Objective: Investigate long-term survival, morbidity, mortality, and pathology results in patients following esophagectomy or total gastrectomy for gastroesophageal junction (GEJ) cancer.

Background: Both a total gastrectomy and an esophagectomy may be valid treatment options in patients with GEJ cancer. Which procedure results in the most optimal patient outcome is not well studied. The aim of this study was to investigate the long-term survival, morbidity, mortality, and pathology results in patients following esophagectomy or total gastrectomy for GEJ cancer.

Methods: A retrospective comparative cohort study of prospectively collected data from the Dutch Upper GI Cancer Audit combined with survival data of the Dutch medical insurance database was performed. Patients with GEJ cancer in whom a total gastrectomy or an esophagectomy was performed between 2011 and 2016 were compared. The primary outcome was 3-year overall survival. Postoperative morbidity, mortality, 3-year conditional survival, radicality of resection, and lymph node yield were secondary endpoints.

Results: A total of 871 patients were included: 790 following esophagectomy and 81 following gastrectomy. The 3-year overall survival was 35.8% after esophagectomy and 28.4% after gastrectomy (hazard ratio 1.2, 95% confidence interval 0.721–1.836, \( P = 0.557 \)). Postoperative morbidity, mortality, radicality of resection, lymph node yield, and 3-year conditional survival did not differ significantly between groups.

Conclusion: A total gastrectomy and an esophagectomy for GEJ cancer show largely comparable results with regard to long-term survival, postoperative morbidity, mortality, and pathology results. If both procedures are feasible, other parameters such as surgeon’s experience and quality of life should be considered when planning for surgery.

Keywords: esophagectomy, esophagogastric junction, gastrectomy, lymph nodes, morbidity, mortality, pathology, survival

Cancer of the gastroesophageal junction (GEJ) has a rapidly increasing incidence.\(^1\) Treatment usually consists of (neo)adjuvant chemo(radio)therapy and surgery.\(^2\) Both a total gastrectomy and an esophagectomy may be technically possible and selecting the most suitable surgical procedure poses a challenge to surgeons treating GEJ cancer. There is no conclusive evidence which procedure yields the best outcome regarding postoperative morbidity and mortality, pathology results (radicality of surgery and lymph node yield), and long-term survival.

As esophagectomy usually includes a thoracic part, which induces more surgical trauma and, especially if an open esophagectomy is performed, is associated with an increased incidence of pulmonary complications.\(^3,4\) However, a more extensive lymphadenectomy can be performed during thoracoabdominal approach, compared to an abdominal approach.\(^5\) Furthermore, a lower rate of R1 resections may be found following a trans-thoracic approach (esophagectomy) compared to a transhiatal approach (gastrectomy).\(^6,7\) Two recent systematic reviews reported no difference in 5-year survival, 30-day mortality, and pathology results between esophagectomy and gastrectomy,\(^8,9\) although one of those systematic review\(^8\) reported a higher rate of postoperative morbidity after an esophagectomy compared to a gastrectomy. Even though the 30-day mortality is described in most studies included in these systematic reviews, the long-term survival rate is poorly investigated. Also, heterogeneity exists in and between the included studies, as some included not only GEJ but also distal esophageal and gastric cardia cancer, and some excluded patients following neoadjuvant therapy, making results difficult to interpret for patients with true GEJ cancer in the era of neoadjuvant therapy.

The aim of this study was to investigate the difference in longterm survival, postoperative morbidity, mortality, and pathology results in GEJ cancer patients following an esophagectomy or a total gastrectomy at a population level. We hypothesized to find a higher 3-year overall and conditional survival in the esophagectomy group because a more extended lymphadenectomy can be performed with a lower chance of a proximal non-radical resection, however, at the cost of increased postoperative morbidity.

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METHODS

Study Design and Patient Population

The data for this population-based comparative cohort study was obtained from the Dutch Upper Gastrointestinal Cancer Audit (DUCA). The DUCA is a mandatory national audit, containing prospective data on the diagnostic process and surgical results of all patients with esophageal or gastric cancer operated in the Netherlands. The purpose of this registration is to gain insight into the quality of care and to accelerate its improvement. This system points to potential areas for improvement as hospitals receive feedback on their own results, compared to the national average. Patients in the DUCA are operated by gastrointestinal surgeons, who perform both the thoracic as well as the abdominal part of an esophagectomy. The same surgeons usually also perform the gastrectomies (although in few centers only esophagectomies or only gastrectomies are being performed). Survival data were obtained from VEKTIS, a database of medical insurance organizations of the Netherlands, containing the date of death and information on medical treatments of almost all Dutch people (99%). Survival data from the VEKTIS database were merged with the DUCA database on the 1st of September, 2017 and the validation of accuracy and completeness has been previously described in a separate article by van der Werf et al.

