Systematic Review / Meta-analysis

Double-tract reconstruction for oesofagocardial gastric cancer: A systematic review

K.V. Stegni, E.V. Maslyantsev*, R.A. Goncharuk, A.A. Krekoten, T.A. Kulakova, E. R. Dvoinikova

Department of Surgery, Medical Center of Far Eastern Federal University, 690922, 10 Ajax Bay, Russky Island, Vladivostok, Russia

A R T I C L E   I N F O

Keywords:
Oncology
Gastrectomy
Proximal gastrectomy
Double-tract reconstruction
Gastric cancer

A B S T R A C T

The number of people with gastric cardia and distal oesophageal cancers has increased in the last five years. The surgical treatment method of choice is proximal gastrectomy, with an option being reconstruction of the gastrointestinal tract. There are many reconstruction techniques for anastomosis of the oesophagus and distal parts of the digestive tract. However, all can result in complications. This systematic review aims to identify the efficacy of the double-tract reconstruction method after gastric resection. Different operative techniques for gastric reconstruction have been included in this review. The double-tract reconstruction method, which is gaining popularity among surgeons in Asia and Europe, is a promising technique that improves the early and late results of surgical treatment. This method is associated with low complications related to gastroesophageal reflux disease and dysphagia. Double-tract reconstruction is a promising method for the treatment of patients with esofagocardial gastric cancer. However, further studies are required on the long-term complications and side effects.

1. Introduction

Gastric cancer is the fifth most common cancer (5.7%) among malignant neoplasms and the third most common cause of cancer-related deaths worldwide (8.3%). Despite the global decline in the number of new cases of non-cardia gastric cancer (approximately 1.5% decrease annually) for several decades, there has been an increase in the number of new cases of proximal stomach and gastroesophageal junction cancers (27% of the total number of gastric cancer cases) [1–3]. In some European and Asian countries, the incidence of gastric cardia cancer is close to or even exceeds the total number of new cases of gastric cancer in other localisations. However, the reasons for this are unknown, and several studies are currently being conducted to examine the reasons for this [4,8]. Potential risk factors for non-cardia gastric cancer are low socioeconomic status (low-quality food), eating habits (intake of a high amount of smoked and spicy food), and the spread of highly virulent Helicobacter pylori strains. According to some sources, the prophylaxis and treatment of H. pylori can prevent cancer development [4].

The pathogenesis of gastric cardia cancer is not fully understood. However, there are two variants of its development. The first is associated with obesity and gastroesophageal reflux disease and presents as adenocarcinoma of the oesophagus [5]. The second type is associated with superficial gastropathy and H. pylori, presenting as cancer in the non-cardia parts of the stomach [5].

H. pylori infection is known to cause gastropathy in the stomach, increasing the risk of non-cardia gastric cancer development [6,7]. At the same time, there is evidence that the H. pylori bacteria protect against gastroesophageal reflux by lowering the secretion of hydrochloric acid in the proximal stomach, thus lowering the oncologic risk at that localisation [6,7]. However, this has not been thoroughly studied and is the subject of further research [8].

Therefore, the success of treatment against H. pylori, which was found to decrease the incidence of non-cardia gastric cancers in developed countries, also increases the occurrence of cardia cancer [6,9].

However, it is impossible to define the exact percentage of cardia gastric cancer among the other locations due to the number of people with late-stage cancer that has spread [10–12].

Surgery is a radical treatment method for this pathology. The major complications after surgery at the site of the gastroesophageal junction are dehiscence of anastomosis, reflux esophagitis in case of anastomosis

---

* Corresponding author. Department of Surgery, Medical Center of Far Eastern Federal University, 18, Mojjevelovaya street, 81 690035, Vladivostok, Russia. E-mail address: masliantsev.ev@dvfu.ru (E.V. Maslyantsev).
between the oesophagus and residuary stomach, stenosis at the site of anastomosis, and pyloric stenosis (postvagotomy syndrome) [3,13,14]. It is assumed that double-tract reconstruction (DT) may avoid or significantly decrease the occurrence of these complications and maintain the patient’s physiological and nutritional status as well as avoid critical body weight loss in the postoperative period [15,16].

