HHS Public Access

Author manuscript

J Surg Res. Author manuscript; available in PMC 2021 July 01.

Published in final edited form as:

J Surg Res. 2020 July ; 251: 168–179. doi:10.1016/j.jss.2020.02.005.

Quality of Life after Curative Resection for Gastric Cancer: Survey Metrics and Implications of Surgical Technique

Yinin Hu, MD[1], **Victor M. Zaydfudim, MD MPH**[2,3]

[1]Department of Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, 20065

[2]Division of Surgical Oncology, University of Virginia, Charlottesville, VA, 22908

[3]Surgical Outcomes Research Center, University of Virginia, Charlottesville, VA 22908

Abstract

Gastric cancer is one of the most common cancers worldwide, and radical gastrectomy is an integral component of curative therapy. With improvements in perioperative morbidity and mortality, attention has turned to short- and long-term post-gastrectomy quality of life. This article reviews the common psychometric surveys and preference-based measures used among patients following gastrectomy. It also provides an overview of studies that address associations between surgical decision-making and postoperative health-related quality of life. Further attention is focused on reported associations between technical aspects of the operation, such as extent of gastric resection, minimally-invasive approach, pouch-based conduits, enteric reconstruction, and postoperative quality of life. While there are several randomized studies that include quality of life outcomes, much remains to be explored. The relationship between symptom profiles and preference-based measures of health state utility is an area in need of further research.

INTRODUCTION

Gastric cancer is the 6th most common cancer worldwide with more than 1 million new cases annually, and is the second leading cause of cancer mortality (1). In the United States, roughly 27,500 new cases are diagnosed each year (2). Since the landmark MAGIC trial, a multimodal approach to locally-advanced gastric cancer has become standard in Western populations (3). However, radical gastrectomy remains integral to the treatment of non-metastatic gastric cancer, and at present nearly 50% of stage IB-III gastric cancers in the United states continue to be treated with surgery alone (4).

CORRESPONDING AUTHOR: Victor M. Zaydfudim, MD MPH, Associate Professor of Surgery, Division of Surgical Oncology, University of Virginia, Charlottesville, VA 22908, vz8h@virginia.edu, Office: 434-924-0391.

AUTHOR CONTRIBUTIONS:

Hu: Conception and design; acquisition of data; analysis and interpretation of data; drafting of the manuscript; final approval of the manuscript; agreement to be accountable for all aspects of the work

Zaydfudim: Conception and design; analysis, synthesis, and interpretation of data; revising the manuscript critically for important intellectual content; final approval of the manuscript; agreement to be accountable for all aspects of the work

Major advances in the safety, patient selection and perioperative care have improved short-term outcomes of radical gastrectomy. Perioperative mortality has decreased from over 15% in the 1990's to less than 5% in modern series (5–8). With improvements in survival, long term impact of major gastrectomy on quality of life has been refocused as an area of academic interest. Despite the durable presence of gastrointestinal symptoms including reflux, early satiety, and episodic nausea, global quality of life appears not impaired permanently following gastrectomy (9). This finding suggests that quality of life is a construct that is broader than physical symptoms, and encompasses perception of disease, psychological well-being, and social health – commonly defined as health-related quality of life (HRQoL). Although measures of HRQoL are commonly incorporated into prospective clinical trials, the interpretation and real-world utility of these findings is poorly understood (10). The relative weight of HRQoL outcomes compared against more traditional measures of clinical efficacy in cancer care—such as recurrence-free survival and overall survival—is under-explored. As a result, while there is a plethora of questionnaires relevant to HRQoL, incorporation of these data into clinical decision-making is frequently underutilized (11).

To better understand the role of HRQoL in surgical decision-making among patients with gastric cancer, surgeons should become acquainted with the available questionnaires and the higher-level evidence behind post-gastrectomy quality of life. In this review we summarize the most common gastric cancer HRQoL metrics. We further focus on patients selected for radical/major gastrectomy with curative intent and the relationship between surgical approach and quality of life.

METHODS

Literature search

We conducted a non-systematic review of the English-language literature to identify peer-reviewed articles pertinent to quality of life after gastric cancer resection. The MEDLINE database was queried for commonly-used quality of life metrics along with the keywords "gastric cancer, stomach cancer, gastric neoplasm, stomach neoplasm, gastric malignancy, and stomach malignancy." For each metric, database queries were conducted using the full survey title and the shorthand acronym—i.e., "FACT" and "functional assessment of cancer therapy." Resulting abstracts were reviewed for relevancy; duplicate articles and articles that did not explicitly state the quality of life metric used were excluded. Survey metrics were categorized by frequency of use based on the number of articles returned via query: low frequency (less than 5 articles), moderate (5-50 articles), and high (greater than 50 articles).

Comparative Summaries

Articles from the above query were reviewed for relevancy to the gastrectomy population and for study size and quality. Study methods were categorized as prospective or retrospective cohorts, cross-sectional studies, or randomized controlled trials. Where available, randomized controlled trials were more heavily emphasized over other study designs. Comparisons of global quality of life included those which describe a global quality of life score, a generalized satisfaction scale, or a summative total score. Published differences pertaining to individual symptoms were logged separately. Only statistically

significant differences between comparison groups are reported in the corresponding summary tables.

SURVEY METRICS

Components of gastric cancer-related HRQoL include gastrointestinal symptoms, systemic symptoms, global functioning, and social and psychological health. Over the past 20 years, there has been increasing interest in creation and validation of HRQoL questionnaires. When selecting a questionnaire relevant to a treatment population, a surgeon or researcher should be attentive toward the relative emphases of individual HRQoL surveys. A summary of characteristics of each of the major gastrectomy-relevant HRQoL assessment tools is provided in Table 1.

GIQLI

Originally reported in 1995, the Gastrointestinal Quality of Life Index (GIQLI) was developed and validated in Germany as a quality of life questionnaire directed toward patients with any type of gastrointestinal diseases (12). Since that time, the survey has been translated to more than a dozen languages. Comprised of 36 questions, the survey encompasses gastrointestinal and non-gastrointestinal symptoms, physical functioning, psychological health, and social health. More recently, shortened versions of the survey have become available (GIQLI-10 and GIQLI-20). Despite wide applicability, GIQLI was not developed or initially implemented in patients with cancer; for this reason, more cancer-specific metrics have gradually replaced GIQLI in applicability and popularity among gastric cancer patients.

EORTC QLQ-C30 and QLQ-STO22

The European Organisation for Research and Treatment of Cancer's (EORTC) QLQ-C30 questionnaire was introduced in 1993 (13). Robustly validated and available in numerous languages, it is one of the most commonly-used questionnaires directed at the symptoms and functional capacity of cancer patients. Among its 30 questions are domains addressing global, social, emotional, cognitive, physical, and role functions, as well as common cancer-related symptoms. In 2001, a disease-specific module, QLQ-STO22, was introduced to measure and compare HRQoL in patients with gastric cancer (14). Focused principally on upper gastrointestinal symptoms, the QLQ-STO22 gastric module is applicable to all aspects of multimodal gastric cancer therapy (15). Importantly, the QLQ-C30 is the only commonly-used, cancer-related English language questionnaire that includes a component on financial difficulty. Although the QLQ-C30 with QLQ-STO22 is arguably the most comprehensive HRQoL package, its length creates challenges for frequent administration. Patients on average require 15 minutes to complete its 52 questions (15).

