Materials and Methods

Search strategy

A comprehensive literature search was carried out for relevant Studies on PubMed using search term "LG" between January 2000 and April 2014 comparing LG and OG in the treatment of adenocarcinomas. A total of 875 entries, were retrieved. Of these, 164 articles were screened from which only 55 manuscripts were included in the review. Two more references from sources elsewhere in PubMed were added to the current review. To create solid background references from two recent books were used.^[3,5] Hence, a

total of 59 manuscripts ultimately formed the basis of current review. Figure 1 depicts the screening and inclusion flow charts as endorsed by the preferred reporting items for systematic reviews and meta-analysis workgroup.

Inclusion criteria

The studies included (1) English language articles published in peer-review journals (2) human studies (3) studies comparing LG with OG in adenocarcinomas only (4) studies with clear documentation of results and with at least one of the mentioned outcomes of interest (5) where multiple studies came from the same institute and/or authors, either the higher quality study or the more recent The publication was included in the review.

Exclusion criteria

Excluded studies (1) studies including LG for gastric tumors other than adenocarcinomas (2) studies comparing two laparoscopic surgical approaches or comparing laparoscopic and robot assisted gastrectomy (3) abstracts, citations, case reports, editorials, and studies lacking control group.

Outcome of interest

The operative outcomes included average blood loss, length of operation, type of lymphadenectomy and number of lymph nodes retrieved. Postoperative outcomes included morbidity and mortality. Long-term outcomes included 5 years survival rate and disease-free survival rates.

Results

Status of lymphadenectomy

Three types of laparoscopic LNDs are performed - D1+ α (perigastric + no. 7 lymph node along left gastric artery), D1+ β (D1 + α + 8a, 9, lymph nodes along common hepatic and celiac artery) and formal D2 nodal dissection (Japanese level 1 and 2 nodes). According to Union for International Cancer Control, the removal of at least 15 lymph nodes is beneficial for pathological examination.^[6] The literature review showed that the mean number of lymph nodes retrieved by LG was adequate and more or less comparable to open gastrectomy group [Table 1].

Kim *et al.*^[7] did a comprehensive, high-quality large-scale multicenter retrospective clinical study (KLASS trial) in

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Quick Response Code:



Website: www.sajc.org

DOI: 10.4103/2278-330X.173173

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How to cite this article: Bushan K, Sharma S, Attarde N. Minimal invasive gastric surgery: A systematic review. South Asian J Cancer 2015;4: 140-2.

Table 1: Studies comparing mean lymphnode harvest in open and laparoscopic gastrectomy

Author and year	Sample size		Extent of surgery and lymph node dissection	Mean lymph nodes harvested	
	OG	LG		OG	LG
Adachi <i>et al.</i> 2000	53	49	DG, B-I; D1+α	22.1	18.4
Yano <i>et al.</i> 2001	35	24	DG, B-I; D1+α	23.9	18.5
Miura <i>et al.</i> 2004	342	89	DG, B-II; D1, D2	31.2	19.2
Huscher <i>et al.</i> 2005	29	30	DG, B-II; R-Y; D1, D2	33.4	30
Mochiki <i>et al.</i> 2005	60	89	DG, B-I; D1+α, D1+β	25	19
Varela <i>et al.</i> 2006	21	15	PG, DG, STG, TG; B-II, R-Y; D1, D2	14	15
Pugliese <i>et al.</i> 2007	99	48	STG, TG, R-Y; D2	36	32
Hwang <i>et al.</i> 2009	83	47	DG, B-I, B-II, R-Y; D2	38.3	35.6
Du J <i>et al.</i> 2010	94	82	TG; R-Y; D2	36.4	34.2
Eom <i>et al.</i> 2012	348	100	TG, R-Y; D2	48.3	49.4
Bo <i>et al.</i> 2013	1	117	TG, R-Y; D2	37.4	35.2
	17				

DG=Distal gastrectomy, TG=Total gastrectomy, PG=Proximal gastrectomy, STG=Subtotal gastrectomy, B-I, II=Billroth I or II, R-Y=Roux en Y, OG=Open group, LG=Laparoscopic group