This method involves the replacement of the removed part of the oesophagus and stomach by the isoperistaltic jejunum loop with sequential anastomotic formation between the oesophagus, stomach, and afferent limb of the jejunal [17]. During proximal gastrectomy (PG), the key features of this technique are resection of the oesophagus and stomach with the transection of the jejunum loop at 20–25 cm from the ligament of Treitz with sequential formation of oesophagoenteroanastomosis and gastroenteroanastomosis with the remaining part of the stomach, followed by entero-entero anastomosis for the reconstruction of the small bowel passage [18]. In cases with distal gastric cancer or a high extent, oesophagoenteroanastomosis, duodenoenteroanastomosis, and entero-entero anastomosis are performed after total gastrectomy transection of the isoperistaltic jejunal loop [19].

2. Materials and methods

Systematic search of international literature (PubMed, Web of Science, EBSCO, Cochrane Library) and Russian literature (Elibrary.ru, Cyberleninka.ru) the databases were conducted between 2010 and September 2020. The search terms were Double Tract Reconstruction, Proximal Gastric Resection, Complete Gastric Resection, Double Tract. Using the above criteria, a total of 12,430 articles were identified. The analysis included studies that compared different types of reconstruction after PG and total gastric resection (TG), as well as separate systematic reviews and case reports that included DT. Studies involving reports of TG and PG, without discussion of DT, lymphadenectomy, changes in the treatment of gastric cancer, case reports were excluded. A total of 22 articles were identified. Data on the duration of the operation, intraoperative blood loss, postoperative complications (divergence of the Anastomosis, reflux esophagitis, stenosis at the site of the anastomosis, gastrostasis), nutritional status and quality of life were extracted and analyzed from these articles.

Work has been reported in line with the PRISMA criteria [20].

2.1. Research accordance with AMSTAR 2 [21]

Research registered in Prospero CRD42021237191. https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021237191.

3. Results and discussion

PG with DT was generally compared to TG or reconstruction by small bowel part insertion using an open or laparoscopic approach in the included studies.

There were comparable results in all the studies in terms of tumour recurrence, metastasis, and long-term survival in the patients that underwent DT compared to those who underwent TG with Roux-en-Y reconstruction and reconstructive techniques after PG for Siewert type II and III adenocarcinomas [18,22,37].

Formation of esophago-entero and gastro-entero anastomosis for DT could be made using a linear or circular stapler or OrVil™ system. There are studies on all the above techniques and their results [23–25]. However, no studies have compared functional results and correlations between different techniques regarding the number of dehiscences.

3.1. Operative time and blood loss

Most studies did not show any statistically significant differences in operative time and intraoperative blood loss in those who underwent PG with DT (PG-DT) and TG for conventional and laparoscopic procedures [19,26,27].

Jung et al. found that operative time and blood loss were lower in those who underwent PG-DT than laparoscopic TG. This may depend on surgical experience and the technique used to create anastomoses [18].

3.2. Early and late postoperative complications

Considering postoperative complications such as reflux esophagitis, anastomosis dehiscence, and stenosis, some researchers concluded that there was no significant difference in the rate of complications between DT and TG [28].

A study by Aburatani et al. revealed that the rate of reflux esophagitis (10.5% vs. 54.4%) and stenosis at the site of anastomosis (0% vs. 27%) in those that underwent PG-DT was lower than those that underwent PG with oesophagogastronomicstosis. These results suggest the efficacy of an intestinal insert between the oesophagus and stomach [29].

In a meta-analysis by Shaibu Z. Chen. Z. et al., which included eight studies with 171 patients, the incidence of postoperative complications after DT was 9.6%, 3.5%, 3.9%, and 39.6% for reflux esophagitis, anastomotic stricture, anastomosis dehiscence, and gastrostasis, respectively [30].

In the same review, data from 15 studies were included on using the interposition of the jejunal loop as the reconstruction method. The rates of postoperative complications included reflux esophagitis (13.8%), anastomotic stricture (11.3%), anastomosis dehiscence (4.1%), and gastrostasis (41.5%) [30].