FACT-GA

The Functional Assessment of Cancer Therapy – General (FACT-G) is a broad, cancer-specific questionnaire comprised of 27 questions encompassing physical, social, emotional, and functional wellbeing (16). Introduced in the same period as the QLQ-C30, the FACT-G addresses broad perceptions of quality of life rather than specific symptoms. To supplement

this, a gastric cancer-specific module of an additional 19 symptoms-focused items was introduced in 2004 and validated in 2011 (17). FACT-GA has been validated in numerous languages. When compared against items in QLQ-C30 and QLQ-STO22, FACT-GA is less granular regarding the ability to tolerate different types of food, does not include a question on financial difficulty, and does not possess a global health component (18).

MDASI-GI

The M. D. Anderson Symptom Inventory (MDASI) is a relatively short (19 questions) HRQoL metric introduced in 2000 (19). Focused primarily on physical symptoms, this survey tool concisely incorporates 1-2 questions each on broader emotional, social, and physical functionality. The MDASI-GI module also includes an additional 5 items specifically addressing GI symptoms of constipation, dysphagia, taste, bloating, and diarrhea (20). Its spectrum of available languages is limited to English, Chinese, Spanish, and Danish. While less comprehensive than the QLQ-C30 STO22 or the FACT-GA and less-often implemented, brevity of MDASI-GI can be an advantage in select testing environments. At 24 questions, it is less than half the length of the QLQ-C30 STO22 and may be more appropriate for frequent testing.

PROMIS

Beginning in 2004, the National Institutes of Health began a cooperative movement to promote the collection of patient-reported outcomes using a publicly available and flexible HRQoL system. The Patient-Reported Outcomes Measurement Information System (PROMIS) stemmed from that project and has expanded from an initial 11 self-reported outcome item banks in 2010 to hundreds within 10 years (21). Item banks are individually validated, and scoring is unique to each item bank. Electronic tools are available to facilitate data collection and scoring. Rather than target specific disease categories, PROMIS item banks are organized by HRQoL domain. Investigators must select from the item banks to build proprietary metrics specific to the purpose of each study. Within the gastrointestinal domain, item banks address pain, bowel function, dysphagia, bloating, and nausea. By design, the primary advantage of PROMIS is its flexibility to measure nearly any HRQoL item of interest. However, while this system is suitable for studies directed at specific questions, it might be less applicable for comprehensive evaluation of a patient population. This is because, while each item bank may be as short as 4-6 questions, accounting for all aspects of HRQoL requires multiple item banks and rapidly increases the total metric length. Similarly, due to its proprietary nature, placing PROMIS data from one study within the context of a greater body of literature could be challenging, as otherwise comparable studies may use different collections of item banks. Perhaps for these reasons, to date, PROMIS has not been widely used in gastric cancer studies, and when used has been generally limited to only one or two of its directed item banks (22, 23).

Non-English Language Metrics

At present, there is no English language metric that specifically addresses the post-gastrectomy health-state. In Asia, where gastric cancer is considerably more prevalent, metrics have been designed and validated to measure specific post-gastrectomy symptoms. These include the Esophagus and Stomach Surgery Symptom Scale [ES(4)] (24), the

Esophageal Symptoms Questionnaire (ESQ) (25), the Dysfunction after Upper Gastrointestinal Surgery for Cancer (DAUGS32) (26), and the Postgastrectomy Syndrome Assessment Scale (PGSAS-45) (27). While the ES(4), ESQ, and DAUGS32 are exclusively symptoms-based, the PGSAS-45 includes questions on broader domains of HRQoL. In Japan, the PGSAS-45 has been used extensively to measure the impact of surgical technique on postoperative enteric function: studies include pylorus-preserving gastrectomy, total versus proximal gastrectomy, reconstruction techniques, and minimally-invasive approaches (28–31). Validation of these postgastrectomy HRQoL metrics in Western populations would provide an important advance in the evaluation and comparison of quality of life.

GASTRECTOMY AND GLOBAL QUALITY OF LIFE

Radical gastrectomy, like most operations, temporarily decreases HRQoL. This transient reduction is present regardless of the extent of resection (32). Frequently summarized as “post-gastrectomy syndrome,” common symptoms include early satiety, abdominal cramping, diarrhea, and dumping (33). While these symptoms may persist for greater than 1 year, recovery of global HRQoL frequently predates symptom resolution (34–37). In a large single institution longitudinal study using the QLQ-C30 STO22, several symptom scores remained lower than preoperative baseline 12 months after surgery (37). However, global quality of life and emotional functioning were higher than baseline as early as 3 months after gastric resection. In a longitudinal cohort study from a major US cancer center, global quality of life recovered to near-baseline within 6 months for two-thirds of patients. However, symptoms including nausea, fatigue, and appetite loss remained below baseline beyond 12-18 months (38). Another multi-institutional Dutch study surveyed a cross-sectional cohort of patients at a median of 29 months after gastrectomy and compared responses to those from a healthy reference population (39). While the gastrectomy population reported significantly worse scores for all functional domains and nearly all symptom scales, the magnitude of the difference in global HRQoL was not clinically relevant.

Surveys that assess patients’ symptoms and functionality through directed questions are categorized as psychometric measures. Data derived from these metrics underscore a disconnect between physical symptoms and the overall perception of post-surgical health state. Further sections within this review primarily focus on the impact of various surgical approaches on post-gastrectomy HRQoL derived from psychometric measures. However, symptom profiles may not be the primary determinants of perceptions of global quality of life. Preference-based measures (PBMs) that encapsulate perceptions of cancer, cure, recurrence, and risk-aversion are necessary to fully represent therapeutic impact and value. These valuations are crucial as endpoints for comparative- and cost-effectiveness research, because conversions between symptom profiles and utility units such as quality-adjusted life-years (QALYs) are often imprecise.

Popular preference-based measures (PBM) include standard gamble and time trade-off. The EQ-5D and SF-6D are general psychometric surveys that have been mapped against PBM’s and are often used as estimates of health state utility. However, these surveys are not tailored for cancer patient populations (40). Formulae that convert QLQ-C30 results to PBM-type

utility units have been described (41, 42), however these conversions are also not specific to gastric cancer. A systematic review published in 2015 summarized gastric cancer PBM studies, most of which pertained to patients with advanced, unresectable gastric cancer (43). Since this published review, four additional studies have estimated that the utility of the post-gastrectomy health state is between 0.77 and 0.85 (44–47). Three of the studies were derived from East Asian populations, while one was from Portugal. Importantly, none of these studies addressed the early post-operative health state. Thus, the short-term utility cost associated with recovery from gastrectomy is an area in need of further investigation.

