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# JGS Journal of Gastric Surgery

*Designed for practictioners involved in oncology, obesity, metabolic and other abdominal diseases*

## IN THIS ISSUE

- Prof. Huang and his team extracted data from eight comparative studies and performed a meta-analysis to assess the risk of gastric cancer in proton pump inhibitors (PPI) users.
- The Clinical Practice section shows the Enhanced Recovery After Surgery (ERAS) protocol recently adopted in a Gastric Cancer Unit based on current evidences from a literature review.
- Robotic surgery has revolutionized the way surgeons perform minimally invasive surgery and can improve some challenging steps during gastrectomy. Dr. Giovanardi in the Technical Note section shows tips and tricks of a robotic subtotal gastrectomy.
- Among the other contents Dr. Rossi shows a rare case of multiple neuroendocrine tumors (NETs) of the small bowel in a patient admitted for intestinal obstruction.
- The Editorial Board is pleased to open the Video section of the journal and in the present issue a case of advanced gastric cancer in a 12-year-old child is described.

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## ABOUT THE JOURNAL

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META-ANALYSIS

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# Long-term proton pump inhibitor use and the incidence of gastric cancer: A systematic review and meta-analysis

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**ABSTRACT**

**Background:**

There are controverted whether the long-term use of proton pump inhibitors (PPI) will increase the risk of gastric cancer. We performed a meta-analysis to assess the risk of gastric cancer in PPI users compared with non-PPI users.

**Methods:**

The main inclusion criteria were original studies reporting the incidence of gastric cancer in PPI users compared with non-PPI users. Key outcomes were the risk ratios (RR) for gastric cancer in association with PPI users or non-PPI users.

**Results:**

We analyzed data from 8 studies, comprising more than 927,684 patients. The risk of gastric cancer in PPI users was significantly higher than in non-PPI users [RR= 2.10, 95% CI (1.17-3.97)]. The risk of gastric cancer was similar between the 2 groups when the duration was ≤1 year [RR= 2.18, 95% CI (0.66-7.11)]. While the risk of gastric cancer for PPI users was higher than in non-PPI users when the duration was between 1-3 years, ≥1 year, ≥3 years and ≥5 years. The risk of non-cardiac gastric cancer for PPI users was higher than for non-PPI users [RR= 2.66, 95% CI (1.66 -4.27)], and the risk of non-cardiac gastric cancer for PPI users was higher than for non-PPI users when the duration ≥1 year [RR= 1.99, 95% CI (1.03-3.83)], but the risk for cardiac gastric cancer was similar between the 2 groups [RR= 1.86, 95% CI (0.71-4.89)].

**Conclusions:**

We found the long-term use of PPI (duration ≥1 year) was significantly associated with a higher risk of non-cardiac gastric cancer.

**Key words:**

proton pump inhibitors; gastric cancer; Helicobacter pylori infection; long-term use

**Background:**
Since the introduction of the proton pump inhibitor (PPI) in the late 1980s[1], the outcomes of gastric acid-related diseases have significantly improved. This innovation has significance in the treatment of gastric acid related diseases[2, 3]. Due to the outstanding efficacy and safety of PPIs, they have been widely used in clinical practice. The quantity of the prescriptions is increasing, and potential adverse effects have also attracted much attention. An increasing in the number of case reports and observational studies on the adverse events in patients receiving long-term PPI therapy had been reported. Currently, the most prominent concerns about long-term PPI use relate to the risks of bone fractures, enteric infection, pneumonia and vitamin B12 deficiency[4-7]. In recent years, studies[8] have shown that the long-term use of PPIs may increase the risk of gastric cancer, but these studies[9-11] are controversial. Helicobacter pylori (H. pylori) infection is one of the risk factors leading to gastric cancer, and PPIs are one of the major drugs used for the treatment of H. pylori. The influence on the occurrence of gastric cancer needs further research. Therefore, the aim of this study is to assess the association between PPI use and risk of gastric cancer through systematic reviews and meta-analyses.

**Methods:**
All the search results were evaluated according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement[12].

***Inclusion criteria and exclusion criteria***
The inclusion criteria are as follows: (1) RCTs or observational studies including cohort and case-control studies; (2) outcomes of PPI users were compared with those of non-PPI users; (3) studies provided adequate data that enabled the estimation of risk ratio (RR), odds ratio (OR), incidence rate ratio (IRR), and standardized incidence ratio (SIR). The exclusion criteria are as follows: (1) The article is a duplicate; (2) inadequate data; (3) sample size less than 20.

***Literature Search***
We conducted a comprehensive systematic literature search of online databases, including PubMed, the Cochrane Library, Embase and clinicaltrials.gov, from January 1, 1987 to Nov 1, 2018 to identify all RCTs and observational studies. The following key words were used in these literature searches: "proton pump inhibitor", "omeprazole", "esomeprazole", "pantoprazole", "lansoprazole", "dexlansoprazole", "rabeprazole", "gastric cancer", "gastric carcinoma", "gastric adenocarcinoma", "gastric neoplasm", gastric neoplasia", "stomach cancer", "stomach carcinoma", "stomach adenocarcinoma", "stomach neoplasm", and "stomach neoplasia". There were no language restrictions. We also reviewed the references of the included articles and related systematic reviews to identify additional studies.

***Study Selection and Quality Assessment***
The quality of included non-RCTs was assessed using the Newcastle–Ottawa Scale (NOS) [13]. The scale used a score system, which ranged from 0 to 9, and the quality of the observational studies were enrolled if they achieved 6 or more.

***Data Extraction***
Data extraction and the evaluation of literature quality were conducted independently by 2 investigators (Ju-li Lin and Jian-xian Lin). When there was any uncertainty about the inclusion of a study, the issue was discussed between the two investigators to achieve a resolution. In cases of disagreement, the qualitative analysis was performed by Chao-Hui Zheng. A Microsoft Excel database was used to record all available information, including baseline details, title, first author's name, year of publication, study design, region, journal, sample size, period of patient recruitment, follow-up time, definition of PPI use, adjusted odds ratio (OR), risk ratio (RR), standardized incidence ratio (SIR), and incidence rate ratio (IRR) of gastric cancer.

***Outcome definition***
Primary outcome: the risk of gastric cancer in PPI users compared with non-PPI users; Secondary outcomes: the risk of gastric cancer when therapy duration ≤1 year, 1-3 years, ≥1 year, ≥3 years and ≥5 years; the risk of cardia gastric cancer; the risk of non-cardia gastric cancer; the risk of gastric cancer with H. pylori infection; and the risk of gastric cancer with prior H. pylori infection.

***Data synthesis***
Because the absolute risk of gastric cancer is low, one can generally ignore the distinctions among the various measures of relative risk (e.g., odds ratio, risk ratio, standardized incidence ratio, incidence rate ratio)[14, 15]. The effect estimates that were extracted, if available, or de novo calculated from available data were SIR, IRR, RR and OR. SIR was estimated as the ratio of the observed over expected number of cases for exposed patients. The 95% confidence interval (CI) for loge(SIR) was constructed via the term"±" 1.96/[square root (O)], where O was the observed number of events (Alder et al, 2006)[16]. Maximally adjusted effect estimates (ORs) were additionally extracted on the total of the sample, wherever possible.

***Statistical Analysis***
The pooled risk ratio (RR) with 95% confidence intervals (95% CIs) was estimated for dichotomous outcomes. Single-arm meta-analyses were performed for the PPI and non-PPI groups. Cumulative meta-analyses were also performed to evaluate the stability of the effect sizes. The Cochran's Q statistic and the I2 statistics were used to assess the heterogeneity among all studies. Heterogeneity among studies was tested using Cochran's Chi-square test and I2, in which I2 > 50% suggested significant heterogeneity. A random-effects model was chosen to pool the results when I2 > 50%, while a fixed-effects model was used when I2 < 50%. When possible, subgroup analyses were performed to assess the potential impact of the duration of PPI exposure, tumor location and H. pylori infection. P <

0.05 was considered to represent statistical significance (2-sided). All the statistical analyses were conducted using STATA, version 13.0 (Stata Corporation, College Station, TX).

**Results:**

***Studies Retrieved and Characteristics***

According to the previous search strategy, 977 citations were obtained from the online database from January 1, 1987 to May 1, 2018. A total of 960 articles were excluded by viewing the titles and abstracts. The full texts of 17 records were read. Among the remaining 17 records, 8 letter and 1 case-control study were removed (supplement reference). Finally, 8 full-text studies were obtained and assessed according to the eligibility criteria, including 4 case-control studies and 4 cohort studies, comprising more than 927,684 patients. The detailed literature search and screening process are shown in *Figure 1*. The characteristics included in the study are shown in *Table 1*, including the first author's name, year of publication, study design, region, journal, sample size, period of patient recruitment patients, follow-up time and definition of PPI use.

The quality of 8 studies was assessed using the Newcastle–Ottawa Scale (NOS). Two studies achieved a NOS score of 6, three studies achieved a NOS score of 7 and three studies achieved a NOS score of 8 (*Table 2*). Six studies had a clear follow-up time, and four studies had a median follow-up period >3 years. The longest median follow-up period was 7.6 years. Six studies had a clear definition of the use of PPIs. Seven studies compared the risk of gastric cancer between PPI users and non-PPI users.