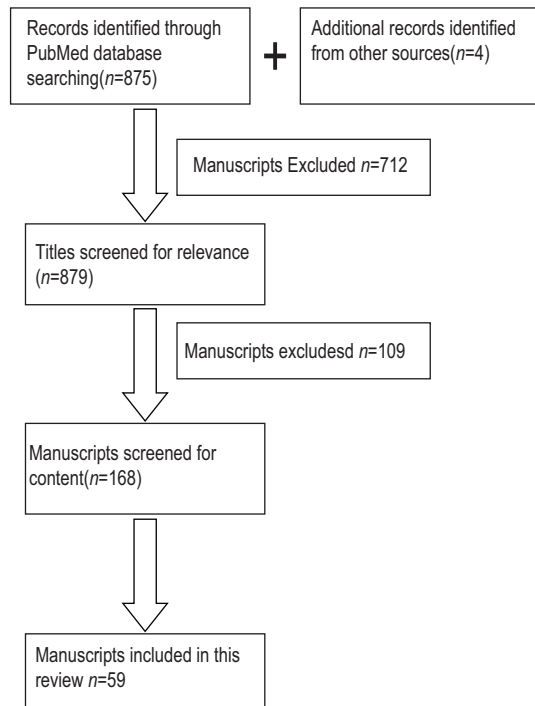


Figure 1: PRISMA flow chart showing the process by which manuscripts were selected for this review

2,976 patients who were treated with curative intent either by LG (1477 patients) or OG (1499 patients) between April 1998 and December 2005. D2 lymphadenectomy was performed in 83.5% of patients in the OG and 56.1% of patients in the LG. LG with D2 lymphadenectomy was reported to be feasible in the hands of experienced surgeons and showed no difference in outcome in morbidity or mortality when compared to OG with D2 nodal dissection. A multi-institutional Phase II trial by Japan Clinical Oncology Group, JCOG^[8] evaluating safety of LADG with nodal dissection in stage I GCs (JCOG 0703) confirmed its safety in experienced hands although the Phase III trial (JCOG 0912) to confirm the noninferiority of LADG to OG in terms of overall survival is going on. Many studies have evaluated feasibility and safety of LG with extended lymphadenectomy for AGC with potential to achieve an oncologic equivalent resection.^[9] On the contrary, many studies have reported a difference of 4 or more nodes in favor of OG group due to added LND along the splenic artery and lack of expertise laparoscopically with fear of adding morbidity by splenectomy or distal pancreatectomy.^[10]

Table 2: Studies comparing open and laparoscopic gastrectomy in terms of operation length and blood loss

Author and year	Average length of operation (min)		Average blood loss (ml)	
	OG	LG	OG	LG
Mochiki <i>et al.</i>	200	209	412	237
Siani <i>et al.</i>	185	211	495	230
Sakuramata <i>et al.</i>	218	313	407	134
Du <i>et al.</i>	212	275	339	156
Strong	126	270	150	200
Varela <i>et al.</i>	241	244	357	138
Huscher <i>et al.</i>	168	196	391	229
Adachi <i>et al.</i>	228	246	302	158
Yano <i>et al.</i>	210	219	296	108
Hwang <i>et al.</i>	208	255	440	330

OG=Open group, LG=Laparoscopic group

Table 3: Studies comparing morbidity and mortality results of open and laparoscopic gastrectomy

Author	Morbidity (%)		Mortality (%)	
	OG	LG	OG	LG
Shinohara <i>et al.</i>	28.5	24.2	0	1.1
Adachi <i>et al.</i>	21	8	0	0
Yano <i>et al.</i>	11.4	4.2	0	0
Huscher <i>et al.</i>	27.6	26.7	6.7	3.3
Varela <i>et al.</i>	24	7	-	-
Kim <i>et al.</i>	15.1	12.5	0.3	0.5
Lee <i>et al.</i>	17.6	16	4.0	0
Bo <i>et al.</i>	11.1	16.3	0	0
Pugliese <i>et al.</i>	14	10	3	2
Hwang <i>et al.</i>	12	15.6	1.2	2.2
Chouillard <i>et al.</i>	16.4	12	2.5	0
Orsenigo <i>et al.</i>	19.3	26	1.4	2.0

OG=Open group, LG=Laparoscopic group

Short-term outcomes

One of the most striking findings was a reduced number of complications including surgical and medical ones in the LG versus OG group. Analysis of data from various retrospective case series almost invariably show that LG can now be performed safely with less amount of the blood loss, less pain, early ambulation and oral feeding and early discharge; although it usually requires a little bit longer operating time [Tables 2 and 3]. Various studies^[11] noted that mean blood loss was less but operation length was more with LG as compared to OG.