RESECTION APPROACH

Extent of Resection

Numerous prospective, randomized trials have indicated that the extent of gastrectomy does not impact survival outcomes in gastric cancer, provided resection margins are appropriate (48–50). While these early trials did not incorporate HRQoL, it may be reasonable to consider that a partial gastrectomy retains partial gastric function and physiology and may translate to superior HRQoL. Studies assessing the association between extent of gastric resection and HRQoL predominantly can be categorized as: 1) large, multi-institutional cross-sectional studies and 2) small longitudinal cohort studies (Table 2). Comparing subtotal or distal gastrectomy against total gastrectomy, the overarching pattern is that total gastrectomy is associated with worse upper gastrointestinal symptoms such as nausea, dysphagia, daily meal requirements, and reflux (38, 51–58). Broader measures of functioning also tend to be lower after total gastrectomy (55, 56, 58–60), however, several studies found no significant association between global HRQoL and extent of resection (52, 54, 57). One randomized trial compared total gastrectomy, subtotal gastrectomy, and subtotal gastrectomy with an S-shaped jejunal conduit (61). Unfortunately, with only 64 participants, the trial was underpowered to detect meaningful differences in most measures of HRQoL.

For cancers of the upper one-third of the stomach, proximal gastrectomy was at one point a popular form of resection. However, a meta-analysis of prospective and retrospective studies found that proximal gastrectomy was associated with higher likelihoods of significant gastrointestinal symptoms including reflux esophagitis and anastomotic stricture (62). These findings were recently corroborated by a propensity-matched analysis (63). Importantly, most patients in these studies underwent circular stapled esophago-gastric or esophago-jejunal anastomoses. In a small, randomized prospective trial, proximal gastrectomy with J-pouch reconstruction appeared to outperform total gastrectomy in measures of weight gain, post-gastrectomy symptoms, and B12-deficiency anemia (64).

While more limited lymphadenectomy strategies—i.e., D1 or modified D2—continue to be performed in Western populations, extended lymph node dissections remain pervasive in Eastern series. In a randomized trial comparing D1 and D3 resections, no difference was noted in HRQoL as measured by the Spitzer QOL index and functional symptom scores (9).

Open vs. Minimally-Invasive

Since its introduction in the 1990s, the minimally-invasive approach to radical gastrectomy has gained in popularity. High-level data including systematic reviews and meta-analysis suggest equivalent oncologic outcomes—i.e., recurrence and survival—between minimally-invasive and open gastrectomy at experienced centers (65, 66). Laparoscopic-assisted gastrectomy has been associated with lower major complication rate, blood loss, hospital length of stay, time to flatus, and analgesic use at the expense of longer operative time (66).

Several randomized trials assessing laparoscopic gastrectomy have incorporated measures of quality of life as secondary outcomes. While the KLASS-01 and JCOG0912 trials both collected quality of life data using QLQ-C30 STO22, only survival outcomes have been reported to date (67, 68). The COACT0301 trial, which randomized patients with early-stage gastric cancer to either open (ODG) or laparoscopic distal gastrectomy (LADG), did report HRQoL secondary endpoints. Within the first 3 months following surgery, LADG was associated with higher global quality of life, physical and emotional functioning, dysphagia, dietary restriction, dry mouth, reflux, pain, and body image (69, 70). However, among these items, only dysphagia remained different beyond 1 year. A small but novel randomized trial comparing ODG and LADG measured capacity for physical activity using an activity sensor in the early postoperative setting (days 1-7). Patients who underwent ODG lagged behind LADG counterparts in physical activity by about 3 days, and in pain score by about 2 days (71). In a meta-analysis, totally-laparoscopic gastrectomy was compared against laparoscopic-assisted gastrectomy. With the laparoscopic-assisted approach, lymphadenectomy is performed laparoscopically, while the gastric resection and reconstruction is performed through a mini-laparotomy. The totally laparoscopic approach outperformed the laparoscopic-assisted approach in measures of pain and analgesic use (72). The ongoing laparoscopic versus open gastrectomy for gastric cancer (LOGICA) trial from the Netherlands, which opened in 2014, incorporates both QLQ-C30 STO22 as well as the EQ-5D (73). This is the only Western randomized trial comparing laparoscopic versus open gastrectomy that incorporates a validated HRQoL metric. However, with the shortest survey interval scheduled at 6 weeks after surgery, early HRQoL differences between groups will not be addressed.

Across non-randomized studies, LADG generally outperforms ODG in a variety of post-gastrectomy symptoms including fatigue, pain, dietary restrictions, dysphagia, reflux, and body image (36, 74–76). Published study characteristics are summarized in Table 3. As was the case for studies on extent of resection data, associations between the laparoscopic approach and global HRQoL were less common. Studies by Kobayashi et al. and Lee et al. noted advantages in global quality of life for laparoscopically-resected patients, but the differences were only present within the first month after surgery (36, 76).

RECONSTRUCTION

Pouch Creation

There are a number of methods to recreate an alimentary reservoir during reconstruction following total gastrectomy. In general, pouch-based methods were associated with lower

rate of dumping symptoms, esophagitis, and dietary restrictions (77). Although numerous randomized trials have tested the function of pouch-based reconstruction, few have utilized validated and publicly-available HRQoL metrics. Among the trials that did employ such metrics, most have identified associations between a pouch-based approach and higher global HRQoL (78–80). When present, HRQoL advantages of pouch-based reconstruction appear to be durable, with effects lasting 12 months or longer following surgery.

Alternatives to the traditional Hunt-Lawrence pouch are common. In a comparison between a two-pouch technique (Hunt-Lawrence plus a jejunojejunostomy pouch) and the traditional Hunt-Lawrence technique, the two-pouch approach was associated with higher global HRQoL at 12 months (81). On the other hand, the addition of a jejunal interposition to a traditional Hunt-Lawrence jejunal pouch did not appear to further improve HRQoL (82). Conversely, the addition of a jejunal pouch to a standardized interposition approach also did not appear to impact HRQoL (83). All these trials are limited by their single-institution nature; replication in more diverse populations is necessary to draw definitive conclusions regarding the benefits of pouch-based reconstruction (Table 4).

Billroth II vs. Roux-en-Y

Among patients who undergo distal gastrectomy, there are three broad options for reconstruction: Billroth I (B-I), Billroth II (B-II), and Roux-en-Y. In populations that undergo routine screening, antral gastric cancers are frequently detected at early stages. In such cases, a B-I reconstruction is frequently adopted as the most technically simple approach. However, for locally-advanced gastric cancers, a partial gastrectomy may not leave an adequate remnant for a B-I anastomosis. In these situations, the primary decision point is between B-II or Roux-en-Y reconstruction. In a meta-analysis of randomized trials, Roux-en-Y reconstruction was associated with greater risk of delayed gastric emptying, but lower risk of remnant gastritis and bile reflux compared to B-I or B-II approaches (84). However, differences in endoscopic findings frequently do not translate to significant differences in patient-reported HRQoL (85, 86).

Several randomized trials have compared Roux-en-Y against B-I or B-II reconstruction using validated HRQoL metrics. There are additional studies that have used longitudinal cohort or cross-sectional survey approaches. However, these studies are susceptible to selection bias since many surgeons choose between reconstruction options based on anatomy and the size of the gastric remnant. For this reason, only randomized clinical trials are summarized in Table 4. In general, the three approaches are comparable in terms of global HRQoL, and only rarely differ in upper gastrointestinal symptoms. When interpreting these studies, one must note that no corrections were made for multiple testing. Thus, the clinical significance of one or two symptomatic differences noted at individual time points is unclear. An ongoing multi-center phase III trial from China which aims to randomize over 800 patients to B-II versus Roux-en-Y includes HRQoL as a secondary objective (87).