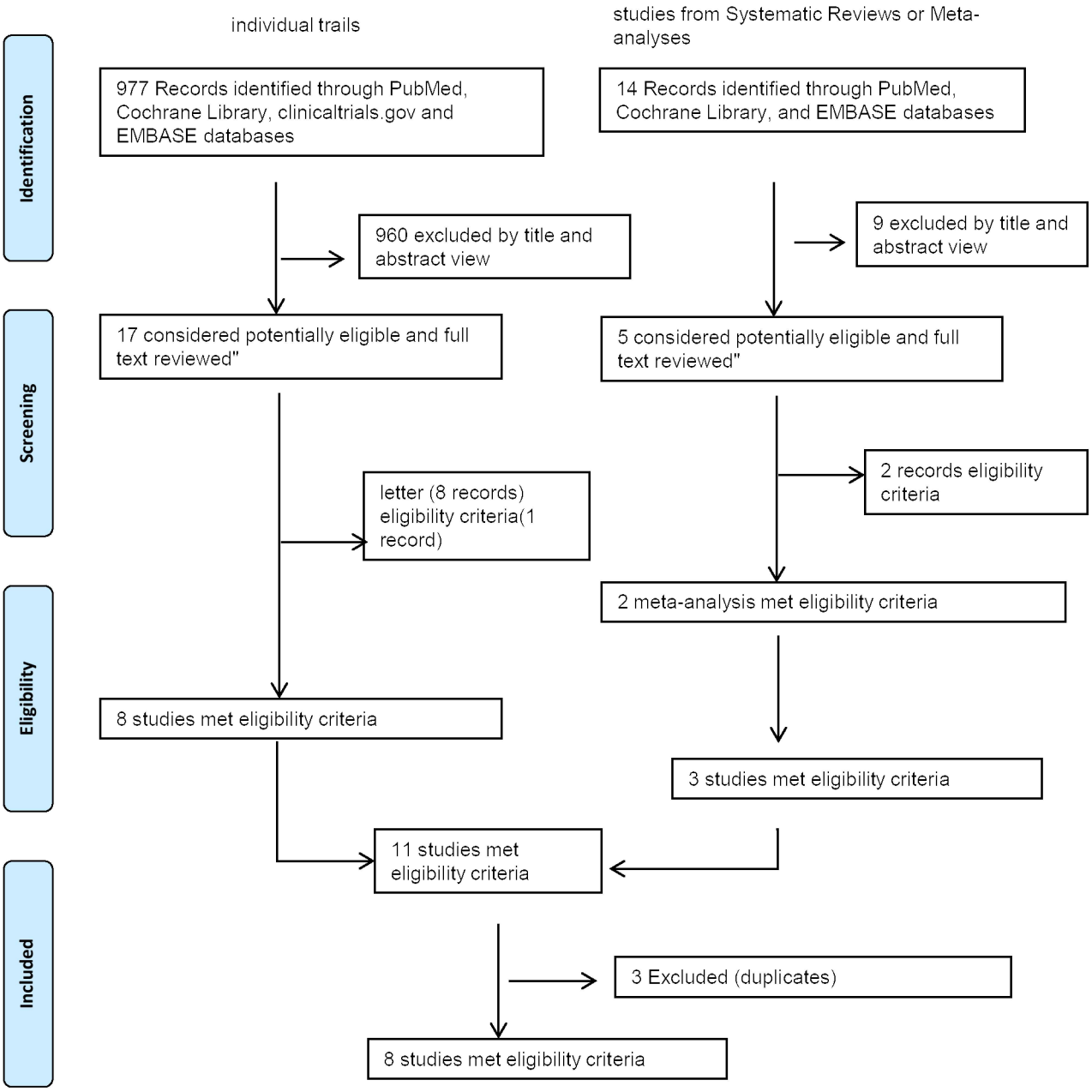


*Figure 1: Literature Search and Screening Process.*

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*Table 1: Characteristics of the included trials and particiants*

| Author | year | Design | Region | Journal | Sample size | Period | Follow-up | Definition of PPI use |
|---|---|---|---|---|---|---|---|---|
| Cheung et al.[8] | 2018 | Cohort study | Hong Kong | Gut | 63,397 | 2003-2012 | 7.6 year (median) | At least weekly use |
| Garcia et al.[17] | 2006 | Case–control study | The UK | Gut | 10,522 | 1994-2001 | NA | Current use represented prescriptions for that drug issued within the year prior to the index date while past use represented whenever the most recent prescription for that drug was issued longer than 1 year before the index date |
| Tamim et al.[18] | 2008 | Case–control study | Canada | Drug Saf | 8,229 | 1995-2003 | 6 months to 5 years | At least one dispensed prescription of the medication of interest during the study period (ie, between 6 months and 5 years prior to the index |
| Niikura et al.[19] | 2017 | Cohort study | Japan | Gut | 533 | 1998-2017 | 6.9 (median) | A cumulative defined daily dose of at least 6 months (≥180 days) during the study period (before a potential cancer diagnosis) |
| Poulsen et al.[20] | 2009 | Cohort study | Denmark | Gut | 18,790 | 1990–2003 | 3.5 (median) | Defined as filing≥2 PPI prescriptions during the study period |
| Brusselaers et al.[21] | 2017 | Cohort study | Sweden | BMJ Open | 82,2793 | 2005–2012 | 4.9 (median) | Maintenance use of PPIs, defined as at least 180 days during the study period |
| Peng et al.[22] | 2018 | Case–control study | Taiwan | Gut | 2,122 | 1996-2001 | From 2004 to 2011 | Participants were treated at least two times |
| Lai et al.[23] | 2018 | Case–control study | Taiwan | Gut | 1,298 | 2000–2013 | NA | NA |

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*Table 2: Quality assessment of the observational studies using the Newcastle-Ottawa Scale (NOS)*

*Table 2.1 Assessment of the cohort studies*

| Author | year | Representativeness of the exposed cohort | Selection of the non-exposed cohort | Ascertainment of exposure to implants | Demonstration that outcome of interest was not present at start of study | Comparability of cohorts | | Assessment of outcome | Was follow up long enough for outcomes to occur | Adequacy of follow up of cohorts | Total score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cheung et al.[8] | 2018 | + | + | + | + | + | - | + | + | + | 8 |
| Brusselaers et al.[19] | 2017 | + | + | - | + | + | - | + | + | + | 7 |
| Poulsen et al.[20] | 2009 | + | + | - | - | + | - | + | + | + | 6 |
| Niikura et al.[21] | 2017 | + | + | - | + | + | - | + | + | + | 7 |

*Table 2.2 Assessment of the case–control study*

| Author | year | Is the case definition adequate | Representativeness of the cases | Selection of Controls | Definition of Controls | Comparability | Ascertainment of exposure | Same method of ascertainment for cases and controls | Non-Response Rate | Total score |
|---|---|---|---|---|---|---|---|---|---|---|
| Garcia et al.[17] | 2006 | + | + | + | + | + | + | + | + | 8 |
| Tamim et al.[18] | 2008 | + | + | + | + | + | + | + | + | 8 |
| Peng et al.[22] | 2018 | + | + | + | + | + | + | + | - | 7 |
| Lai et al.[23] | 2018 | + | + | + | + | - | + | + | - | 6 |

***The risk of gastric cancer in PPI users compared with non-PPI users***

Seven studies involving 926,386 patients compared the risk of gastric cancer in PPI users compared with non-PPI users: Cheung et al[8], Garcia et al[17], Tamim et al[18], Niikura et al[19], Poulsen et al[20], Brusselaers et al[21], and Peng YC et al[22]. As shown in *Figure 2A*, the risk of gastric cancer PPI users was significantly higher than non-PPI users [RR=2.10, 95% CI (1.17-3.97)]. Regional variations are also analyzed low-intermediate incidence vs high incidence. Cheung et al[8], Niikura et al[19] and Peng YC et al[22] is from high incidence region(HK, Japan, Taiwan). Garcia et al[17], Tamim et al[18], Poulsen et al[20] and Brusselaers et al[21] is from low-intermediate incidence region (UK, Canada, Denmark, Sweden). We found the risk of gastric cancer PPI users was significantly higher than non-PPI users [RR=2.53, 95% CI (2.03-3.17)] in high incidence region, but no significant differences were seen between the two groups [RR=1.66, 95% CI (0.95-2.89)] in low incidence region. The result of cumulative meta-analysis showed that the significant difference supporting PPI users was first found in the latest study in 2008, with the CI narrowing and the effect size becoming stable (*Figure 2B*).