Surgeons who registered patients in the DUCA database could choose from 10 input options for tumor location: cervical, intrathoracic (proximal part), intrathoracic (middle part), intrathoracic (distal part), esophagus-stomach transition point (GEJ), fundus, corpus, antrum, pylorus and diffuse gastric cancer. Choice for location was made by the responsible surgeon. Patients with an adenocarcinoma of the GEJ were included in this study. Patients who underwent a total gastrectomy or an esophagectomy (transthoracic and transhiatal) with curative intent in the period between January 2011 and December 2016 were compared. Patients in whom no anastomosis was performed or who underwent no resection, patients operated for recurrent disease, or patients with a colonic or jejunal interposition, patients undergoing salvage, palliative or emergency surgery, and patients with a squamous cell carcinoma were excluded from this study. In addition, all patients who underwent a subtotal gastrectomy were excluded. In the Netherlands, a subtotal gastrectomy is a distal gastrectomy, hence cannot be performed for a GEJ cancer. Ethical approval for this study was not required under Dutch law. The STROBE checklist was used for guidance during the composition of this paper.

(Neo) Adjuvant Therapy

(Neo)adjuvant therapy was administered according to the Dutch guidelines for gastric and esophageal cancer. In case of a true GEJ cancer, patients usually received neoadjuvant chemoradiotherapy according to the CROSS regimen. Patients with cardia or GEJ cancers extending >2 cm in to the stomach were usually treated with perioperative chemotherapy (EOX: Epirubicin, Oxaliplatin and Capecitabine) according to MAGIC study protocol. Patients who participated in the CRITICS study received adjuvant chemoradiotherapy following neoadjuvant chemotherapy and gastrectomy. Patients with World Health Organization functional Classification (WHO) grade ≥3 or early-stage cancer (≤cT2N0) received no neoadjuvant or perioperative therapy.

Surgical Techniques

Surgery was performed according to the Dutch guidelines for gastric and esophageal cancer. In total gastrectomy, the entire stomach was removed by a minimally invasive or an open approach with a modified D2 lymphadenectomy, after which an esophago-junostomy was created with Roux-Y reconstruction. An esophagectomy was either performed open or minimally invasively by a transthoracic (TTE) or transhiatal (THE) approach, with an extended 1-field (THE) or 2-field (TTE) lymphadenectomy, with a cervical or intrathoracic esophago-gastric anastomosis.

Endpoints

The primary endpoint was 3-year overall survival. Long-term disease-specific survival could not be analyzed as the cause of death was not registered in either the VEKTIS or DUCA database. Secondary endpoints were postoperative morbidity [anastomotic dehiscence, pulmonary complications, chyle leakage, cardiac complications, supraventricular arrhythmia, re-interventions, length of Intensive Care Unit (ICU) stay, length of hospital stay, readmissions], short-term mortality (30-day and 90-day), 3-year conditional survival (survival calculated after exclusion of combined 30-day/in-hospital mortality), and pathology results [R0-resection rate, circumferential resection margin (CRM), (positive) lymph node count]. Accurate information on location of resected lymph nodes in the DUCA database is lacking. Since 2016, a division into 5 regions (“intrathoracic high” [paratracheal; laryngeal nerve, aortopulmonary], “intrathoracic low” [subcarinal, paraesophageal], “N1 gastric lymph node stations” (at least 3 of 6), “N2 gastric lymph node stations” (at least 3 of 6), and distant lymph node stations has been added to the registry. As the inclusion period of this study was January 2011 and December 2016, we cannot analyze location of resected lymph nodes in this complete cohort.