CONCLUSION

Unlike traditional clinical outcomes such as survival, recurrence, or perioperative mortality, HRQoL is a complex, multifaceted endpoint. It incorporates subjective measures of

postoperative symptoms as well as overall perceptions of health. Research from Western institutions tend to use one of four validated gastric-specific questionnaires, however, more modern PROMIS metrics are growing in popularity. In general, limiting the extent of resection when feasible and considering pouch-based reconstruction after total gastrectomy may be associated with higher long-term global quality of life. On the other hand, selection between a laparoscopic versus open approach or Billroth versus Roux-en-Y reconstruction are less likely to affect global HRQoL in a durable manner. Many existing studies are limited by sample size, selection bias, or multiple-testing, but several ongoing trials may improve our understanding of the relationship between surgical technique and post-gastrectomy quality of life. As comparative- and cost-effectiveness research becomes more sophisticated, further comparisons are necessary to address the relationship between traditional HRQoL metrics and preference-based measures of health state utility.

Acknowledgments

FUNDING: This work was supported by the L30 CA220861 Award from the National Cancer Institute and Grant #IRG 81-001-26 from the American Cancer Society to VMZ.

References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018 11;68(6):394–424. [PubMed: 30207593]
2. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2019. CA Cancer J Clin. 2019 1;69(1):7–34. [PubMed: 30620402]
3. Cunningham D, Allum WH, Stenning SP, Thompson JN, Van de Velde CJ, Nicolson M, et al. Perioperative chemotherapy versus surgery alone for resectable gastroesophageal cancer. N Engl J Med. 2006 7 6;355(1):11–20. [PubMed: 16822992]
4. Jabo B, Selleck MJ, Morgan JW, Lum SS, Bahjri KA, Aljehani M, et al. Comparison of perioperative chemotherapy with adjuvant chemoradiotherapy for resectable gastric cancer: findings from a population-based study. J Gastrointest Oncol. 2018 2;9(1):35–45. [PubMed: 29564169]
5. Cuschieri A, Fayers P, Fielding J, Craven J, Bancewicz J, Joypaul V, et al. Postoperative morbidity and mortality after D1 and D2 resections for gastric cancer: preliminary results of the MRC randomised controlled surgical trial. The Surgical Cooperative Group. Lancet. 1996 4 13;347(9007):995–9. [PubMed: 8606613]
6. Bonenkamp JJ, Songun I, Hermans J, Sasako M, Welvaart K, Plukker JT, et al. Randomised comparison of morbidity after D1 and D2 dissection for gastric cancer in 996 Dutch patients. Lancet. 1995 3 25;345(8952):745–8. [PubMed: 7891484]
7. Randle RW, Swords DS, Levine EA, Fino NF, Squires MH, Poultsides G, et al. Optimal extent of lymphadenectomy for gastric adenocarcinoma: A 7-institution study of the U.S. gastric cancer collaborative. J Surg Oncol. 2016 6;113(7):750–5. [PubMed: 26996496]
8. Gosselin-Tardif A, Lie J, Nicolau I, Molina JC, Cools-Lartigue J, Feldman L, et al. Gastrectomy with Extended Lymphadenectomy: a North American Perspective. J Gastrointest Surg. 2018 3;22(3):414–20. [PubMed: 29124550]
9. Wu CW, Chiou JM, Ko FS, Lo SS, Chen JH, Lui WY, et al. Quality of life after curative gastrectomy for gastric cancer in a randomised controlled trial. Br J Cancer. 2008 1 15;98(1):54–9. [PubMed: 18182977]
10. McNair AG, Blazeby JM. Health-related quality-of-life assessment in GI cancer randomized trials: improving the impact on clinical practice. Expert Rev Pharmacoecon Outcomes Res. 2009 12;9(6):559–67. [PubMed: 19941433]

11. Greenhalgh J, Long AF, Flynn R. The use of patient reported outcome measures in routine clinical practice: lack of impact or lack of theory? Soc Sci Med. 2005 2;60(4):833–43. [PubMed: 15571900]
12. Eypasch E, Williams JI, Wood-Dauphinee S, Ure BM, Schmulling C, Neugebauer E, et al. Gastrointestinal Quality of Life Index: development, validation and application of a new instrument. Br J Surg. 1995 2;82(2):216–22. [PubMed: 7749697]
13. Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, et al. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. J Natl Cancer Inst. 1993 3 3;85(5):365–76. [PubMed: 8433390]
14. Vickery CW, Blazeby JM, Conroy T, Arraras J, Sezer O, Koller M, et al. Development of an EORTC disease-specific quality of life module for use in patients with gastric cancer. Eur J Cancer. 2001 5;37(8):966–71. [PubMed: 11334720]
15. Blazeby JM, Conroy T, Bottomley A, Vickery C, Arraras J, Sezer O, et al. Clinical and psychometric validation of a questionnaire module, the EORTC QLQ-STO 22, to assess quality of life in patients with gastric cancer. Eur J Cancer. 2004 10;40(15):2260–8. [PubMed: 15454251]
16. Cella DF, Tulsky DS, Gray G, Sarafian B, Linn E, Bonomi A, et al. The Functional Assessment of Cancer Therapy scale: development and validation of the general measure. J Clin Oncol. 1993 3;11(3):570–9. [PubMed: 8445433]
17. Garland SN, Pelletier G, Lawe A, Biagioni BJ, Easaw J, Eliasziw M, et al. Prospective evaluation of the reliability, validity, and minimally important difference of the functional assessment of cancer therapy-gastric (FACT-Ga) quality-of-life instrument. Cancer. 2011 3 15;117(6):1302–12. [PubMed: 20960518]
18. Woo A, Fu T, Popovic M, Chow E, Cella D, Wong CS, et al. Comparison of the EORTC STO-22 and the FACT-Ga quality of life questionnaires for patients with gastric cancer. Ann Palliat Med. 2016 1;5(1):13–21. [PubMed: 26841811]
19. Cleeland CS, Mendoza TR, Wang XS, Chou C, Harle MT, Morrissey M, et al. Assessing symptom distress in cancer patients: the M.D. Anderson Symptom Inventory. Cancer. 2000 10 1;89(7):1634–46. [PubMed: 11013380]
20. Wang XS, Williams LA, Eng C, Mendoza TR, Shah NA, Kirkendoll KJ, et al. Validation and application of a module of the M. D. Anderson Symptom Inventory for measuring multiple symptoms in patients with gastrointestinal cancer (the MDASI-GI). Cancer. 2010 4 15;116(8):2053–63. [PubMed: 20166216]
21. Cella D, Riley W, Stone A, Rothrock N, Reeve B, Yount S, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. J Clin Epidemiol. 2010 11;63(11):1179–94. [PubMed: 20685078]
22. Moye J, June A, Martin LA, Gosian J, Herman LI, Naik AD. Pain is prevalent and persisting in cancer survivors: differential factors across age groups. J Geriatr Oncol. 2014 4;5(2):190–6. [PubMed: 24495701]
23. Kaurah P, Talhouk A, MacMillan A, Lewis I, Chelcun-Schreiber K, Yoon SS, et al. Hereditary diffuse gastric cancer: cancer risk and the personal cost of preventive surgery. Fam Cancer. 2019 7 4.
24. Honda M, Wakita T, Onishi Y, Nunobe S, Hiki N, Miura A, et al. Development and validation of a symptom scale to evaluate postoperative patients with esophagogastric cancer. J Am Coll Surg. 2014 11;219(5):895–903. [PubMed: 25241187]
25. Kwiatek MA, Kiebles JL, Taft TH, Pandolfino JE, Bove MJ, Kahrilas PJ, et al. Esophageal symptoms questionnaire for the assessment of dysphagia, globus, and reflux symptoms: initial development and validation. Dis Esophagus. 2011 11;24(8):550–9. [PubMed: 21595774]
26. Nakamura M, Kido Y, Yano M, Hosoya Y. Reliability and validity of a new scale to assess postoperative dysfunction after resection of upper gastrointestinal carcinoma. Surg Today. 2005;35(7):535–42. [PubMed: 15976949]
27. Nakada K, Ikeda M, Takahashi M, Kinami S, Yoshida M, Uenosono Y, et al. Characteristics and clinical relevance of postgastrectomy syndrome assessment scale (PGSAS)-45: newly developed