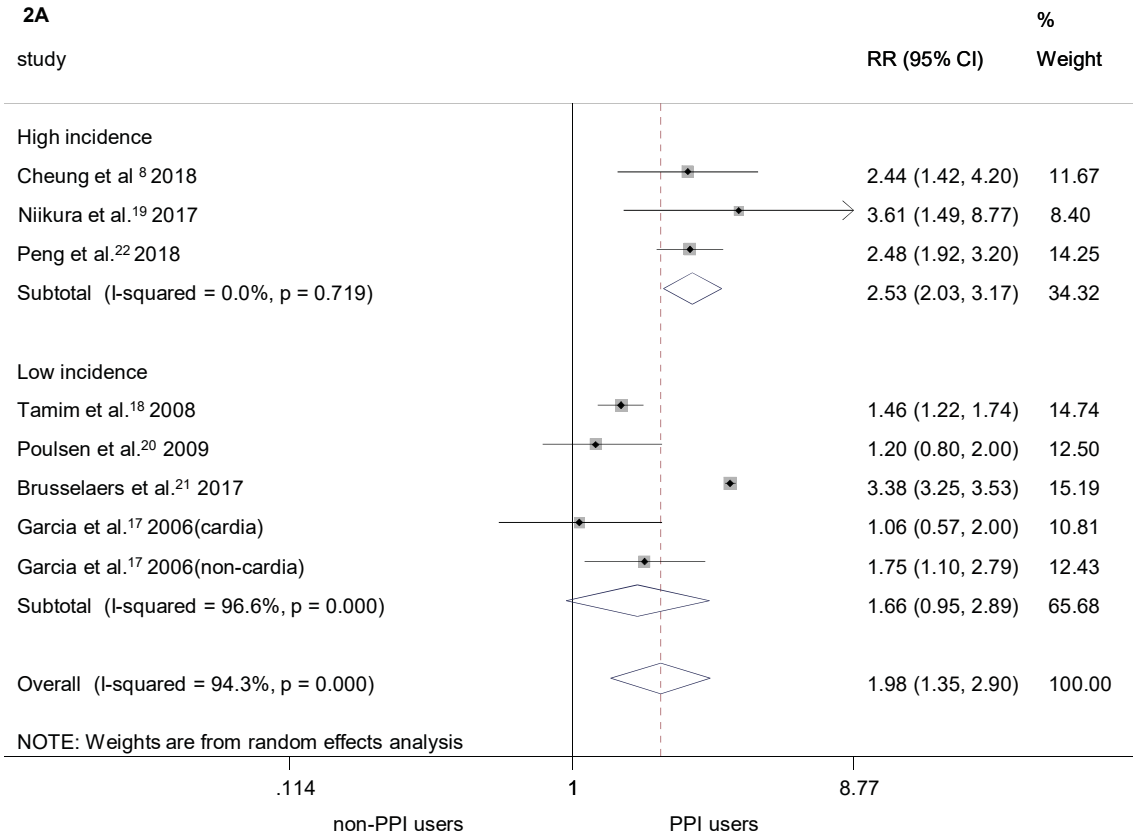


*Figure 2A: Forest plot of pooled risk ratio for gastric cancer in PPI users versus non-PPI users.*

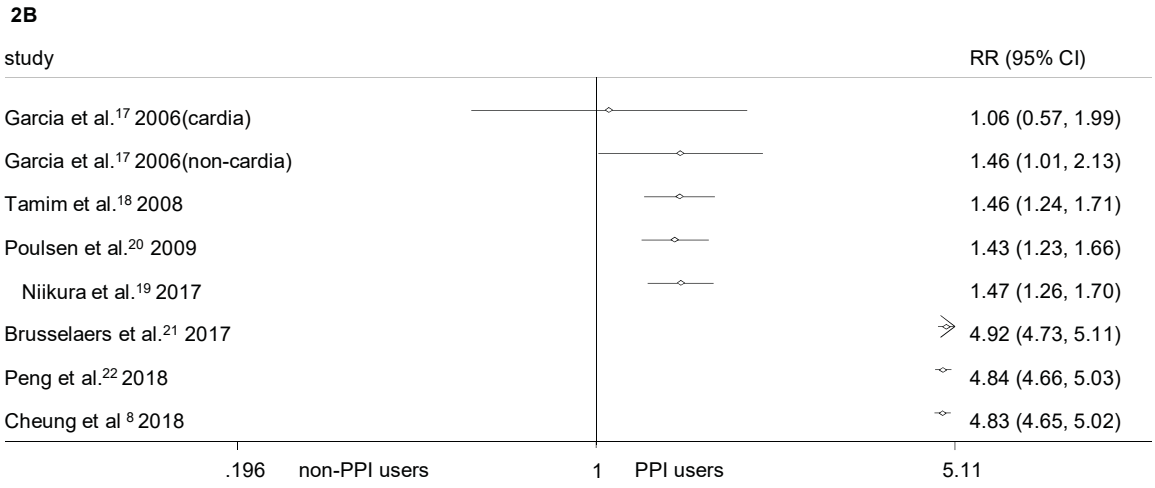


*Figure 2B: Cumulative meta-analysis of the risk ratio for the gastric cancer according to time.*

***Subgroup analysis according to duration***

Duration ≤1 year: Five studies enrolled 15,494 patients including Garcia et al[17], Poulsen et al[20], Brusselaers et al[21], and Lai et al[23]. No significant differences were seen between the two groups [RR=2.18, 95% CI (0.66-7.11)] (*Figure 3*).

Duration 1-3 years: Two studies enrolled 12,715 patients, including Garcia et al[17] and Brusselaers et al[21]. The risk of gastric cancer PPI users was significantly higher than non-PPI users [RR=1.74, 95% CI (1.04-2.90)] (*Figure 3*).

Duration ≥1 year: Four studies enrolled 93,807 patients, including Cheung et al[8], Garcia et al[17], Poulsen et al[20], and Brusselaers et al[21]. The risk of gastric cancer PPI users was significantly higher than in non-PPI users [RR=1.88, 95% CI (1.60-2.22),] (*Figure 3*).

Duration ≥3 years: Four studies enrolled 93,807 patients, including Garcia et al[17], Poulsen et al[20], and Brusselaers et al[21]. The risk of gastric cancer PPI users was significantly higher than non-PPI users [RR=1.95, 95% CI (1.65-2.31)] (*Figure 3*).

Duration ≥5 years: Four studies enrolled 19,323 patients, including Poulsen et al[20] and Brusselaers et al[21]. The risk of gastric cancer in PPI users was significantly higher than in non-PPI users [RR= 2.03, 95% CI (1.75-2.35)] (*Figure 3*).

Furthermore, the risk increased with a longer duration of PPI use (RR=1.74, 95% CI (1.04-2.90) for 1-3 years of use; RR=1.95, 95% CI (1.65-2.31) for ≥3 years of use and RR=2.03, 95% CI (1.75-2.35) for ≥5 years of use).

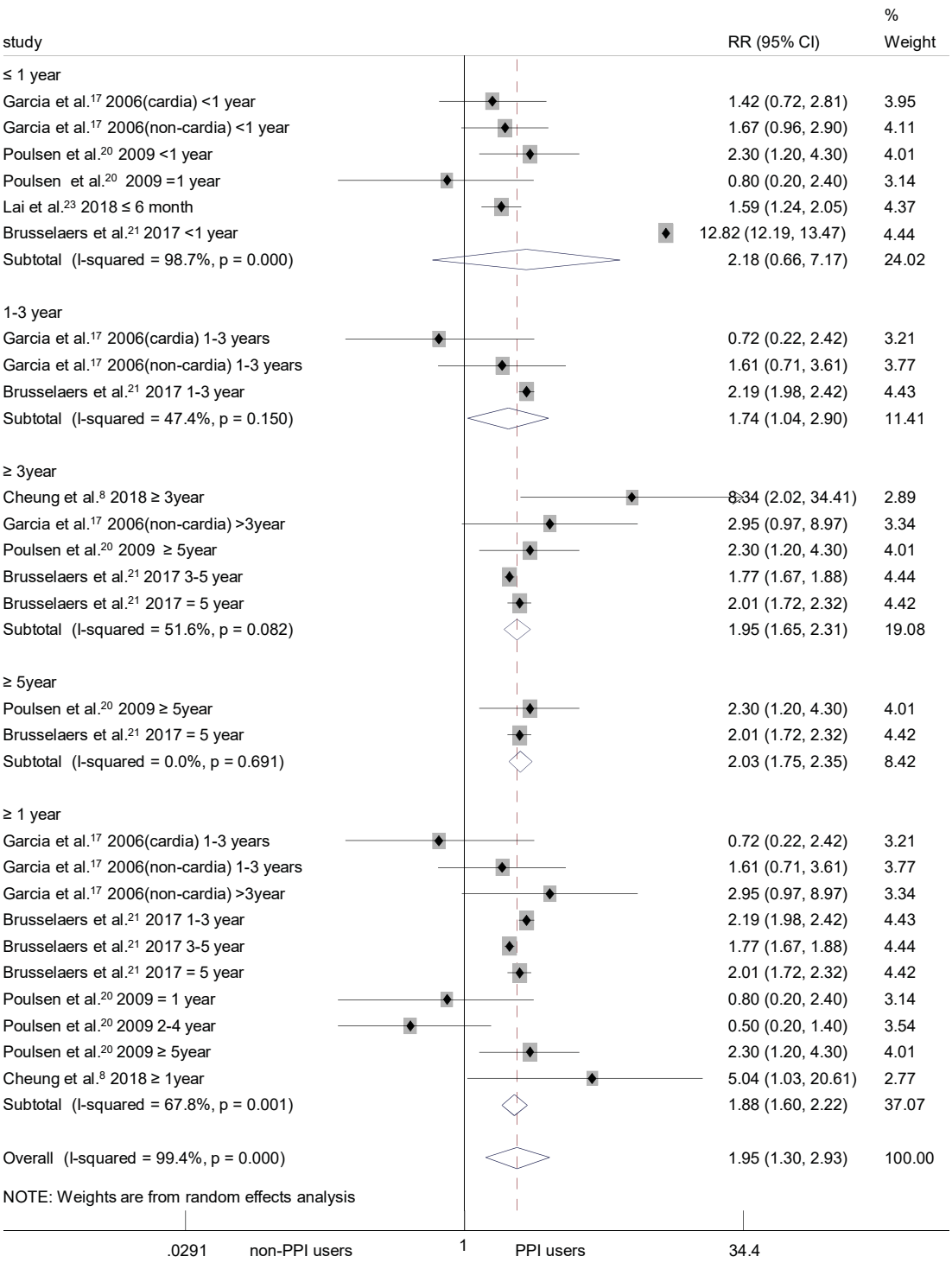


*Figure 3: Forest plot of the pooled risk ratio for gastric cancer in PPI users versus non-PPI users according to duration.*

***Subgroup analysis according to location***

Four studies enrolled 12,294 patients, including Cheung et al[8], Garcia et al[17], Tamim et al[18], Brusselaers et al[21], and Peng YC et al[22]. The risk of non-cardia gastric cancer in PPI users was significantly higher than in non-PPI users [RR= 2.66, 95% CI (1.66 -4.27)]. However, no significant differences were found between the two groups for the risk of cardia gastric cancer [OR=1.86, 95% CI (0.71-4.89)] (*Figure 4A*).