Statistical Analysis

Statistical analysis was performed with SPSS 26.0 software (SPSS, Inc., Chicago, IL). The distribution of continuous variables was assessed using Shapiro-Wilk test. For normally distributed continuous variables, mean values with standard deviation (SD) were reported. In the case of not normally distributed continuous variables, median values with interquartile ranges (IQR) were reported. Binary and categorical variables were reported as proportions. For the analysis of baseline patient and tumor characteristics, Mann-Whitney U test, student t test, x² test, or Fisher exact test was used where applicable. TTE and THE were analyzed separately because results may differ regarding morbidity and lymph node yield. The 3-year overall and conditional survival was displayed using Kaplan Meier survival curves and analyzed using Cox regression analysis. Baseline patient and tumor characteristics with a P value <0.1 were added to the multivariable regression analysis as possible confounders using backwards stepwise method. The 3-year overall and conditional survival of patients after TTE, THE, and total gastrectomy was compared to exclude the effect of heterogeneity in the esophagectomy group. Subgroup analyses were performed in patients following perioperative chemotherapy, in patients following neoadjuvant chemoradiotherapy and in ypN+ patients. For the analysis of secondary outcomes (postoperative mortality, morbidity, and pathology results), Mann-Whitney U test, student t test, x² test, or Fisher exact test was used where applicable and a Bonferroni correction for multiple testing was performed. If a P < 0.1 was found, postoperative morbidity, mortality, and/or pathology results were entered in...
# Table 1. Baseline patient and tumor characteristics of patients after transthoracic or transhiatal esophagectomy and total gastrectomy (N = 871) in the period of 2011–2016