There were nine studies that included the imposition of oesophago-gastroanastomosis reconstructive technique, with the following results: reflux esophagitis (19.3%), anastomotic stricture (13.0%), anastomosis dehiscence (4.6%), and gastrostasis (21.8%) [30].

There are conflicting data on the long-term results. In the works of Kim DJ, Kim W et al., and Park et al. the data on the lower requirement of vitamin B12 and iron preparations in the postoperative period in those that underwent DT are presented [31,32]. At the same time, other studies have provided data on the absence of a significant difference between changes in blood test parameters (haemoglobin, ferritin, ferritin saturation, total protein, albumin, and cholesterol) and the development of anaemia in those that underwent DT or TG [33]. For example, although ferritin and haemoglobin levels have been reported to be higher in those that underwent DT, the values of both those that underwent DT or TG were within the normal range. In this case, the researchers also concluded that in the DT group, fewer patients required vitamin B12 supplementation [34]. These results indicate the functionality of the preserved part of the stomach during the digestive process [35].

A long-term decrease in the body mass index (BMI) was more favourable in the DT group in all the studies reviewed. After six months of observation, the decrease in BMI of the group after gastrectomy was 14.9% and 5.7% after PG-DT. After 12 months, the changes were 17.9% and 9.6%, respectively [36].

In a study by Nam-ryong Choi et al., 37 patients who underwent laparoscopic PG-DT reconstruction were examined. The authors concluded that maximum weight loss was observed one year after surgery (6.1%). After that, patients’ body weights gradually increased. Furthermore, after three years of recovery, patients’ body weights were 96.8% of the preoperative level. The haemoglobin level in the blood serum decreased the most (by 5.9%) one year after surgery and then gradually increased. After two years, the level was higher than before surgery. In addition, the serum iron level in patients increased after surgery and was at its maximum after two years. Vitamin B12 in the blood reached a minimum after six months and then fluctuated. Moreover, the level of albumin was higher than the preoperative level six months after surgery [37].
4. Conclusions

The main disadvantages of the DT method are reflux esophagitis and obstruction of the passage of food through the rest of the stomach [27, 30, 38]. This could be due to the presence of pyloric spasms from post-vagotomy syndrome. Reflux esophagitis may occur due to the reconstruction and surgical techniques used during anastomosis. For example, the length of the small intestine section being incorrectly chosen when forming an insert between the oesophagus and the stomach.

The results of this review indicate the need for further study of DT to determine its efficacy. It is also necessary to search for a solution that limits the disadvantages to this reconstruction technique (improvement of the operative technique, acceptable anastomosis techniques, and vagus-sparing surgical intervention methods).

Given the lack of reliable data on the development of postoperative complications and the advantages of this method over other interventions, DT is a promising technique for surgical intervention in pathology of the cardioesophageal junction. However, further studies in experimental and clinical conditions are required.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Sources of funding

Non-commercialized scientific review article. No funding from any source.

Author contribution

K.V. Stegniy: study concept, data interpretation, writing the paper.
E.V. Maslyantsev: study concept, data interpretation, writing the paper.
R.A. Goncharuk: study concept, data interpretation, writing the paper.
A.A. Krekoten: data collection.
T.A. Kulakova: data collection.
E.R. Dvoinikova: data collection.

Research registration number

Name of the registry: PROSPERO
Unique Identifying number or registration ID: CRD42021237191
Hyperlink to your specific registration (must be publicly accessible and will be checked): https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021237191

Guarantor

K.V. Stegniy.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jamsu.2021.102496.