In Garcia et al[17], the risk of non-cardiac gastric cancer for PPI users was higher than non-PPI users when the duration ≥1 year [RR=1.99, 95% CI (1.03 -3.83)] (*Figure 4B*). Cheung et al[8], Tamim et al[18], Brusselaers et al[21] and Peng YC et al[22] included only gastric cancer , while Garcia et al[17] included only gastric adenocarcinoma.

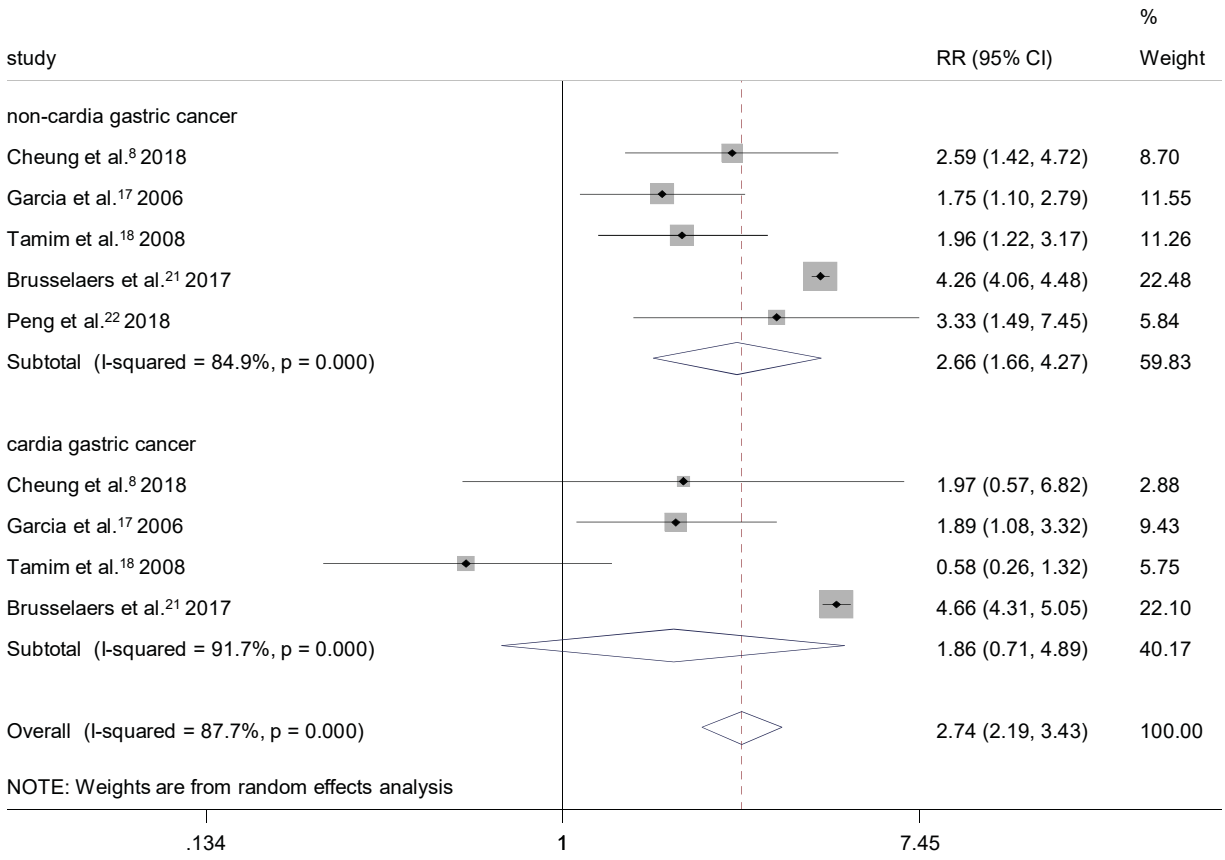


*Figure 4A: Forest plot of the pooled risk ratio for gastric cancer in PPI users versus non-PPI users according to location.*

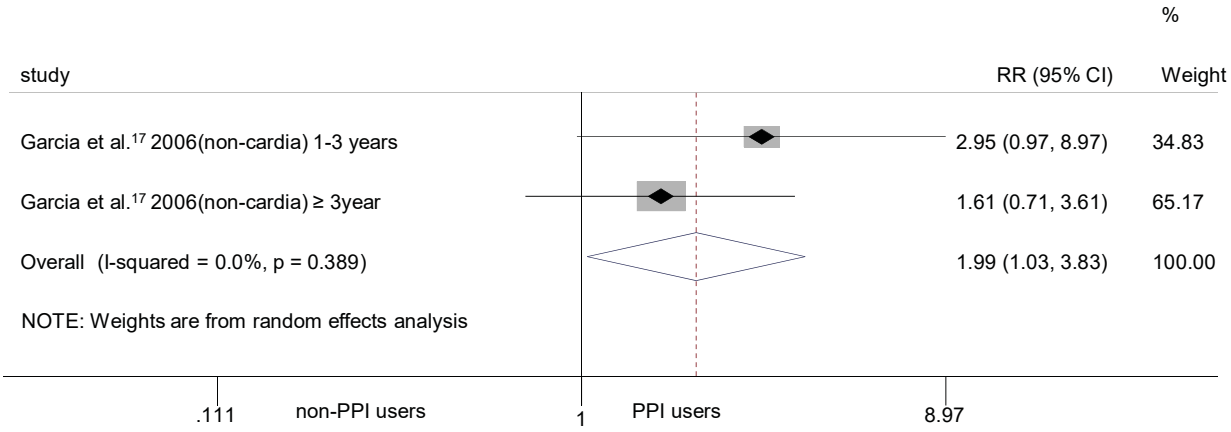


*Figure 4B: Forest plot of the pooled risk ratio for non-cardia gastric cancer in PPI users versus non-PPI users when duration ≥1 year.*

***Subgroup analysis according to H. pylori infection***

Three studies enrolled 845,923 patients, including Cheung et al[8], Niikura et al[19], and Brusselaers et al[21]. The risk of gastric cancer in PPI users was significantly higher than in non-PPI users with prior H. pylori infection [RR=4.8, 95% CI (1.82 -12.67)] (*Figure 4C*).

Three studies enrolled 123,915 patients, including Cheung et al[8], Brusselaers et al[21], and Lai et al[23]. The risk of gastric cancer was similar between the two groups with H. pylori infection [OR= 0.91, 95% CI (0.17 -4.90)] (*Figure 4c*).

Cheung et al[8] included 142 460 PPIs users without prior H. pylori eradication therapy were identified with a total of 705 094 person-years of follow-up. Niikura et al[19] included 571 patients who achieved H.pylori eradication were selected using thedatabase of University Tokyo Hospital from 1998 to 2017.

**Discussion:**

This study included recent studies with large sample sizes from 1987 to 2018 to explore the risk of gastric cancer in PPI users compared with non-PPI users. Although all the included studies were retrospective studies, they were of were relatively high quality according to the results of quality evaluation and had large sample sizes. Our study included 8 publications with 926,386 patients, and the data suggested that long-term PPI use increases the risk of gastric cancer. Subgroup analysis suggested that long-term PPI use may increase the risk of non-cardiac gastric cancer when the duration is ≥1 year. Long-term PPI use after H. pylori eradication therapy for patients with prior H. pylori infection may increase the risk of gastric cancer.

In recent years, the reported incidence rates of gastric cancer in PPI patients has been 0.081%-5.0%[8, 17, 20, 21]. This rate is significantly higher than the incidence of gastric cancer in the general population (0.014%-0.491%) [24, 25]. In our study, the risk of gastric cancer in PPI users was also significantly higher than that in non-PPI users. Regional variations also be analyzed (low-intermediate incidence (Sweden, Denmark, Canada, UK) vs high incidence (Taiwan, Japan, HK)). Subgroup analysis according to incidence, the risk of gastric cancer PPI users was significantly higher than non-PPI users [RR=2.53, 95% CI (2.03-3.17)] in high incidence region, but no significant differences were seen between the two groups [RR=1.66, 95% CI (0.95-2.89)] in low incidence region. Currently, the mechanism by which a PPI may increase the occurrence of gastric cancer has not been fully elucidated. Some studies suggest that the long-term use of PPIs profoundly reduces gastric acid production and consequently leads to the increased secretion of gastrin. Hypergastrinemia as a result of acid suppression causes the hyperplasia of enterochromaffin-like cells, resulting in the formation of microcarcinomas and gastric neuroendocrine tumors[26-29]. Song et al suggest that a PPI inhibits gastric acid and leads to hypergastrinemia, which may lead to hyperproliferation, chronic hypochloremia, chronic inflammation, intestinal metaplasia and atrophy of the stomach [30]. In addition, a high pH environment can cause double infection with H. pylori and non-H. pylori bacterial species[31, 32].The synergistic effect of many bacteria can produce nitrosamine carcinogens, which may lead to the development of gastric cancer.

