Review Article

Laparoscopic splenic hilar lymphadenectomy for advanced gastric cancer

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Abstract: Laparoscopic distal gastrectomy has recently become accepted as a surgical option for early gastric cancer in the distal stomach, but laparoscopic total gastrectomy (LTG) has not become widespread because of technical difficulties of esophagojejunal anastomosis and splenic hilar lymphadenectomy. Splenic hilar lymphadenectomy should be employed in the treatment of advanced proximal gastric cancer to complete D2 dissection, but laparoscopically it is technically difficult even for skilled surgeons. Based on the evidence that prophylactic combined resection of spleen in total gastrectomy increased the risk of postoperative morbidity with no survival impact, surgeons have preferred laparoscopic spleen-preserving splenic hilar lymphadenectomy (LSPL) for advanced tumors without metastasis to splenic hilar nodes or invasion to the greater curvature of the stomach, and reports with LSPL have been increasing rather than LTG with splenectomy. In this paper, recent reports with laparoscopic splenic hilar lymphadenectomy were reviewed.

Keywords: Laparoscopic total gastrectomy (LTG); splenic hilar lymphadenectomy; advanced gastric cancer; spleen-preserving; splenectomy

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Introduction

Laparoscopic distal gastrectomy (LDG) has become widespread as a treatment of early gastric cancer in the distal stomach especially in Eastern Asia with the short-term advantages such as less blood loss and prompter postoperative recovery (1). LDG has recently been applied to advanced gastric cancer, and several large-scale randomized controlled trials comparing open and laparoscopic distal gastrectomy for advanced gastric cancer in the distal stomach have been performed in Korea and Japan (2,3) to evaluate feasibility and long-term oncologic outcome of LDG. However, the use of laparoscopic total gastrectomy (LTG) remains limited because of the high technical demands of esophagojejunostomy (4-6) and the complexity of lymphadenectomy at the splenic hilum (5,7,8-21). Because of the variation of the vascular anatomy in the splenic hilum and with the concern of pancreas-related complications, splenic hilar lymphadenectomy is technically challenging even for skilled surgeons. Based on the evidence that prophylactic combined resection of spleen in total gastrectomy increased the risk of postoperative morbidity (22,23) or had no survival benefit (24,25), surgeons have preferred laparoscopic spleen-preserving splenic hilar lymphadenectomy (LSPL) (8-19) rather than LTG with splenectomy (20,21). Since the first report by Hyung *et al*. (8) in 2008, the number of studies with acceptable feasibility of LSPL has increased (8-19). For further advanced cases, such as with metastasis to splenic hilar nodes or invasion to the greater curvature

of the stomach, or with direct invasion to distal pancreas, LTG with splenectomy, sometimes with combined resection of distal pancreas has been performed (19-21). In this paper, the recent reports of LTG with splenic hilar lymphadenectomy were reviewed.

Inclusion/exclusion criteria for the review

For the review of laparoscopic splenic hilar lymphadenectomy, an English literature search was performed on the PubMed database using the terms "gastric cancer" AND "laparoscopic" AND "splenic hilar lymphadenectomy" along with their synonyms or abbreviations on December 23, 2015. Case series including less than 10 patients, or technical reports without surgical outcomes were excluded to keep the quality of the review. The endpoints were clinical indication, the length of the operation, blood loss, conversion, overall morbidity, mortality, length of the hospital stay, and number of harvested lymph nodes (in total and in the splenic hilum). As a result, 15 studies were included in this review. Tumor stage was classified according to the 7th edition of TNM classification (26). Postoperative complications were classified according to the Clavien-Dindo classification system (27).

Laparoscopic spleen-preserving splenic hilar lymphadenectomy (LSPL) (*Table 1*)