integrated questionnaires for assessment of living status and quality of life in postgastrectomy patients. Gastric Cancer. 2015 1;18(1):147–58. [PubMed: 24515247]

28. Hosoda K, Yamashita K, Sakuramoto S, Katada N, Moriya H, Mieno H, et al. Postoperative quality of life after laparoscopy-assisted pylorus-preserving gastrectomy compared With laparoscopy-assisted distal gastrectomy: A cross-sectional postal questionnaire survey. Am J Surg. 2017 4;213(4):763–70. [PubMed: 27751530]
29. Fujita J, Takahashi M, Urushihara T, Tanabe K, Kodera Y, Yumiba T, et al. Assessment of postoperative quality of life following pylorus-preserving gastrectomy and Billroth-I distal gastrectomy in gastric cancer patients: results of the nationwide postgastrectomy syndrome assessment study. Gastric Cancer. 2016 1;19(1):302–11. [PubMed: 25637175]
30. Takiguchi S, Yamamoto K, Hirao M, Imamura H, Fujita J, Yano M, et al. A comparison of postoperative quality of life and dysfunction after Billroth I and Roux-en-Y reconstruction following distal gastrectomy for gastric cancer: results from a multi-institutional RCT. Gastric Cancer. 2012 4;15(2):198–205. [PubMed: 21993852]
31. Nishigori T, Okabe H, Tsunoda S, Shinohara H, Obama K, Hosogi H, et al. Superiority of laparoscopic proximal gastrectomy with hand-sewn esophagogastrostomy over total gastrectomy in improving postoperative body weight loss and quality of life. Surg Endosc. 2017 9;31(9):3664–72. [PubMed: 28078458]
32. McCall MD, Graham PJ, Bathe OF. Quality of life: A critical outcome for all surgical treatments of gastric cancer. World J Gastroenterol. 2016 1 21;22(3):1101–13. [PubMed: 26811650]
33. Davis JL, Ripley RT. Postgastrectomy Syndromes and Nutritional Considerations Following Gastric Surgery. Surg Clin North Am. 2017 4;97(2):277–93. [PubMed: 28325187]
34. Tyrvainen T, Sand J, Sintonen H, Nordback I. Quality of life in the long-term survivors after total gastrectomy for gastric carcinoma. J Surg Oncol. 2008 2 1;97(2):121–4. [PubMed: 18181160]
35. Avery K, Hughes R, McNair A, Alderson D, Barham P, Blazeby J. Health-related quality of life and survival in the 2 years after surgery for gastric cancer. Eur J Surg Oncol. 2010 2;36(2):148–54. [PubMed: 19836921]
36. Kobayashi D, Kodera Y, Fujiwara M, Koike M, Nakayama G, Nakao A. Assessment of quality of life after gastrectomy using EORTC QLQ-C30 and STO22. World J Surg. 2011 2;35(2):357–64. [PubMed: 21104250]
37. Kim AR, Cho J, Hsu YJ, Choi MG, Noh JH, Sohn TS, et al. Changes of quality of life in gastric cancer patients after curative resection: a longitudinal cohort study in Korea. Ann Surg. 2012 12;256(6):1008–13. [PubMed: 23154395]
38. Karanicolas PJ, Graham D, Gonen M, Strong VE, Brennan MF, Coit DG. Quality of life after gastrectomy for adenocarcinoma: a prospective cohort study. Ann Surg. 2013 6;257(6):1039–46. [PubMed: 23665970]
39. Brenkman HJF, Tegels JJW, Ruurda JP, Luyer MDP, Kouwenhoven EA, Draaisma WA, et al. Factors influencing health-related quality of life after gastrectomy for cancer. Gastric Cancer. 2018 5;21(3):524–32. [PubMed: 29067597]
40. Brooks R. EuroQol: the current state of play. Health Policy. 1996 7;37(1):53–72. [PubMed: 10158943]
41. Rowen D, Brazier J, Young T, Gaugris S, Craig BM, King MT, et al. Deriving a preference-based measure for cancer using the EORTC QLQ-C30. Value Health. 2011 Jul-Aug;14(5):721–31. [PubMed: 21839411]
42. Pickard AS, Shaw JW, Lin HW, Trask PC, Aaronson N, Lee TA, et al. A patient-based utility measure of health for clinical trials of cancer therapy based on the European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire. Value Health. 2009 9;12(6):977–88. [PubMed: 19402850]
43. Carter GC, King DT, Hess LM, Mitchell SA, Taipale KL, Kiiskinen U, et al. Health state utility values associated with advanced gastric, oesophageal, or gastro-oesophageal junction adenocarcinoma: a systematic review. J Med Econ. 2015;18(11):954–66. [PubMed: 26212479]
44. Zhou HJ, So JB, Yong WP, Luo N, Zhu F, Naidoo N, et al. Validation of the functional assessment of cancer therapy-gastric module for the Chinese population. Health Qual Life Outcomes. 2012 11 30;10:145,7525-10-145. [PubMed: 23194009]