However, does the correlation between PPI use and gastric cancer depend on the time of treatment? Cheung et al [8] thought that PPIs increase the risk of gastric cancer development in the context of underlying H. pylori-associated chronic gastritis and atrophy. A meta-analysis [33] revealed that the long-term use of PPIs (≥12 months) is associated with an increased risk of fundic gland polyps. Suissa S et al [10] thought that the correlation between the use of PPIs and the risk of gastric cancer may be caused by time bias. In this study, we found that there was a significant time correlation between a PPI and the incidence of gastric cancer. The incidence of gastric cancer

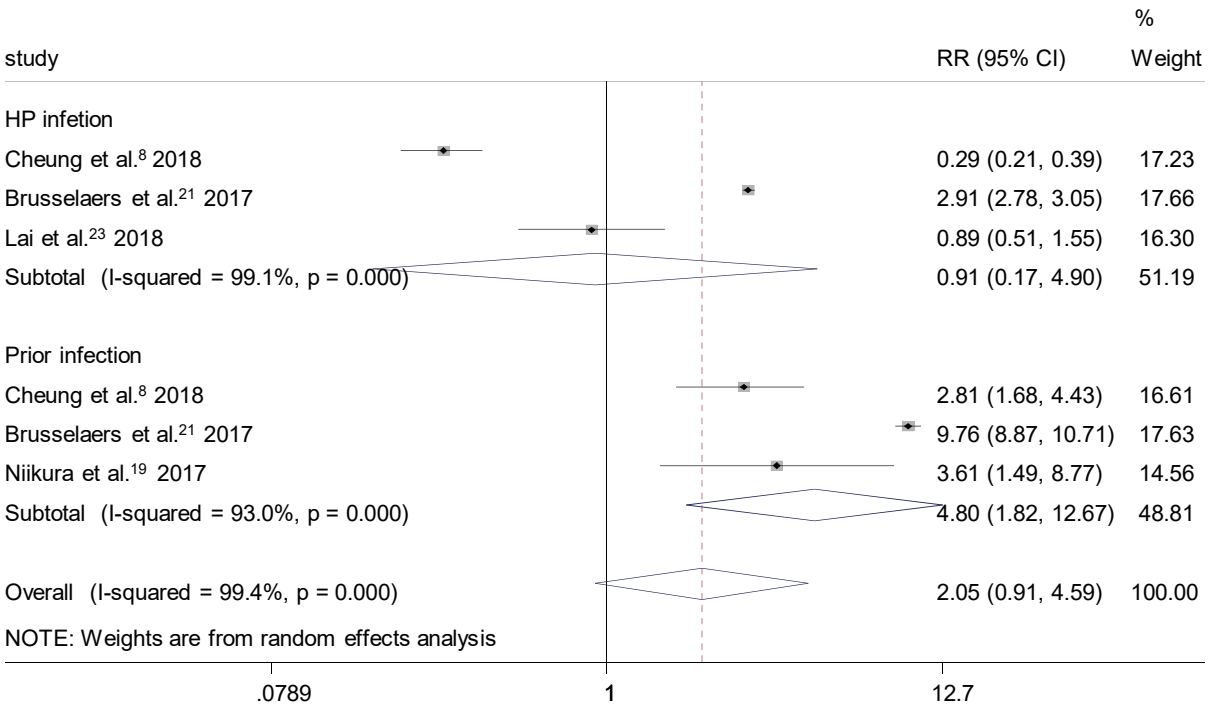


*Figure 4C: Forest plot of pooled risk ratio for gastric cancer in PPI users versus non-PPI users according to H. pylori infection.*

was significantly higher when a PPI was used for ≥1 year. Because of the different functional cells on different parts of stomach, the study found that long-term PPI use may increase the incidence rate of non-cardia cancer according to stratification analysis of location. This may be because gastrin is secreted by G cells in the mucosa of the gastric antrum and proximal duodenum. These locations tolerate gastric acid well but are more prone to intestinal metaplasia and precancerous lesions after gastric acid suppression. In addition, PPIs are one of the main drugs for the treatment of H. pylori[4], but they are often abused. Subgroup analysis found that the risk of gastric cancer in PPI users was significantly higher than non-PPI users with prior H. pylori infection, while there was no statistically significant difference between PPI users and non-PPI users with H. pylori infection. However, while is relatively safe after H. pylori eradication, it is not appropriate to prescribe long-term PPIs to these patients, even after successful eradication of H. pylori.

There are also some limitations in this study. First, there is certain publication bias and selection bias because of the retrospective design of the original research. Second, the inconsistencies in the definition, dosage, duration, type of PPI use and the inclusion criteria of the original study may lead to bias. In addition, other potential confounding factors include precancerous diseases of gastric cancer, such as gastric polyps, gastroesophageal reflux disease and peptic ulcers, and a family history of gastric cancer. Those factors have not been systematically evaluated because of the lack of related data. However, based on the results of meta-analysis, this study shows that the long-term use of a PPI was associated with an increased risk of gastric cancer development, particularly for non-cardia cancer and in high incidence region, which is of great significance for the rational clinical application of PPIs.

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***Contributors***
CMH, JXL and JLL conceptualized and designed the study, acquired and analysed data, interpreted the study results, drafted the manuscript and critically revised the manuscript for important intellectual content. CHZ and PL acquired and analysed data, interpreted the study results and critically revised the manuscript for important intellectual content. JWX and JBW designed the study, interpreted the study results and critically revised the manuscript for important intellectual content. JL and QY designed the study, interpreted the study results and critically revised the manuscript for important intellectual content. LLC and ML conceptualized and designed the study, interpreted the study results and critically revised the manuscript for important intellectual content.

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***Availability of data and materials***
Further information are available from the corresponding author on reasonable request.

***Ethics approval***
Our protocol was approved by the ethics committee of the Fujian Medical University Union Hospital.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions. Informed consent or substitute for it was obtained from all patients for being included in the study.

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CLINICAL PRACTICE OPEN ACCESS

# Enhanced recovery after surgery (ERAS) protocol for gastrectomy: A tailored program developed at a gastric cancer unit

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**ABSTRACT**

**Background:**

Planning for and managing patients who follow multidisciplinary paths allow institutions to provide better care administration; greater collaboration among medical staff, patients, and their relatives; better patients education; reduced possible complications related to surgery and hospital stay; and increased patient adherence to the proposed treatments due to better information. The ERAS Society's guidelines align in this direction, and many institutions are now looking to apply the suggestions contained in its items. This effort is especially important in surgical oncology. In this work, we report the experience of our center in developing tailored guidelines for patients undergoing gastrectomy based on evidence from the literature and adapted to address the availability of personnel and equipment in our institute.

**Methods:**

A permanent institutional working group was established at St. Mary's Hospital. Evidence-based comprehensive research was conducted to find optimal perioperative care management for patients undergoing gastrectomy.

Evidence and recommendations were thoroughly evaluated and considered together with the items from the ERAS Society's guidelines.

**Results:**

A complete patient pathway has been established from the first outpatient visit to discharge.

All ERAS items were considered and adapted to our hospital's care environment. Education, nutrition, anesthesiologist care, surgical approach, and ward organization are the main points of strength highlighted in the present work.

**Conclusion:**

This proposed institutional evidence-based protocol show comprehensive management for patients with gastric cancer eligible for enhanced surgical pathways.

**Key words:**

ERAS, Enhanced Recovery After Surgery, Gastrectomy, Gastric Cancer.

**Background:**

Gastric cancer is the second leading cause of cancer-related death globally, and surgery is the most important treatment of this disease. Even so, gastric cancer surgery remains a high-risk procedure that is associated with clinically significant postoperative stress, complications, and relevant sequelae. The morbidity and mortality of radical gastrectomy are 9.1–46.0% and 0–13%, respectively.

In this context, ERAS programs have been proposed with which to improve postoperative physiological functionality and facilitate patient recovery. ERAS protocols have many elements, including preoperative patient education, preoperative loading of carbohydrates, nutrition from the first postoperative days, early mobilization of patients, and antithrombotic prophylaxis.

Briefly, we summarize the evidence relating to the points of greatest interest:

***Nasal–Gastric Tube, Abdominal Drainage, Mobilization***

No advantage is reported in the literature from the routine use of the nasogastric tube[1].

Some studies have shown that the nasogastric tube is not able to reduce the risk of anastomotic leakage, the number of lung complications, or mortality and that it significantly reduces the patient's postoperative comfort[2-4]. Furthermore, Yang's meta-analysis[5] indicated that postoperative maintenance of the tube prolongs the postoperative ileum and time to first flatus. Yamada[6] reported that complications that could be caused by a shortening of the postoperative fasting period, such as pneumonia ab-ingestis or anastomotic leakage, did not increase in a group of patients undergoing ERAS. In addition, the absence of abdominal drainage is an additional factor that improves patient comfort, stimulates and facilitates walking.

The evidence does not show any benefit to using abdominal drainage in numerous surgical procedures[7, 8]. However, little evidence is available regarding gastric surgery. In particular, the use of drainages after total gastrectomy is still widely debated in the context of the development of ERAS programs.

An important item in the ERAS protocol is early mobilization[9], which is facilitated by absence of the tube and drainage as well as by early removal of the urinary catheter. Smart[10] has shown that failure of early patient mobilization is significantly associated with an extension of the postoperative stay.

Several studies[6, 11-13] have shown that application of these points of the ERAS program can significantly accelerate recovery of postoperative intestinal function compared with conventional management.

***Nutrition***

Consideration of functional outcomes such as first flatus or resumption of peristalsis can be at risk of bias. For this reason, it is appropriate to analyze in more detail variables related to recovery of oral intake.

ERAS protocols require that the patient not be subjected to long periods of fasting. Early nutrition has been shown to reduce postoperative catabolism, accelerate the return of intestinal function, and reduce the risk of complications[14, 15]. Furthermore, Lewis et al. [16] confirmed in their meta-analysis that keeping patients on an empty stomach brings no benefit. Several studies have shown that early oral nutrition not only is feasible in gastric surgery but also brings significant benefits[11, 17]; however, this point remains controversial.