Since Hyung *et al*. (8) firstly reported the initial case series of LSPL with the acceptable feasibility, the number of patients included in the following studies has increased. Some technical reports provided better anatomical understandings. We have proposed efficient lymphadenectomy technique with 'medial approach' (5) by identifying the membranous border between the perigastric tissue and the surface of the retroperitoneum. The concept following the perigastric fascias and the intrafascial space based on embryological and anatomical background was also helpful (11). Together with the technical progress, comparative study of laparoscopy-assisted total gastrectomy (LATG) with LSPL and open total gastectomy for clinical T1-T2 tumors (9) was performed. Longer operation time, less blood loss, and earlier postoperative recovery were found in LATG with LSPL, which was consistent with the previous results of LDG (1). Gradually this operative procedure was applied to more advanced tumors (10-12,14-19), unless they had definite lymph node enlargement in the splenic hilum or direct tumor invasion of the gastrosplenic ligament. Among the 13 studies with LSPL, the indication was up to T2 in three studies, and up to T3 in five and T4a in five studies, respectively. The overall morbidity rate was 6–19%, which was acceptable, but Lu *et al*. (15) revealed in the study with 325 cases, that BMI exceeding 25 kg/m^2, tumor location in the greater curvature, and No.10 LN metastases were significantly associated with increased rates of major perioperative complications, and further consideration of optimal indication seemed required. Because there are anatomical variations in the splenic hilum, preoperative evaluation by three-dimensional (3D) CT angiography was helpful to accomplish LSPL safely (12,14,16,18). Kinoshita *et al*. (16) used integrated 3D anatomic simulation software, which was also helpful in enhancing the quality of surgery. Robotic approach might be also helpful in completing technically-demanding LSPL procedure with current laparoscopic instruments (13).

Regarding the surgical outcomes of LSPL among the 13 studies, the operation time and blood loss ranged from 162 to 359 minutes, and 18 to 201 g, respectively. The length of hospital stay ranged from 7 to 13 days. The mortality rate was extremely low, and with the low overall morbidity rate (6–19%), LSPL seemed technically feasible with acceptable short-term surgical outcome.

LTG with splenectomy (*Tables 2,3*)

Because prophylactic combined resection of spleen increased the risk of postoperative morbidity (22,23) with no survival benefit (24,25) in open total gastrectomy, the reports on LTG with splenectomy were limited (19-21). There were only small case series so far. The indication was for advanced tumors such as T3-T4aN1-2 (19), or tumors invading the greater curvature of the upper third of the stomach, pancreatic parenchyma, or spleen (20), in which splenectomy was mandatory to accomplish R0 resection. These reports showed technical feasibility of this procedure, but the number of the patients included in the studies were limited. Further larger study is required for precise evaluation of this procedure.

Discussion

Splenic hilar lymphadenectomy should be employed in the treatment of advanced proximal gastric cancer to complete D2 dissection, and LTG with LSPL or splenectomy are selected. Because combined splenectomy increased

Table 1 Laparoscopic spleen-preserving splenic hilar lymphadenectomy

Author (ref)	Year	n	Clinical indication	Operation time (min)	Blood loss (g)	Conversion (%)	Morbidity[b] (%)	Mortality (%)	Hospital stay (days)	Harvested LNs (n)	Splenic hilar LNs (n)	Novelty
Hyung *et al*., (8)	2008	15	cT1–2, cN0–1	211	68	0	13.0[c]	0	7.0	57.0	2.7	Novel technical report
Okabe *et al*., (7)	2010	53[a]	Stage IA–IIIB	359	187	1.9	19.0	0	13.0	51.0	2.6	Laparoscopic medial approach technique
Guan *et al*., (9)	2013	41	cT1–2	236	104	2.4	4.9[c]	0	9.7	23.0	1.1	Earlier recovery than open total gastrectomy
Mou *et al*., (10)	2013	12	Stage IIA–IIIC	268	150	0	0	0	9.4	24.0	4.8	Technically feasible for advanced cancer
Huang *et al*., (11)	2014	54	T2–3	162	42	0	9.3[c]	0	10.3	40.0	3.0	Technically feasible following the perigastric fascia
Li *et al*., (12)	2014	108	T2–3	169	46	0	12.0[c]	0	11.9	44.0	3.0	With multi-slice spiral CT angiography
Son *et al*., (13)	2014	58	T1b–T2	210	201	0	8.6	0	7.9	43.0	0.8	Robotic versus laparoscopic
Wang *et al*., (14)	2014	312	T2–T4a	174	50	NE	15.0[c]	0	12.3	43.0	2.9	With 3-dimensional CT
Lu *et al*., (15)	2015	325	T2–T3	174[d], 224[e]	NE	0	2.5[f]	0.6	12.0[d], 20.0[e]	NE	NE	Risk factors of perioperative complications

Table 1 (*continued*)

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Author (ref)	Year	n	Clinical indication	Operation time (min)	Blood loss (g)	Conversion (%)	Morbidity[b] (%)	Mortality (%)	Hospital stay (days)	Harvested LNs (n)	Splenic hilar LNs (n)	Novelty
Kinoshita *et al*., (16)	2015	20	Up to T3N1M0	318	18	0	0	0	8.0	43.0	2.0	With 3-dimensional anatomic simulation software
Wang *et al*., (17)	2015	16	T2–T4a	329	136	0	6.0	0	9.6	28.0	4.3	Technically feasible with omnibearing method
Zheng *et al*., (18)	2015	317	Up to T4a	175	54	NE	6.9[c]	NE	12.0–13.0[g]	40.0–44.0[g]	2.5–3.0[g]	Analysis of splenic hilar vascular anatomy
Usui *et al*., (19)	2015	159	T2–3, N0	339	106	0	0	0	8.4	40	1.3	In comparison with combined splenectomy