|                      | Transthoracic esophagectomies | Transhiatal esophagectomies | All esophagectomies | Gastrectomies |
|----------------------|------------------------------|-----------------------------|---------------------|---------------|
|                      | N = 365                      | N = 425                     | N = 790             | N = 81        |
| **Sex (men)**        |                              |                             |                     |               |
| Yes                  | 241 (66.0)                   | 212 (63.9)                  | 453 (69.4)          | 40 (54.1)     |
| No                   | 124 (34.0)                   | 153 (36.1)                  | 337 (30.6)          | 31 (45.9)     |
| **Age, median (IQR), y** | 64 (57–69)                 | 66 (59–72)                  | 65 (58–70)          | 68 (60–74)    |
| **Body mass index, median (IQR), kg/m²** | 25.0 (23.0–28.0)            | 25.7 (23.3–29.0)            | 25.5 (23.1–28.4) | 25.2 (22.7–27.7) |
| Comorbidity          |                              |                             |                     |               |
| No                   | 124 (34.0)                   | 83 (19.5)                   | 207 (26.2)          | 19 (23.5)     |
| Yes                  | 241 (66.0)                   | 342 (80.5)                  | 583 (73.8)          | 62 (76.5)     |
| **Cardiac**          | 73 (20.0)                    | 116 (27.3)                  | 189 (23.9)          | 28 (34.6)     |
| **Vascular**         | 116 (31.8)                   | 194 (45.6)                  | 310 (39.2)          | 37 (45.7)     |
| **Diabetic**         | 48 (13.2)                    | 71 (16.7)                   | 119 (15.1)          | 19 (23.5)     |
| **Pulmonary**        | 47 (12.9)                    | 76 (17.9)                   | 123 (15.6)          | 18 (22.2)     |
| Thrombotic           | 13 (3.6)                     | 21 (4.9)                    | 34 (4.3)            | 12 (14.8)     |
| ASA                  |                              |                             |                     |               |
| 1                    | 82 (22.5)                    | 61 (14.5)                   | 143 (18.2)          | 10 (12.5)     |
| 2                    | 216 (59.2)                   | 249 (59.0)                  | 465 (59.1)          | 39 (48.8)     |
| 3                    | 67 (18.4)                    | 109 (25.8)                  | 176 (22.4)          | 30 (37.5)     |
| 4                    | 0                            | 3 (0.7)                     | 3 (0.4)             | 1 (1.3)       |
| Neoadjuvant therapy  |                              |                             |                     |               |
| No                   | 20 (5.5)                     | 39 (9.2)                    | 59 (7.5)            | 12 (15.0)     |
| Yes                  | 344 (94.5)                   | 385 (90.8)                  | 729 (92.5)          | 68 (85.1)     |
| Chemotherapy         | 57 (15.6)                    | 88 (20.7)                   | 145 (19.9)          | 57 (83.8)     |
| Chemoradiotherapy    | 287 (78.6)                   | 297 (69.9)                  | 584 (80.1)          | 11 (16.2)     |
| cT                   |                              |                             |                     |               |
| T0                   | 0                            | 0                           | 0                    | 0             |
| T1                   | 13 (3.7)                     | 18 (4.4)                    | 31 (4.1)            | 3 (4.0)       |
| T2                   | 50 (14.4)                    | 67 (16.5)                   | 117 (15.5)          | 16 (21.3)     |
| T3                   | 275 (79.0)                   | 310 (76.2)                  | 595 (77.5)          | 55 (73.3)     |
| T4                   | 10 (2.9)                     | 12 (2.9)                    | 22 (2.9)            | 1 (1.3)       |
| cN                   |                              |                             |                     |               |
| N0                   | 125 (35.8)                   | 154 (38.2)                  | 279 (37.1)          | 28 (36.8)     |
| N1                   | 137 (39.3)                   | 168 (41.7)                  | 305 (40.6)          | 28 (36.8)     |
| N2                   | 77 (22.1)                    | 70 (17.4)                   | 147 (19.5)          | 16 (21.1)     |
| N3                   | 10 (2.9)                     | 11 (2.7)                    | 21 (2.8)            | 4 (5.3)       |
| cM                   |                              |                             |                     |               |
| M0                   | 351 (99.2)                   | 410 (99.5)                  | 761 (99.3)          | 80 (98.8)     |
| M1                   | 3 (0.8)                      | 2 (0.5)                     | 5 (0.7)             | 1 (1.2)       |
| Approach             |                              |                             |                     |               |
| Open                 | 76 (20.8)                    | 305 (71.8)                  | 381 (48.2)          | 49 (60.5)     |
| Hybrid               | 16 (4.4)                     | 115 (27.0)                  | 131 (16.6)          | 29 (35.8)     |
| Minimal invasive     | 273 (74.8)                   | 5 (1.2)                     | 278 (35.2)          | 3 (3.7)       |
| Adjuvant therapy     |                              |                             |                     |               |
| No                   | 329 (90.6)                   | 363 (86.6)                  | 692 (88.5)          | 39 (49.4)     |
| Yes                  | 34 (9.3)                     | 56 (13.2)                   | 90 (11.5)           | 40 (50.6)     |
| Chemotherapy         | 28 (82.4)                    | 51 (91.1)                   | 79 (87.8)           | 34 (85.0)     |
| Chemoradiotherapy    | 6 (17.6)                     | 5 (8.9)                     | 11 (12.2)           | 5 (12.5)      |
| Radiotherapy         | 0                            | 0                           | 0                    | 0             |
| Histology            |                              |                             |                     |               |
| Adenocarcinoma       | 365 (100)                    | 425 (100)                   | 790 (100)           | 81 (100)      |
| ypT                  |                              |                             |                     |               |
| T0                   | 43 (12.3)                    | 47 (12.1)                   | 90 (12.2)           | 4 (12.5)      |
| T1                   | 47 (13.4)                    | 59 (15.1)                   | 106 (14.3)          | 3 (9.4)       |
| T2                   | 71 (20.3)                    | 82 (21.0)                   | 153 (20.7)          | 7 (21.9)      |
| T3                   | 185 (52.9)                   | 200 (51.3)                  | 385 (52.0)          | 13 (40.6)     |
| T4                   | 4 (1.1)                      | 2 (0.5)                     | 6 (0.8)             | 5 (1.6)       |
| ypN                  |                              |                             |                     |               |
| N0                   | 182 (51.6)                   | 203 (51.9)                  | 385 (51.7)          | 15 (46.9)     |
| N1                   | 80 (22.7)                    | 84 (21.5)                   | 164 (22.0)          | 6 (18.8)      |
| N2                   | 55 (15.6)                    | 62 (15.9)                   | 117 (15.7)          | 4 (12.5)      |
| N3                   | 36 (10.2)                    | 41 (10.5)                   | 77 (10.3)           | 7 (21.9)      |
| ypM                  |                              |                             |                     |               |
| M0                   | 348 (98.9)                   | 405 (98.3)                  | 753 (98.6)          | 76 (93.8)     |
| M1                   | 4 (1.1)                      | 7 (1.7)                     | 11 (1.4)            | 5 (6.2)       |

Data are presented as n (%) unless otherwise indicated. ASA, American Society of Anesthesiologists; IQR, interquartile range; cTNM indicates clinical TNM staging classification before the treatment (AJCC 8th edition); na, not applicable.

*All esophagectomies vs gastrectomies. Bold P values represent significance.
the multivariable analysis. Multivariable logistic regression was planned for dichotomous variables (postoperative morbidity, reinterventions, mortality, readmissions, and R0 resection rate) and multivariable linear regression was planned for linear variables [length of ICU stay, length of hospital stay, CRM and (positive) lymph node count]. A 2-sided alpha of 0.05 was considered statistically significant.