Although early resumption of feeding has been shown to accelerate recovery of the patient after several surgical procedures, use of such an approach after gastrectomy has historically been viewed with distrust born out of a concern, not well demonstrated in the literature, that early oral intake could cause anastomotic leakage or intestinal obstruction.

Over the past few years, several studies have confirmed that early feeding after gastrectomy is safe and that it is associated with an improvement in functional recovery and a reduction in hospital stay[6, 18]. In particular, a randomized controlled trial reported data on safety in the resumption of oral feeding from the second postoperative day after gastrectomy[19].

Studies by Makuuchi[20] and Pedziwiatr[21], which contrasted use of an ERAS protocol and conventional management after gastrectomy, confirmed that resumption of oral nutrition is safe from the second postoperative day and that it is correlated with a reduction in postoperative administration of fluids intravenously as well as with early discharge[22].

Sugisawa[20] evaluated anastomotic leakage rate and pneumonia ab-ingestis to evaluate the real risk attributable to early nutrition. In this study, incidence of anastomotic leakage was 0.8% in the ERAS group—a figure not only lower than that of its historical comparison cohort (1.7%) but also in line with or lower than data from previous studies reporting conventional perioperative management (0.8–1.9%). Hence the author concluded that early oral nutrition does not adversely affect the anastomotic site. Similar results were obtained by Yamada[6, 23], who showed a similar incidence in incidence of leaks (1.1%).

***Hospital Stay***

The effects of adopting an ERAS program on postoperative hospital stay depend not only on clinical factors but also on the health systems and sociocultural substrate of patients. For example, Yamada[6] reported that even though ERAS patients had a quicker functional recovery than those in the conventional group, length of stay did not significantly differ between the two groups. The authors attributed this result first to the Japanese Diagnosis Procedure Combination-based Payment System (DPC), which allows patients to extend their hospitalization at a reduced cost.

Among others, Sugisawa[20] reported that the median of postoperative hospital stay was significantly reduced in the ERAS group (8 days) compared with its historical cohort (10 days; $p = 0.001$). Similar results were obtained by Wang[11]. With regard to postoperative complications and the need for reoperation, all studies confirmed the safety of the ERAS approach and the absence of any statistically significant difference with the control groups[6, 20].

In conclusion, it has been widely demonstrated that adoption of management based on ERAS principles in

a reference center for gastric cancer can improve the patient's functional recovery and quality of life while allowing early discharge[24].
We show, in the present article, the ERAS Protocol approved at our gastric cancer unit.

## ERAS PROTOCOL

**Eligibility of patients:**
Each patient must meet all the inclusion criteria and none of the exclusion criteria:

*Inclusion Criteria*
- Histological diagnosis of gastric cancer
- Preoperative staging performed by EGD and/or endoscopic ultrasound and CT, in accordance with international guidelines
- Early gastric cancer (EGC)
- Advanced gastric cancer (AGC)
- Patients treated with curative intent, in accordance with international guidelines

*Exclusion Criteria*
- Distant metastasis: peritoneal carcinosis, liver metastases, remote lymph node metastases, Krukenberg tumors, involvement of other organs
- Patients at high operative risk, as defined by the American Society of Anesthesiologists (ASA), score ≥ 4
- History of previous abdominal surgery for gastric cancer
- Synchronous malignant tumor in other organs
- Palliative surgery

**Preoperative outpatient/home management:**

*Preoperative Counseling and Education*
The meeting with the patient must take place well in advance of the planned intervention and/or hospitalization in a dedicated environment (ERAS outpatient clinic) stocked with easily accessible and readily understandable information material, allowing for an interview between the patient and the multidisciplinary team (surgeon, anesthesiologist, nurse, dietician). The aim is to promote compliance with the protocol by sharing the objectives with the patient and motivating him or her to adhere to the path outlined. To this end, family members participate in the preoperative interview and assist the patient both during the hospitalization and once they return home.
Counseling should take place sufficiently in advance of the scheduled admission date. It is highly recommended that the meeting take place in a multidisciplinary manner, with simultaneous participation of all professionals involved. Doing so allows all subjects to share health education and information data that the patient must receive, while avoiding repetition and finalizing the interview in an optimal way.
The anesthesiologist and surgeon should inform the patient of the relevant procedures and obtain informed consent. It is advisable that verbal information be integrated with delivery of informative material (brochures, brochures, videos, etc.).

*Assessment of Respiratory*
If the patient has a positive history of severe respiratory disease (COPD, asthma, sleep apnea syndrome), a clinical-instrumental evaluation of respiratory function is indicated, aimed at identifying subjects who could benefit from pre- and/or postoperative respiratory physiotherapy.
Nutritional and Behavioral Management in the Preoperative Period
- Assessment of nutritional status and dietary prescriptions. A preoperative nutritional risk assessment should be performed, preferably using the Malnutrition Universal Screening Tool (MUST https://www.bapen.org.uk/screening-and-must/must-calculator )[25, 26]. Preoperative administration of immunonutrition is indicated for at least 5 days in all patients, and at least 7 days in malnourished patients, before surgery. The dietitian's evaluation is indicated in patients with a MUST score ≥ 2.
- The patient should be asked to abstain from smoking and intake of all alcoholic beverages.
- In the days preceding the intervention (5 days), the patient should follow a special diet, as outlined during the outpatient visit.
- The patient is hospitalized the afternoon before surgery and from the start of the hospitalization can ingest only rusk, clear liquids, and dinners tailored by the dietetic and nutrition service.
- The patient may not consume food during the 6–8 h before surgery but might be able to consume clear liquids (clear fluids: water, tea, coffee, sports drinks, meat or vegetable broth, fruit juices without grape/apple/blueberry pulp, popsicles without pulp or pieces of fruit) up to 2–4 h before surgery.
- The patient must also be instructed in how to take the immunonutrient mixtures per OS. The protocol provides for the intake of 750 mL/day of product, starting 5 days before surgery (7 days in the malnourished patient).
- Administer a maltodextrin-based drink free of lipids, lactose, fiber, and gluten in the recommended dose of 800 mL the evening before the intervention and then, if the intervention occurs in the afternoon, another in a dose of 400 mL 2–4 h before the intervention. The drink should be taken fresh and not at room temperature.

*Intestinal Preparation*
No preparation of principle.

*Antithrombotic Prophylaxis*
According to guidelines.

*Antibiotic prophylaxis*
Administration of cefazoline 2 g IV 30 min before induction.

**Operative management:**

*Anesthesiological Protocol*

Premedication

- Low doses of Midazolam ~0.05mg/kg.

Type of anesthesia:

- general balanced with vapors: sevoflorane or desflurane associated with continuous infusion of short-acting opiates such as remifentanyl

or

- totally intravenous anesthesia (TIVA TCI) with propofol and remifentanyl in continuous infusion so as to associate anesthesiological depth control with BIS (bispectral index) sensor
- Use of fast-metabolizing curaries such as cisatracurium or those that guarantee a total reversal of neuromuscular blockade by sugammadex, such as rocuronium
- Continuous monitoring with skin temperature sensor
- Patient skin heating systems

Intraoperative fluid therapy optimization

- Heating of fluids infused to the patient
- EW1000 Edwards less invasive hemodynamic monitoring based on pulse contour method with headphone sensor or intra-arterial catheter for beat-by-beat evaluation of cardiac output (CI) and stroke volume (SV)
- Optimization of intraoperative fluid therapy according to SV, based on the NICE protocol, to avoid edema of the intestinal mucosa and consequent slowing of motility due to overloading or underloading ischemias of the intestinal loops[27].

*Intraoperative Pain and Postoperative Nausea and Vomiting (PONV) Control*

- Transversus abdominis plane block (TAP block): Ropivacaine 0.2% (8-10ml/h) infused for 48-72 h through a multihole catheter.
- Use of Paracetamol and fans, infiltration of surgical wounds with long-acting local anesthetics such as levobupivacaine or ropivacaine for pain control
- Intraoperative prevention of postoperative nausea and vomiting according to Apfel score[28]
- Removal of the SNG if present before the end of the intervention
- In the event of open interventions, infiltration of the surgical wound with long-acting local anesthetics such as levobupivacaine or ropivacaine and placement of continuous-release catheters of local anesthetic at the suprafascial level.

*Surgical Technique*

- Surgical access: 2D/3D/4K laparoscopic, robotic-assisted via the Da Vinci platform Yes. Laparotomic access is considered when the minimally invasive approach is not practicable.
- Drains: Not positioned in the distal gastrectomy. In the case of total gastrectomy, 1 drainage is positioned near the esophagus–jejunal anastomosis.

**Postoperative management:**

*Immediate Postoperative Monitoring*

- Transfer of the patient to recovery room
- Recovery of cognitive skills and evaluation according to Ramsay score
- After laparoscopic/robotic intervention continuous monitoring of CO2 in spontaneous breathing for 1 h
- Pain assessment with analogue–visual VAS scale at 5, 30, and 60 min
- Temperature control (time 0, 3 h, 6 h)

*Postoperative Nausea and Vomiting (PONV)*

- The goal in ERAS is not to suspend liquid intake and oral feeding. Optimal control of symptoms (nausea and vomiting) with multimodal drug therapy (e.g., cortisone, ondansetron) should be guaranteed.
- In subjects who are at high risk of PONV (assessed on the basis of Apfel score), anti-emetic therapy should be prescribed, in principle[28].