References

[1] F. Bray, J. Ferlay, I. Soerjomataram, R.L. Siegel, L.A. Torre, A. Jemal, Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries, CA A Cancer J. Clin. 68 (6) (2018) 394–424, https://doi.org/10.1002/ca.21492.
[2] E. Nomura, S.W. Lee, M. Kawai, M. Yamazaki, K. Nabeshima, K. Nakamura, K.Ichihaya, Functional outcomes by reconstruction technique following laparoscopic proximal gastrectomy for gastric cancer: double tract versus jejunal interposition, World J. Surg. Oncol. 12 (2014) 20, https://doi.org/10.1186/1477-7827-12-20.
[3] S.H. Ahn, H. Jung do, S.Y. Son, C.M. Lee, J. Park do, H.H. Kim, Laparoscopic double-tract proximal gastrectomy for proximal early gastric cancer, Gastric Cancer 17 (3) (2014) 562–570, https://doi.org/10.1007/s10120-013-0303-5.
[4] A. Colquhoun, M. Arnold, J. Ferlay, K.J. Goodman, D. Forman, I. Soerjomataram, Global patterns of cardia and non-cardia gastric cancer incidence in 2012, Gut 64 (12) (2015) 1881–1888, https://doi.org/10.1136/gutjnl-2014-308915.
[5] K.I. Mukaihoh, T. Nakayama, T. Hagiwara, T. Hattori, H. Sugihara, Two distinct etiologies of gastric cardia adenocarcinoma: interactions among pH, Helicobacter pylori, and bile acids, Front. Microbiol. 6 (2015) 1–7, https://doi.org/10.3389/fmicb.2015.00412.
[6] P. Rawla, A. Barsouk, Epidemiology of gastric cancer: global trends, risk factors and prevention, Przeglad Gastroenterol. 14 (1) (2019) 26–38, https://doi.org/10.5114/pg.2018.80091.
[7] F.R. Polat, S. Polat, The effect of helicobacter pylori on gastroesophageal reflux disease, J. Soc. Laparoendosc. Surg. 16 (2) (2012) 260–263, https://doi.org/10.1053/j.jsls.2012.02.006.
[8] S. Scida, M. Russo, C. Miraglia, G. Leandro, L. Franzoni, F. Di Mario, Relationship between helicobacter pylori infection and GERD, Acta Biomed. 89 (4) (2018) 40–43, https://doi.org/10.4293/108680812X13427982376981.
[9] D.Y. Graham, Helicobacter pylori update: gastric cancer, reliable therapy, and possible benefits, Gastroenterology 148 (2015) 719–731, https://doi.org/10.1053/j.gastro.2015.01.040.
[10] M.J. Thun, M.S. Litner, J.R. Cerhan, C. Haiman, D. Schottenfeld, Schottenfeld and成立美国团队

---

K.V. Stegniy et al.  
Annals of Medicine and Surgery 67 (2021) 102496

---

3

https://doi.org/10.1016/j.jamsu.2021.102496.
[22] J.W. Xiao, Z.L. Liu, P.C. Ye, Y.J. Luo, Z.M. Fu, Q. Zou, S.J. Wei, Clinical comparison of antrum-preserving double tract reconstruction vs roux-en-Y reconstruction after gastrectomy for Siewert types II and III adenocarcinoma of the esophagogastric junction, World J. Gastroenterol. 21 (34) (2015) 9999–10007, https://doi.org/10.3748/wjg.v21.i34.9999.

[23] Y.J. Jung, D.J. Kim, J.H. Lee, W. Kim, Safety of intracorporeal circular stapling esophagojejunostomy using trans-orally inserted anvil (OrVilTM) following laparoscopic total or proximal gastrectomy - comparison with extracorporeal anastomosis, World J. Surg. Oncol. 11 (2013) 1–7, https://doi.org/10.1186/1477-7819-11-209.

[24] J. Hu, L. Zhao, H. Xue, Z. Zhang, J. Du, Predominant classic circular-stapled double-tract reconstruction after totally laparoscopic proximal gastrectomy: safe, feasible, time-saving anastomoses by technical tie-up, Surg. Endosc. (2020), https://doi.org/10.1007/s00464-020-07824-w.

[25] J. Hong, L. Qian, Y.P. Wang, J. Wang, L.C. Hua, H.K. Hao, A novel method of delta-shaped intracorporeal double-tract reconstruction in totally laparoscopic proximal gastrectomy, Surg. Endosc. 30 (6) (2016) 2396–2403, https://doi.org/10.1007/s00464-015-4490-5.

[26] E. Nomura, H. Kayano, F. Lee, Functional evaluations comparing the double-tract method and the jejunal interposition method following laparoscopic proximal gastrectomy for gastric cancer: an investigation including laparoscopic total gastrectomy, Surg. Today 49 (2019) 38–48, https://doi.org/10.1007/s00595-018-1699-7.