45. Areia M, Alves S, Brito D, Cadime AT, Carvalho R, Saraiva S, et al. Health-related quality of life and utilities in gastric premalignant conditions and malignant lesions: a multicentre study in a high prevalence country. J Gastrointestin Liver Dis. 2014 12;23(4):371–8. [PubMed: 25531994]
46. Lee HJ, Ock M, Kim KP, Jo MW. Estimation of population-based utility weights for gastric cancer-related health states. Patient Prefer Adherence. 2018 5 23;12:909–18. [PubMed: 29872276]
47. Hisashige A, Sasako M, Nakajima T. Cost-effectiveness of adjuvant chemotherapy for curatively resected gastric cancer with S-1. BMC Cancer. 2013 10 1;13:443,2407-13-443. [PubMed: 24079752]
48. Gouzi JL, Huguier M, Fagniez PL, Launois B, Flamant Y, Lacaine F, et al. Total versus subtotal gastrectomy for adenocarcinoma of the gastric antrum. A French prospective controlled study. Ann Surg. 1989 2;209(2):162–6. [PubMed: 2644898]
49. Robertson CS, Chung SC, Woods SD, Griffin SM, Raimes SA, Lau JT, et al. A prospective randomized trial comparing R1 subtotal gastrectomy with R3 total gastrectomy for antral cancer. Ann Surg. 1994 8;220(2):176–82. [PubMed: 8053740]
50. Bozzetti F, Marubini E, Bonfanti G, Miceli R, Piano C, Gennari L. Subtotal versus total gastrectomy for gastric cancer: five-year survival rates in a multicenter randomized Italian trial. Italian Gastrointestinal Tumor Study Group. Ann Surg. 1999 8;230(2):170–8. [PubMed: 10450730]
51. Jentschura D, Winkler M, Strohmeier N, Rumstadt B, Hagmuller E. Quality-of-life after curative surgery for gastric cancer: a comparison between total gastrectomy and subtotal gastric resection. Hepatogastroenterology. 1997 Jul-Aug;44(16):1137–42. [PubMed: 9261613]
52. Huang CC, Lien HH, Wang PC, Yang JC, Cheng CY, Huang CS. Quality of life in disease-free gastric adenocarcinoma survivors: impacts of clinical stages and reconstructive surgical procedures. Dig Surg. 2007;24(1):59–65. [PubMed: 17369683]
53. Nakamura M, Hosoya Y, Yano M, Doki Y, Miyashiro I, Kurashina K, et al. Extent of gastric resection impacts patient quality of life: the Dysfunction After Upper Gastrointestinal Surgery for Cancer (DAUGS32) scoring system. Ann Surg Oncol. 2011 2;18(2):314–20. [PubMed: 20809177]
54. Rausei S, Mangano A, Galli F, Rovera F, Boni L, Dionigi G, et al. Quality of life after gastrectomy for cancer evaluated via the EORTC QLQ-C30 and QLQ-STO22 questionnaires: surgical considerations from the analysis of 103 patients. Int J Surg. 2013;11 Suppl 1:S104–9. [PubMed: 24380539]
55. Park S, Chung HY, Lee SS, Kwon O, Yu W. Serial comparisons of quality of life after distal subtotal or total gastrectomy: what are the rational approaches for quality of life management? J Gastric Cancer. 2014 3;14(1):32–8. [PubMed: 24765535]
56. Nakada K, Takahashi M, Ikeda M, Kinami S, Yoshida M, Uenosono Y, et al. Factors affecting the quality of life of patients after gastrectomy as assessed using the newly developed PGSAS-45 scale: A nationwide multi-institutional study. World J Gastroenterol. 2016 10 28;22(40):8978–90. [PubMed: 27833389]
57. Lee SS, Chung HY, Kwon OK, Yu W. Long-term Quality of Life After Distal Subtotal and Total Gastrectomy: Symptom- and Behavior-oriented Consequences. Ann Surg. 2016 4;263(4):738–44. [PubMed: 26501699]
58. Takahashi M, Terashima M, Kawahira H, Nagai E, Uenosono Y, Kinami S, et al. Quality of life after total vs distal gastrectomy with Roux-en-Y reconstruction: Use of the Postgastrectomy Syndrome Assessment Scale-45. World J Gastroenterol. 2017 3 21;23(11):2068–76. [PubMed: 28373774]
59. Davies J, Johnston D, Sue-Ling H, Young S, May J, Griffith J, et al. Total or subtotal gastrectomy for gastric carcinoma? A study of quality of life. World J Surg. 1998 10;22(10):1048–55. [PubMed: 9747165]
60. Munene G, Francis W, Garland SN, Pelletier G, Mack LA, Bathe OF. The quality of life trajectory of resected gastric cancer. J Surg Oncol. 2012 3 15;105(4):337–41. [PubMed: 22095440]
61. Svedlund J, Sullivan M, Liedman B, Lundell L, Sjodin I. Quality of life after gastrectomy for gastric carcinoma: controlled study of reconstructive procedures. World J Surg. 1997 5;21(4):422–33. [PubMed: 9143576]

62. Wen L, Chen XZ, Wu B, Chen XL, Wang L, Yang K, et al. Total vs. proximal gastrectomy for proximal gastric cancer: a systematic review and meta-analysis. Hepatogastroenterology. 2012 Mar-Apr;59(114):633–40. [PubMed: 22328267]
63. Rosa F, Quero G, Fiorillo C, Bissolati M, Cipollari C, Rausei S, et al. Total vs proximal gastrectomy for adenocarcinoma of the upper third of the stomach: a propensity-score-matched analysis of a multicenter western experience (On behalf of the Italian Research Group for Gastric Cancer-GIRCG). Gastric Cancer. 2018 9;21(5):845–52. [PubMed: 29423892]
64. Yoo CH, Sohn BH, Han WK, Pae WK. Long-term results of proximal and total gastrectomy for adenocarcinoma of the upper third of the stomach. Cancer Res Treat. 2004 2;36(1):50–5. [PubMed: 20396565]
65. Best LM, Mughal M, Gurusamy KS. Laparoscopic versus open gastrectomy for gastric cancer. Cochrane Database Syst Rev. 2016 3 31;3:CD011389. [PubMed: 27030300]
66. Jiang L, Yang KH, Guan QL, Cao N, Chen Y, Zhao P, et al. Laparoscopy-assisted gastrectomy versus open gastrectomy for resectable gastric cancer: an update meta-analysis based on randomized controlled trials. Surg Endosc. 2013 7;27(7):2466–80. [PubMed: 23361259]
67. Kim HH, Han SU, Kim MC, Kim W, Lee HJ, Ryu SW, et al. Effect of Laparoscopic Distal Gastrectomy vs Open Distal Gastrectomy on Long-term Survival Among Patients With Stage I Gastric Cancer: The KLASS-01 Randomized Clinical Trial. JAMA Oncol. 2019 4 1;5(4):506–13. [PubMed: 30730546]
68. Katai H, Mizusawa J, Katayama H, Takagi M, Yoshikawa T, Fukagawa T, et al. Short-term surgical outcomes from a phase III study of laparoscopy-assisted versus open distal gastrectomy with nodal dissection for clinical stage IA/IB gastric cancer: Japan Clinical Oncology Group Study JCOG0912. Gastric Cancer. 2017 7;20(4):699–708. [PubMed: 27718137]
69. Kim YW, Baik YH, Yun YH, Nam BH, Kim DH, Choi IJ, et al. Improved quality of life outcomes after laparoscopy-assisted distal gastrectomy for early gastric cancer: results of a prospective randomized clinical trial. Ann Surg. 2008 11;248(5):721–7. [PubMed: 18948798]
70. Kim YW, Yoon HM, Yun YH, Nam BH, Eom BW, Baik YH, et al. Long-term outcomes of laparoscopy-assisted distal gastrectomy for early gastric cancer: result of a randomized controlled trial (COACT 0301). Surg Endosc. 2013 11;27(11):4267–76. [PubMed: 23793805]
71. Takiguchi S, Fujiwara Y, Yamasaki M, Miyata H, Nakajima K, Sekimoto M, et al. Laparoscopy-assisted distal gastrectomy versus open distal gastrectomy. A prospective randomized single-blind study. World J Surg. 2013 10;37(10):2379–86. [PubMed: 23783252]
72. Jin HE, Kim MS, Lee CM, Park JH, Choi CI, Lee HH, et al. Meta-analysis and systematic review on laparoscopic-assisted distal gastrectomy (LADG) and totally laparoscopic distal gastrectomy (TLDG) for gastric cancer: Preliminary study for a multicenter prospective KLASS07 trial. Eur J Surg Oncol. 2019 6 22.
73. Haverkamp L, Brenkman HJ, Seesing MF, Gisbertz SS, van Berge Henegouwen MI, Luyer MD, et al. Laparoscopic versus open gastrectomy for gastric cancer, a multicenter prospectively randomized controlled trial (LOGICA-trial). BMC Cancer. 2015 7 29;15:556,015-1551-z. [PubMed: 26219670]
74. Misawa K, Fujiwara M, Ando M, Ito S, Mochizuki Y, Ito Y, et al. Long-term quality of life after laparoscopic distal gastrectomy for early gastric cancer: results of a prospective multi-institutional comparative trial. Gastric Cancer. 2015 4;18(2):417–25. [PubMed: 24801197]
75. Liu J, Yang K, Chen XZ, Dai B, Zhang B, Chen ZX, et al. Quality of life following laparoscopic-assisted distal gastrectomy for gastric cancer. Hepatogastroenterology. 2012 10;59(119):2207–12. [PubMed: 22282128]
76. Lee SS, Ryu SW, Kim IH, Sohn SS. Quality of life beyond the early postoperative period after laparoscopy-assisted distal gastrectomy: the level of patient expectation as the essence of quality of life. Gastric Cancer. 2012 7;15(3):299–304. [PubMed: 22083419]
77. Syn NL, Wee I, Shabbir A, Kim G, So JB. Pouch Versus No Pouch Following Total gastrectomy: Meta-analysis of Randomized and Non-randomized Studies. Ann Surg. 2018 12 6.
78. Horvath OP, Kalmar K, Cseke L, Poto L, Zambo K. Nutritional and life-quality consequences of aboral pouch construction after total gastrectomy: a randomized, controlled study. Eur J Surg Oncol. 2001 9;27(6):558–63. [PubMed: 11520089]