*Prophylaxis of Postoperative Pain*

- Infiltration of surgical wounds with local anesthetic
- Administration of 1 g Paracetamol IV 20 min before the end of the intervention, repeated 4 h and 8 h apart
- Targin 20 mg cpr for OS or ketorolac 30 mg IV as needed

*Nutritional Management*

Specific nutritional protocol attached, but general principles include the following:

1. Preventing and/or managing malnutrition by default through nutritional risk assessment and gradual introduction of energy and nutrients until complete coverage needs are met.
2. Adaptation of diet to the new anotomic–functional capacities of the residual gastrointestinal tract and prevention or modulation of the different symptoms that can arise in the early postoperative period (sense of early satiety, nausea, vomiting, reflux, and dumping syndrome) through the following:

- splitting the diet into small and frequent meals (at least 6 meals/day)
- fluid intake between meals, reduced intake of foods and drinks rich in simple sugars due to their high osmotic power
- behavioral recommendations for meal management: eat slowly in small bites, chew well and sit upright for at least 30 to 60 minutes after the meal

*Resumption of Thromboembolic Prophylaxis*

Enoxaparin sodium starting from the 2nd postoperative day and in accordance with the guidelines.

*Use of Antibiotics*

Avoid if not necessary.

*Infusion Therapy*
Suspend when oral intake of fluids meets patient's water needs.

*Gastrografin Swallow*
1st postoperative day.

*Urinary Catheter Removal*
1st postoperative day.

*Start Mobilization*
- Encourage patient to mobilize as early as 2 h after returning to the ward.
- 1st day: patient must stay out of bed for at least 8 h and walk at least 600 m.
- 2nd day: normal activity, not less than that prescribed for the 1st day.
- It is recommended that adequate rooms and armchairs be used to help the patient stay out of bed. It is useful for the patient to keep a diary in which to record time spent out of bed and, providing appropriate references, the precise distance walked.

*Respiratory Rehabilitation Using Incentive Spirometer*
1st postoperative day.

*Drainage Removal*
After execution of gastrografin swallow (1st postoperative day).

**Discharge criteria:**
- Ability to mobilize and independently practice personal hygiene care
- Free diet according to nutritional indications
- Adequate pain control with oral analgesics and VAS score ≤ 4
- No clinical or laboratory evidence of postoperative complications or unresolved medical problems
- Patient consent

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*Availability of data and materials*
The datasets used and/or analyzed during the current study are available
from the corresponding author on reasonable request.

*Appendix A. Supplementary data*
Supplementary data associated with this article can be found, in the on-line version at https://www.journalofgastricsurgery.com/index.php/JGS/article/view/21

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TECHNICAL NOTE

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# Robotic distal subtotal gastrectomy with D2 lymphadenectomy for advanced gastric cancer: A case report and technical description

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**ABSTRACT**
Robotic systems have revolutionized the way we perform minimally invasive surgery and has facilitated the evolution of traditional laparoscopic gastric surgery. Surgeons have several advantages that can overcome some of the well-known limits of laparoscopy: three-dimensional vision, articulated instruments, the absence of tremors. These can give greater dexterity and precision in dissection and suturing movements that are key elements when performing complex and gentle reconstruction to restore digestive continuity.
The present case shows the technical details and tips and tricks of a robotic surgical approach for a subtotal gastrectomy.

**Key words:**
robotic surgery, gastric cancer, subtotal gastrectomy, minimally invasive surgery.

**Introduction:**
The robotic approach for technically demanding complex abdominal cancer operations, such as radical surgery for advanced gastric cancer, has been standardized to facilitate minimally invasive surgery[1-4]. Robotic subtotal gastrectomy with D2 lymphadenectomy using the DaVinci Xi Surgical System is described in the present case (St. Mary's Hospital of Terni).

**Case presentation:**
A 52-year-old woman with biopsy proven signet ring cell adenocarcinoma of the stomach was clinically staged cT3N1M0 after endoscopic ultrasound and a CT scan. She was found to have a prepyloric mass invading the subserosa and two pathological appearing lymph nodes in station #6 without evidence of metastatic disease. After discussion of treatment options including upfront surgery followed by adjuvant treatment versus neoadjuvant treatment followed by surgery, the patient underwent a robotic distal subtotal gastrectomy with D2 lymphadenectomy.

**Procedure details:**
The procedure was performed with the patient in the supine position with arms tucked to the patient sides. Four 8mm robotic trocars and one 15mm assist trocar were placed.
The daVinci Xi Surgical System's bedside chart was brought in from the patient's right side and docked. The instruments were inserted into the robotic arms (Arm 1. cadiere forceps; Arm 2: harmonic ultrasonic shears / cautery hook; Arm 3: Camera; Arm 4: Maryland bipolar).
The primary surgeon moved to the surgeon console and the procedure began with the division of gastrocolic ligament using the harmonic scalpel from right to left and proximally to identify and divide, between hem-o-lock, the left gastroepiploic artery and retrieve lymph node station #4sb. The level of the proximal resection is also identified.
Then, the greater curvature was cleared of #4d, including the lymph nodes along the second branch and distal part of the right gastroepiploic artery (RGEA).
The division of the gastrocolic ligament continued distally. To do that, the posterior surface of the stomach should be well lifted up, exposing the pancreatico-duodenal area.
The superior right colic vein was identified in order to find the gastrocolic trunk of Henle (*Figure 1).*

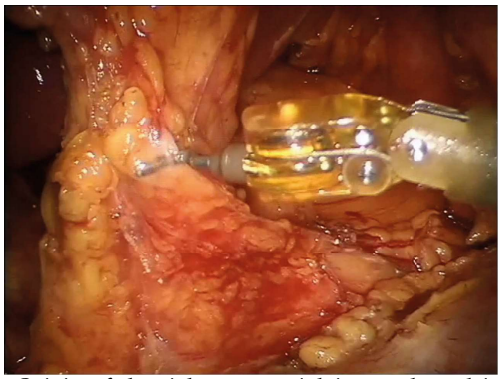

*Figure 1: Origin of the right gastroepiploic vessels and infrapyloric lymphnodes (#6).*

The latter was dissected, and the right gastroepiploic vein was sectioned at its origin.
The base of the right gastroepiploic vein was identified and isolated, as it entered the superior mesenteric vein and divided between hem-o-lock.
The posterior gastric wall was completely mobilized from the anterior surface of the pancreas by sectioning all adhesions with the pancreatic capsule.
The right gastroepiploic artery was identified at its origin from the gastroduodenal artery and divided as well. This allowed for the en-block retrieval of #6, the soft tissue along the proximal part of the RGEA and on the anterior surface of the head of the pancreas above the anterior superior pancreaticoduodenal vein.
Here, the pylorus and the first portion of the duodenum need to be completely released and particularly the entire course of the gastroduodenal artery behind the duodenum, marking the distal visceral resection.
The duodenocolic ligament was divided and the infraduodenal and supradudonal area were cleared allowing for the division of the duodenum.
The assistant introduced, through the assistant port, an articulated linear mechanical stapler with a visceral cartridge, placing and firing it 1cm downstream from the pylorus.
This step needs to be well coordinated by the robotic surgeon in order to obtain the correct angle of section. However, the primary surgeon can decide to perform that by himself with a robotic stapler.
Now, the extra-gastric lymphadenectomy begins along the proper hepatic artery.
The soft tissue anterior to the artery was cleared identifying the base of the right gastric artery and allowing for retrieval of #5.
The proper hepatic artery was identified and isolated up the hepatic pedicle, in the context of the hepatoduodenal ligament. The soft tissue anterior to and medial to the portal vein along the proper hepatic artery was cleared, retrieving #12a.
The peri-hepatic major vessels were completely released of their perivascular tissue.
Now, the dissection can continue at the level of the upper edge of the pancreas (*Figure 2*).

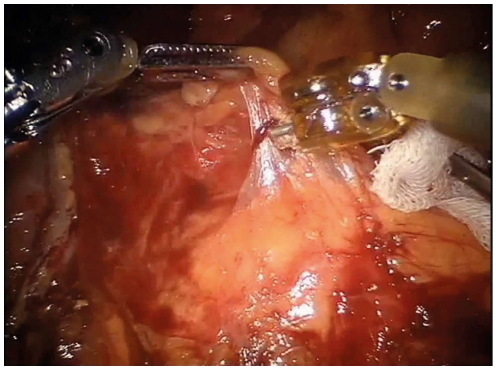

*Figure 2: Dissection along the common hepatic artery (limphnode station #8).*

The common hepatic artery was stripped of the lymphatic tissue from the origin of the gastro-duodenal artery to the celiac axis, #8.
The left gastric vein was reached, in this case anterior to the celiac axis (*Figure 3*).
The Maryland bipolar helped in this case to isolate the left gastric vein from the other vessels. Then, it was divided, offering access to #9 that was cleared lateral to the celiac

axis.
At this point, the base of the left gastric artery was identified, clipped with hem-o-lock and divided, clearing #7.

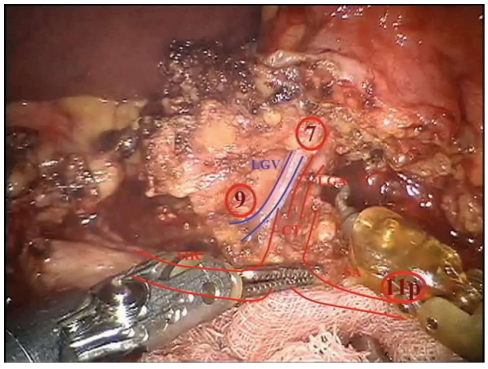


*Figure 3: Coeliac trunk (CT) and its branches (common hepatic artery CHA, left gastric artery LGA, splenic artery SA). The left gastric vein (LGV) is anterior to the LGA. View of limphnode stations #9 and #7.*

The course of the splenic artery was identified and the dissection prolonged to include the proximal splenic artery lymph nodes from its origin to halfway between its origin and the pancreatic tail end (*Figure 4*).