[a], including cases with D1+ LN dissection; [b], grade II or more by Clavien-Dindo classification; [c], grade not mentioned; [d], without major perioperative complications (n=310); [e], with major perioperative complications (n=15); [f], grade IIIa or higher; [g], with subgroup analysis by variation of vascular anatomy; LN, lymph node; NE, not evaluated.

Table 2 Laparoscopic total gastrectomy with splenectomy

Author (ref)	Year	n	Clinical indication	Operation time (min)	Blood loss (g)	Conversion (%)	Morbidity[a] (%)	Mortality (%)	Hospital stay (days)	Harvested LNs (n)	Splenic hilar, LNs (n)	Novelty
Nakata *et al*., (20)	2015	18	T1bN1–	388	45	0	33	0	12	51	NE	Technically feasible
Usui *et al*., (19)	2016	19[h]	T3–T4a, N1–2	357	210	NE	0	0	14	41	2.4	Technically feasible

[a], including cases with D1+ LN dissection; [h], 12 cases were hand-assisted; LN, lymph node; NE, not evaluated.

Table 3 Laparoscopic total gastrectomy with D2 lymphadenectomy

Author (ref)	Year	n	Clinical indication	Operation time (min)	Blood loss (g)	Conversion (%)	Morbidity[a] (%)	Mortality (%)	Hospital stay (days)	Harvested LNs (n)	Splenic hilar, LNs (n)	Novelty
Lee *et al*., (21)	2012	94[i]	Up to T4aN1	230	150	0	18	0	7.4	61	NE	D2 lymphadenectomy feasible

[a], including cases with D1+ LN dissection; [i], 46 cases with spleen-preserving, and 48 cases with splenectomy; LN, lymph node; NE, not evaluated.

the risk of postoperative morbidity and mortality in randomized clinical trials and could not show survival benefit compared with spleen preservation (22-25), routine or prophylactic splenectomy is not recommended by National Comprehensive Cancer Network guidelines (28). Recently, a large, multicenter, randomized controlled trial with 505 patients comparing splenectomy with spleen preservation on the proximal gastric cancer was performed (29,30). Proximal gastric adenocarcinoma of T2-4/N0-2/M0 not invading the greater curvature was eligible, and splenectomy resulted in higher morbidity, larger blood loss, and no survival advantage. The 5-year overall survivals were 75.1% and 76.4% in the splenectomy and spleen-preserving arms respectively, and the non-inferiority of spleen preservation was confirmed. They concluded that prophylactic splenectomy should be avoided not only for operative safety but also for survival benefit.

Even with the evidence described above, further advanced tumors such as those with direct invasion of the gastrosplenic ligament, pancreatic parenchyma, or spleen need to be resected by total gastrectomy with splenectomy, sometimes with combined resection of distal pancreas. Laparoscopic resection of such advanced tumors is technically demanding because huge tumor prevents laparoscopic view, or handling of the tumor is sometimes difficult, and care must be taken not to manipulate the tumor. Technical improvement for better short-term outcomes and validation of oncological outcomes with longer follow-up data would be required.

LTG with LSPL has gradually become popular with acceptable surgical outcomes, but careful interpretation is required. These excellent surgical results were provided by laparoscopic expert surgeons. Even if prophylactic splenectomy was denied, D2 lymphadenectomy for advanced gastric cancer is still a standard (31) for advanced gastric cancer. LTG with LSPL is still technically difficult for many surgeons and cannot be a standard at this moment. Further technical progress or acceptance of more simplified concept of lymphadenectomy, such as 'D2-No.10' lymphadenectomy for some limited cases might be required for LTG to be a first choice for advanced gastric cancer.

Conclusions

With the short-term advantage over open gastrectomy, laparoscopic gastrectomy has been applied not only in early but also advanced gastric cancer, or more complicated procedures such as LTG with LSPL or splenectomy.

With the development of laparoscopic devices, advanced knowledge of laparoscopic view, and accumulated technical experiences, such laparoscopic advanced surgery could be feasible in near future. And by overcoming a critical validation of oncological outcomes, it still has a chance to be a procedure of choice as a treatment for advanced gastric cancer.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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