Table 4: Studies showing long-term outcomes in open and laparoscopic gastrectomy

Author	5 years survival rate (%)		Disease free survival rates (%)	
	OG	LG	OG	LG
Lee <i>et al.</i>	77.5	93.2	89.0	96.9
Bo <i>et al.</i>	46.5	49.3	-	-
Shinohara <i>et al.</i>	62.0	65.8	63.7	68.1
Siani <i>et al.</i>	52.9	55.7	54.2	52.1
Mochiki <i>et al.</i>	-	-	95	98.0
Huscher <i>et al.</i>	55.7	54.8	58.9	57.3
Eom <i>et al.</i>	-	-	87.6	93.0
Lee			87.1	94.5
Chen	90.9	95	-	-
Chun	95	96	-	-
Zhao	49.2	50.3	-	-

OG=Open group, LG=Laparoscopic group

The JSES survey reported the incidence of intraoperative and postoperative complications associated with LADG as 2.0% and 12% respectively. Kim *et al.* reported the interim analysis of the KLASS-01 clinical trial. The morbidity of the case-control cohort was 17% in the OG and 13.4% in the LG, which was not statistically significant. The morbidity of the case-matched group was 15.1% in the OG and 12.5% in the LG, which was also not statistical significance.

Long-term outcomes

There are reports but not many which show noninferiority of long-term outcomes after LG when compared to OG. The 5 years overall survival rate and disease free survival rates are almost comparable between the two groups [Table 4]. The KLASS group of Korea reported the actual 5 years overall survival rate in OG and LG was 94.0% and 95.6% for stage IA, 96.9% and 92.7% for stage IB, 88.4% and 85.5% for stage IIA, 80.3% and 80.0% for stage IIB, 70.0% and 61.9% for stage IIIA, 68.8% and 47.8% for stage IIIB, and 40.0% and 33.3% for stage IIIC, respectively. Shinohara *et al.*^[12] have reported that the 5 years disease-free and overall survival rates were 65.8 and 68.1% in the LG and 62.0 and 63.7% in the OG with no differences in the patterns of recurrence between the two groups.

The issue of port site recurrences has been addressed in many studies, but needs to be thoroughly probed especially in setting of AGCs. Many studies have reported port site recurrences.^[13]

Conclusion

There is high-quality evidence to support short-term efficacy, safety and feasibility of LG for gastric adenocarcinomas, although accounts on long-term survivals are still infrequent. Many studies have demonstrated the benefits of LG over open surgery, such as less blood loss, shorter hospital stay, accelerated recovery, extended lymphadenectomy and reduced postoperative complications. Moreover, the indications are even extended from EGC to AGC. The occurrence of port site recurrences especially in advanced gastric adenocarcinomas have also been reported. Therefore, concerns like oncological effects of pneumoperitoneum, technical feasibility of systematic laparoscopic lymphadenectomy, cancer recurrence and the

long-term survival rate must still be proven. For these reasons, in a revised 2010 version of the Japanese GC Treatment Guidelines, it still remains classified as an investigational procedure eligible for stage IA and IB because no prospective study with sample size sufficient to investigate long-term benefits of LADG has ever been reported (14).^[14] Literature suggests that a good learning curve in LG is required to make it safe and sound oncologically. The JCOG study included surgeons who had performed more than 30 LG procedures and more than 30 OG procedures prior to the trial. In the KLASS trial, the participating surgeons had to have performed at least 50 LGs and 50 OGs in their own institution each year. If LG techniques can be standardized further and its safety and oncological feasibility proven by prospective randomized controlled trials with a good sample size, it is likely that in near future all patients with GC will be treated by this minimum invasive operation.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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