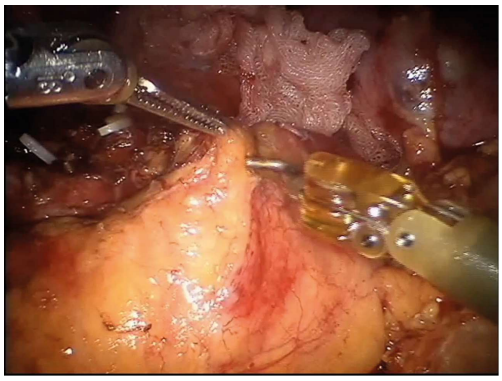

*Figure 4: Dissection along the proximal part of the splenic artery.*

At this point, the D2 lymphadenectomy was completed by removing the soft tissue along the esophageal crus, clearing the right paracardial nodes, #1, as well as that along the lesser curvature including all nodes along the lower branch of the left gastric artery up to the right gastric artery, #3.
All vessels should be well identified after a D2 lymphadenectomy, particularly the common hepatic artery which surrounds the upper edge of the pancreas and the right and left gastric artery, divided at their origins from the proper hepatic artery and the celiac axis, respectively.
The proximal stomach was resected with the linear stapler introduced by the assistant. A loop of small bowel was identified and an intra-corporeal side-to-side anastomosis was created (*Figure 5*).
The umbilical incision was extended to about 4cm to remove the specimen.
Patient followed an enhanced recovery after surgery protocol and was discharged on fifth postoperative day without complications.
Final pathology revealed a pT3N2 poorly differentiated adenocarcinoma with 76 nodes examined.

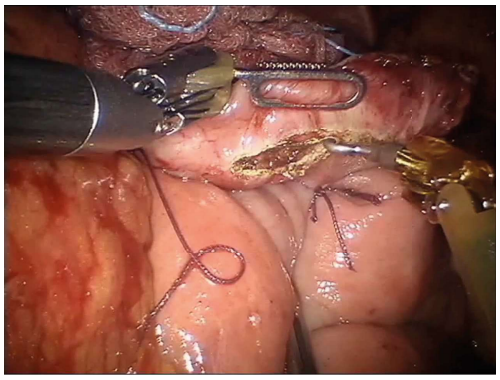

*Figure 5: Reconstruction phase: Billroth II gastrojejunostomy.*

**Conclusion:**
The robotic system can enhance a minimally invasive oncological dissection, allowing a complete removal of the soft tissue around major vessels, considered the most challenging step for a complete D2 gastrectomy.

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***Contributors***
FG conceptualized and designed the study, acquired and analysed data, drafted and revised the final manuscript.

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Informed consent was obtained from the patients for being included in the study.

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CASE REPORT OPEN ACCESS

# Multiple neuroendocrine tumors of the small bowel: A case report

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**ABSTRACT**
Neuroendocrine tumors of the small bowel are rare malignancies that often occur in the case of bowel obstruction or intestinal bleeding. The present case is a 46-year-old man who underwent emergency surgery for obstruction due to a rare presentation of multiple neuroendocrine lesions located in an intestinal loop. Pathology showed 15 NETs (grade 1) between 4 and 15 mm diameter with positive lymph nodes and liver metastases already detected by the preoperative CT scan.

**Key words:**
neuroendocrine tumor, NETs, small bowel.

**Background:**
Primary small bowel malignant tumors represent only 1-2% of all gastrointestinal neoplasms. Neuroendocrine tumors (NET) are classified as a rare subgroup of malignant diseases, although they are the second most common malignant tumors of the small bowel after adenocarcinoma.[1, 2]
These tumors are asymptomatic for a long time, or they occur with gastrointestinal bleeding, carcinoid syndrome, abdominal pain or bowel obstruction; thus, their diagnosis is often challenging.[3]

**Case Report:**
Our patient is a 46-year-old man admitted for abdominal pain and intestinal obstruction.
Diabetes and hypertension are reflected in his case history. A CT scan of the abdomen revealed a small bowel stenosis of about 4 cm in its proximal tract associated with intussusception, multiple metastases in the liver and lymph nodes. The radiologist suspected a neuroendocrine tumor of the ileum due to the typical hypervascularization of these metastases.
During surgery, multiple intestinal nodules were detected, and a small bowel resection was performed (67 cm in length, *Figure 1*).
The pathology report showed multiple NET lesions (15 tumors, diameter between 4 and 15 mm, grade 1, *Figure 2*). Metastases were found in 11 of the 34 total analyzed lymph nodes.
The patient underwent adjuvant oncological treatment.

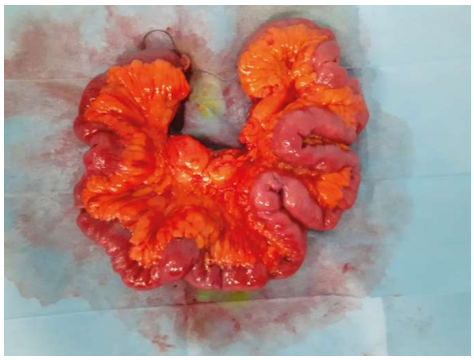

*Figure 1: View of the surgical specimen*

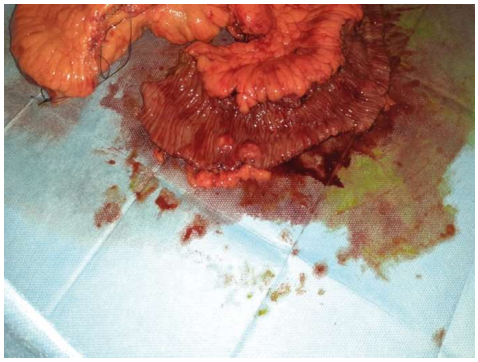

*Figure 2: Internal view of the small bowel showing multiple NETs*

**Discussion:**
NETs of the small bowel commonly occur as a surgical emergency with symptoms of obstruction and intussusception as in the present case.
Moreover, according to international guidelines, surgical treatment is recommended in the case of multiple intestinal NET lesions[4]. Multiple tumors are found in up to 40% of cases[5], and even small tumors under 1 cm may show early lymph node metastases.
NETs larger than 2 cm have an increased risk of metastases in the lymph nodes and liver with a probability of 80% and 20%, respectively[6]. Carcinoid syndrome, which occurs in 20-30% of patients with NETs, is often (95%) associated with the presence of liver metastases[4].
In our case, the CT scan suggested the type of disease through the typical metastases' characteristics. The final diagnosis was only possible after surgical exploration and subsequent pathological analysis.
In our patient, the diameter of the lesions detected was between 0.4 and 1.5 cm, without carcinoid syndrome but with liver and lymph node metastases. In cases with distant metastases, the decision of whether to resect the primary tumor or not is based on the following considerations[4]:
1. Achieving R0 resection including the primary tumor and distant metastases (curative intent).
2. In patients with symptoms due to intestinal obstruction or bleeding, palliative resection of the primary tumor is mandatory as a life-saving treatment. Moreover, mesenteric pathological lymph nodes should be removed as completely as possible to avoid occlusion of vessels with consequent intestinal ischemia.
3. Non-curative primary tumor resection in metastatic disease seems to improve overall survival and therefore may be considered. This evidence is shown in a recent systematic review of the literature that analyzed data from six comparative observational studies[7].
The prognosis for patients with NETs depends on both disease staging and grading. Jann et al.[8] reported a 5-year tumor-specific survival rate for small bowel NETs of 100% for stages I and II, 97.1% for stage III and 84.8% for stage IV.

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VIDEO

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# Laparoscopic-assisted total gastrectomy with D2 lymph node dissection: a case of 12-year-old child with advanced gastric cancer

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**ABSTRACT**
The video shows the operation of laparoscopic-assisted total gastrectomy with D2 lymph node dissection for a 12-year-old child with advanced gastric cancer.

**Keywords:**
gastric cancer, laparoscopic gastrectomy, children.

**Background:**
Primary gastric adenocarcinoma is extremely rare in children, with advanced stage, poorer differentiation, lower radical resection rate and poorer prognosis [1-4]. Surgery is the most efficient treatment for gastric cancer in children. However, there is no report on laparoscopic gastrectomy (LG) for gastric cancer in children. Here, we report a laparoscopy-assisted total gastrectomy (LATG) with D2 lymph node (LN) dissection performed on a 12-year-old child with advanced gastric cancer.

**Methods**:
A 12-year-old girl admitted our institution because of hematemesis and melena. Preoperative endoscopy and biopsy showed a signet-ring cell carcinoma in the body of stomach. Both ultrasonography and computerized tomography showed no distant metastasis. She was submitted to a LATG with D2 LN dissection in December 21, 2011.

**Results:**
The total operation time was 180 min, and the blood loss was 20 ml. We also find two anatomic variants of perigastric vessels: absence of the coronary vein and the common hepatic artery ran behind the portal vein. The postoperative pathological was pT4aN0M0, Stage IIB, and the number of dissection LNs was 56. The postoperative course was smooth with the child resuming diet by postoperative day (POD) 4. She discharged on POD 9. No adjuvant chemotherapy post-operation, until Dec. 2019, she has disease-free survival for 96 months.

**Conclusions:**
LG may be benefit for children gastric cancer with the advantages of minimally invasive. However, because of small abdominal space, smaller vessels, and more fragile tissue, this technique still has some difficulties and should be performed by experienced surgeons.

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***Contributors***
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***Availability of data and materials***
The video associated whit this article can be found, in the on-line version, at:
https://www.journalofgastricsurgery.com/index.php/JGS/article/view/14

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Not applicable

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