[27] S. Li, L. Gu, Z. Shen, D. Mao, P.A. Khadaroo, H. Su, A meta-analysis of comparison of proximal gastrectomy with double-tract reconstruction and total gastrectomy for proximal early gastric cancer, BMC Surg. 19 (2019) 117, https://doi.org/10.1186/s12893-019-0584-7.

[28] T. Nishigori, H. Okabe, S. Tsunoda, H. Shinohara, K. Obama, H. Hosogi, S. Hisamori, K. Miyazaki, T. Nakayama, Y. Sakai, K. Miyazaki, T. Nakayama, Y. Sakai, Superiority of laparoscopic proximal gastrectomy with hand-sewn esophagogastrostomy over total gastrectomy in improving postoperative body weight loss and quality of life, Surg. Endosc. 31 (2017) 3664–3672, https://doi.org/10.1007/s00464-016-5403-y.

[29] A. Aburatani, K. Kojima, S. Otsuki, H. Murase, K. Okuno, K. Gokita, C. Tomii, T. Tanioka, M. Inokuchi, Double-tract reconstruction after laparoscopic proximal gastrectomy using detachable ENDO-PSD, Surg. Endosc. 31 (2017) 4848–4856, https://doi.org/10.1007/s00464-017-5539-4.

[30] Z. Shahil, Z. Chen, S.A.S. Mzee, A. Theophilus, L.A. Danbala, Effects of reconstruction techniques after proximal gastrectomy: a systematic review and meta-analysis, World J. Surg. Oncol. 18 (1) (2020) 1–14, https://doi.org/10.1186/s12957-020-01938-2.

[31] D.J. Kim, W. Kim, Laparoscopy-assisted proximal gastrectomy with double tract anastomosis is beneficial for vitamin B12 and Iron absorption, Anticancer Res. 36 (2016) 4753–4758, https://doi.org/10.21873/anticanceres.11031.

[32] J.Y. Park, K.B. Park, O.K. Kwon, W. Yu, Comparison of laparoscopic proximal gastrectomy with double-tract reconstruction and laparoscopic total gastrectomy in terms of nutritional status or quality of life in early gastric cancer patients, Eur. J. Surg. Oncol. 44 (2018) 1963–1970, https://doi.org/10.1016/j.ejso.2018.08.014.

[33] J. Hong, S.Y. Wang, H.K. Hao, A comparative study of double-tract reconstruction and roux-en-Y after gastrectomy for gastric cancer, Surg. Laparosc. Endosc. Percutaneous Tech. 29 (2) (2019) 82–89, https://doi.org/10.1097/SLF.0000000000000399.

[34] M. Cho, T. Son, H.I. Kim, S.H. Noh, S. Choi, W.J. Seo, C.K. Roh, W.J. Hyung, Similar hematologic and nutritional outcomes after proximal gastrectomy with double-tract reconstruction in comparison to total gastrectomy for early upper gastric cancer. https://doi.org/10.1007/s00464-018-6448-x, 2019, 33,1757-1768.

[35] Fumio Watanabe, Vitamin B12 sources and bioavailability, Exp. Biol. Med. 232 (2007) 1266–1274, https://doi.org/10.3181/0703-MR-67.

[36] M. Sugiyama, E. Oki, K. Ando, Y. Nakashima, H. Sasaki, Y. Maehara, Laparoscopic proximal gastrectomy maintains body weight and skeletal muscle better than Total gastrectomy, World J. Surg. 42 (2018) 3270–3276, https://doi.org/10.1007/s00268-018-4625-7.

[37] N. Choi, M. Choi, C. Ko, J. Lee, C. Goeg, Kim, B Totally laparoscopic proximal gastrectomy with double tract reconstruction: outcomes of 37 consecutive cases, Videosurgery Mininv 15 (3) (2020) 446–454, https://doi.org/10.5114/visst.2020.94154.

[38] S. Wang, S. Lin, H. Wang, J. Yang, P. Yu, Q. Zhao, M. Li, Reconstruction methods after radical proximal gastrectomy, Medicine 97 (11) (2018), https://doi.org/10.1097/MD.0000000000010121.