79. Fein M, Fuchs KH, Thalheimer A, Freys SM, Heimbucher J, Thiede A. Long-term benefits of Roux-en-Y pouch reconstruction after total gastrectomy: a randomized trial. Ann Surg. 2008 5;247(5):759–65. [PubMed: 18438112]
80. Zonca P, Maly T, Ihnat P, Peteja M, Kraft O, Kuca K. J-pouch versus Roux-en-Y reconstruction after gastrectomy: functional assessment and quality of life (randomized trial). Onco Targets Ther. 2016 12 16;10:13–9. [PubMed: 28031718]
81. Gioffre'Florio MA, Bartolotta M, Miceli JC, Giacobbe G, Saitta FP, Paparo MT, et al. Simple versus double jejunal pouch for reconstruction after total gastrectomy. Am J Surg. 2000 7;180(1):24–8. [PubMed: 11036134]
82. Fuchs KH, Thiede A, Engemann R, Deltz E, Stremme O, Hamelmann H. Reconstruction of the food passage after total gastrectomy: randomized trial. World J Surg. 1995 Sep-Oct;19(5):698–705; discussion 705-6. [PubMed: 7571666]
83. Hoksch B, Ablassmaier B, Zieren J, Muller JM. Quality of life after gastrectomy: Longmire's reconstruction alone compared with additional pouch reconstruction. World J Surg. 2002 3;26(3):335–41. [PubMed: 11865371]
84. Cai Z, Zhou Y, Wang C, Yin Y, Yin Y, Shen C, et al. Optimal reconstruction methods after distal gastrectomy for gastric cancer: A systematic review and network meta-analysis. Medicine (Baltimore). 2018 5;97(20):e10823. [PubMed: 29768387]
85. Montesani C, D'Amato A, Santella S, Pronio A, Giovannini C, Cristaldi M, et al. Billroth I versus Billroth II versus Roux-en-Y after subtotal gastrectomy. Prospective [correction of prespective] randomized study. Hepatogastroenterology. 2002 Sep-Oct;49(47):1469–73. [PubMed: 12239969]
86. So JB, Rao J, Wong AS, Chan YH, Pang NQ, Tay AYL, et al. Roux-en-Y or Billroth II Reconstruction After Radical Distal Gastrectomy for Gastric Cancer: A Multicenter Randomized Controlled Trial. Ann Surg. 2018 2;267(2):236–42. [PubMed: 28383294]
87. Chen S, Chen DW, Chen XJ, Lin YJ, Xiang J, Peng JS. Postoperative complications and nutritional status between uncut Roux-en-Y anastomosis and Billroth II anastomosis after D2 distal gastrectomy: a study protocol for a multicenter randomized controlled trial. Trials. 2019 7 12;20(1):428,019-3531-0. [PubMed: 31300019]
88. Yoo CH, Sohn BH, Han WK, Pae WK. Proximal gastrectomy reconstructed by jejunal pouch interposition for upper third gastric cancer: prospective randomized study. World J Surg. 2005 12;29(12):1592–9. [PubMed: 16311849]
89. Lee MS, Ahn SH, Lee JH, Park DJ, Lee HJ, Kim HH, et al. What is the best reconstruction method after distal gastrectomy for gastric cancer? Surg Endosc. 2012 6;26(6):1539–47. [PubMed: 22179454]
90. Woo J, Lee JH, Shim KN, Jung HK, Lee HM, Lee HK. Does the Difference of Invasiveness between Totally Laparoscopic Distal Gastrectomy and Laparoscopy-Assisted Distal Gastrectomy Lead to a Difference in Early Surgical Outcomes? A Prospective Randomized Trial. Ann Surg Oncol. 2015;22(6):1836–43. [PubMed: 25395149]
91. Yang K, Zhang WH, Liu K, Chen XZ, Zhou ZG, Hu JK. Comparison of quality of life between Billroth-capital I, Ukrainian and Roux-en-Y anastomosis after distal gastrectomy for gastric cancer: A randomized controlled trial. Sci Rep. 2017 9 12;7(1):11245,017-09676-2. [PubMed: 28900096]

Table 1:

Quality of Life Metrics

Metric	Year	Origin	Questions	English	Global	Symptoms	Financial	Gastric Focus	Surgery Focus	Frequency of use
EORTC QLQ C30 (13)	1993	NED	30	✓	✓	✓	✓			High
EORTC QLQ STO22 (14)	2001	UK	22	✓		✓		✓		High
FACT-G (16)	1993	USA	27	✓	✓	✓				Moderate
FACT-GA (17)	2011	CAN	19	✓		✓		✓		Moderate
GIQLI (12)	1995	GER	36	✓		✓				Moderate
MDASI-GI (19)	2000	USA	24	✓	✓	✓		✓		Low
PROMIS (21)	2010	USA	Varies	✓	✓	✓	✓	✓		Low
DAUGS32 (26)	2005	JPN	34			✓		✓	✓	Moderate
ES(4) (24)	2014	JPN	40			✓		✓	✓	Low
PGSAS-45 (27)	2015	JPN	45		✓	✓		✓	✓	Moderate

Frequency of use: low frequency (less than 5 articles), moderate (5-50 articles), and high (greater than 50 articles).

Table 2:

Extent of Resection

Author	Year	Design	N	Groups	Superior Group	Metric	Global Advantage	Symptom Advantage
Total versus Partial								
Jentschura (51)	1997	Cohort	195	Subtotal Total	Subtotal	GILQI	ND	Weight gain, diet restrict, bowel function
Svedlund (61)	1997	RCT	64	Subtotal Subtotal (S-pouch) Total	Subtotal	Other		Diarrhea (GSRS)
Davies (59)	1998	Cohort	47	Subtotal Total	Subtotal	GIQLI	GIQLI	Rotterdam sx score GIQLI
Huang (52)	2007	Cross-section	51	Subtotal Total	Subtotal	EORTC-C30 STO22	ND	Role function Nausea, appetite
Nakamura (53)	2011	Cross-section	165	Distal Total	Distal	DAUGS32	ND	Pain, dysphagia, diarrhea
Munene (60)	2012	Cohort	43	Distal Total	Distal	FACT-Ga Karnovsky	Karnovsky	No difference in FACT-Ga
Karanicolas (38)	2013	Cohort	134	Proximal Distal Total	Distal/Total	EORTC-C30 STO22	Global	Reflux, nausea
Rausei (54)	2013	Cross-section	103	Subtotal Total	Subtotal	EORTC-C30 STO22	ND	Appetite, nausea, diarrhea, anxiety, weight gain, pain, belching
Park (55)	2014	Cohort	275	Subtotal Total	Subtotal	EORTC-C30 STO22	Global	Physical functioning Nausea, dysphagia, reflux, diet restrict, dry mouth
Nakada(56)	2016	Cross-section	1777	Distal Total	Distal	PGSAS-45	Daily satisfaction	Diet restrict, weight gain Post-gastrectomy symptoms
Lee (57)	2016	Cross-section	178	Subtotal Total	Subtotal	EORTC-C30 STO22	ND	Social functioning Nausea Eating restriction Taste
Takahashi (58)	2017	Cross-section	868	Distal Total	Distal	PGSAS-45	Daily satisfaction	Number of meals, weight gain Post-gastrectomy symptoms
Total versus Proximal								
Yoo (88)	2005	RCT	51	Proximal (J-pouch) Total	Proximal (J-pouch)	Symptoms		Post-gastrectomy symptoms Weight gain
Yoo (64)	2004	Cohort	259	Proximal Total	Total	Endoscopy		Stricture Reflux esophagitis

J Surg Res. Author manuscript; available in PMC 2021 July 01.

Author	Year	Design	N	Groups	Superior Group	Metric	Global Advantage	Symptom Advantage
Rosa (63)	2018	Cross-section	150	Proximal Total	Total	Endoscopy		Stricture Reflux esophagitis
Lymphadenectomy								
Wu (9)	2008	RCT	221	D1 D3	ND	Spitzer index Symptoms	ND	ND

ND = No difference

Table 3:

Minimally-invasive versus Open Approach

Author	Year	Design	N	Groups	Superior Group	Metric	Global Advantage	Symptom Advantage
Kim (69) (COACT 0301)	2008	RCT	164	Lap Open	LADG	EORTC-C30 STO22 (< 1 year)	Global (up to 3 mo)	Physical, emotional functioning Dysphagia, diet restrict, dry mouth, body image, reflux, pain
Kim (70) (COACT 0301)	2013	RCT	164	Lap Open	ND	EORTC-C30 STO22 (> 1 year)		Dysphagia higher in ODG Dyspnea higher in LADG
Kobayashi (36)	2011	Cohort	98	LADG ODG	LADG	EORTC-C30 STO22	Global (1 mo)	Physical functioning (up to 12 mo) Fatigue, dyspnea, dysphagia (1-3 mo)
Lee (76)	2012	Cross-section	80	LADG ODG	ODG	EORTC-C30 STO22		Role, cognitive functioning Fatigue
Liu (75)	2012	Cohort	74	LADG ODG	LADG	EORTC-C30 STO22		Role, cogni, emotional function Reflux, body image
Lee (89)	2012	Cohort	148	LADG ODG	LADG	GIQLI	Total	Physical function Post-gastrectomy symptoms
Takiguchi (71)	2013	RCT	40	LADG ODG	LADG	VAS Activity sensor		3-day lag in physical activity recup 1-2 day lag in VAS (vis analog scale)
Woo (90)	2015	RCT	110	Lap-assist Lap	ND	EORTC-C30 STO22		
Misawa (74)	2015	Cohort	145	Lap Open	LADG	EORTC-C30 STO22		Role, emotional, cognitive, social Fatigue, pain, diet retrict, taste, anxiety
Katai (68) (JCOG0912)	2017	RCT	921	LADG ODG	LADG	EORTC-C30 STO22 Analgesics	Not available	Less analgesia POD 5

ND = No difference

J Surg Res. Author manuscript; available in PMC 2021 July 01.

Table 4:

Postgastrectomy Reconstruction

Author	Year	Design	N	Groups	Superior Group	Metric	HRQOL Global	Symptom Items
Pouch Reconstruction								
Fuchs (82)	1995	RCT	106	JI with pouch Hunt-Lawrence pouch	ND	Spitzer Index Visick grade	ND	ND
Gioffre'Florio (81)	2000	RCT	41	Double J-pouch Hunt-Lawrence pouch	Double-J pouch	Visick grade	Visick	
Horvath (78)	2001	RCT	46	Aboral pouch Roux-en-Y	Aboral Pouch	GIQLI	GIQLI	Meals/day
Hoksch (83)	2002	RCT	48	JI with pouch (7 cm) JI with pouch (15 cm) JI no pouch	ND	EORTC QLQ-C30 STO22	ND	ND
Fein (79)	2008	RCT	138	Hunt-Lawrence pouch Roux-en-Y	HL-pouch	GIQLI	GIQLI (1-5 years)	
Zonca(80)	2017	RCT	72	JI with pouch Roux-en-Y	Interposition with pouch	GIQLI	GIQLI	
Roux-en-Y versus Billroth								
Montesani (85)	2002	RCT	45	B-I B-II Roux-en-Y	ND	GIQLI	ND	ND
Takiguchi (30)	2012	RCT	332	B-I Roux-en-Y	Roux-en-Y	EORTC QLQ-C30 DAUGS20	ND	Dyspnea, reflux
Lee (89)	2012	RCT	159	B-I B-II Braun Roux-en-Y	ND	GIQLI	ND	ND
Nakamura (56)	2016	RCT	122	B-I Roux-en-Y	B-I	FACT-Ga	ND	Fullness, diarrhea, fatigue
Yang (91)	2017	RCT	140	B-I Roux-en-Y	Roux-en-Y	EORTC QLQ-C30 STO22	Roux-en-Y	Reflux, pain
So(86)	2018	RCT	162	B-II Roux-en-Y	ND	EORTC QLQ-C30	ND	ND

ND = No difference

JI = jejunal interposition