RESULTS

Demographics and Cohort Features

A total of 871 patients with GEJ cancer, of 7214 registered upper gastrointestinal (upper GI) cancer patients, were included in the analysis. A total of 790 patients underwent an esophagectomy (365 TTE and 425 THE) and 81 patients underwent a total gastrectomy (Table 1). The reasons for patient exclusion can be found in the flowchart in Figure 1. Most patients were male: 84.4% in the esophagectomy and 82.7% in the gastrectomy group. Patients following an esophagectomy were significantly younger than patients following a gastrectomy [median 65 years (IQR 58–70) vs median 68 years (IQR 60–74), \( P = 0.004 \)]. Patients in the esophagectomy group received significantly more neoadjuvant treatment than patients in the gastrectomy group (92.5% vs 85.1%, \( P < 0.001 \)). The majority of patients receiving neoadjuvant treatment in the gastrectomy group received perioperative chemotherapy (83.8%) and the majority of patients in the esophagectomy group received neoadjuvant chemoradiotherapy (80.1%, \( P < 0.001 \)). An open approach was significantly less common in the esophagectomy group compared to the gastrectomy group (48.2% vs 60.3%, \( P < 0.001 \)).

Primary Endpoint: The 3-Year Overall Survival

The Cox proportional hazards assumption was not violated, and Cox regression revealed that the 3-year overall survival was not significantly different between patients undergoing an esophagectomy or a gastrectomy (35.8% vs 28.4%, \( P = 0.557 \)) after correction for the possible confounders age, operation date, comorbidities (cardiac, diabetic, thrombotic), American Society of Anesthesiologists (ASA) classification, neoadjuvant therapy (yes/no and chemoradiotherapy or chemotherapy), surgical approach (open, hybrid, or minimally invasive), adjuvant therapy (yes/no), (yp)T stage, and (yp)M stage (Table 2 and Fig. 2A). The 3-year overall survival did not differ between a TTE, a THE, and a total gastrectomy (supplementary Figure 1 A, http://links.lww.com/SLA/C753). Subgroup analyses in patients following perioperative chemotherapy, in patients following chemoradiotherapy, and in (yp)N+ patients did not show differences in 3-year overall and conditional survival (supplementary Figures 2-4, http://links.lww.com/SLA/C754, http://links.lww.com/SLA/C755, http://links.lww.com/SLA/C756). The number of gastrectomy patients in those subgroup analyses, however, became so small, that strong conclusions cannot be drawn.
TABLE 2. Cox Regression of the 3-year Overall Survival of Patients With Gastroesophageal Cancer After an Esophagectomy or a Total Gastrectomy

| Hazard Ratio | 95% CI | P    |
|--------------|-------|------|
| Esophagectomy | 1.2   | 0.721| 1.836| 0.557 |
| Age          | 1.0   | 0.986| 1.007| 0.491 |
| Operation date |      |       |      | <0.001|
| 2011         | 1.1   | 0.735| 1.636| 0.652 |
| 2012         | 1.4   | 0.965| 2.157| 0.074 |
| 2013         | 2.0   | 1.410| 2.929| <0.001|
| 2014         | 5.0   | 3.456| 7.372| <0.001|
| 2015         | 10.0  | 6.703| 15.029| <0.001|
| Cardiac comorbidity | 1.0   | 0.768| 1.220| 0.782 |
| Diabetes     | 1.2   | 0.915| 1.520| 0.203 |
| Thrombotic comorbidity | 1.2   | 0.786| 1.820| 0.404 |
| ASA classification |      |       |      | 0.372 |
| ASA 1        | 1.1   | 0.878| 1.454| 0.343 |
| ASA 2        | 1.3   | 0.962| 1.831| 0.085 |
| ASA 3        | 1.1   | 0.362| 3.167| 0.902 |
| Neoadjuvant therapy | 1.1   | 0.912| 1.285| 0.365 |
| Surgical approach | 1.0   | 0.955| 1.106| 0.468 |
| Adjuvant therapy | 0.9   | 0.655| 1.251| 0.346 |
| (yp)T stage  | 1.1   | 1.068| 1.169| <0.001|
| (yp)M stage  | 1.1   | 0.602| 2.121| 0.704 |

ASA, American Society of Anesthesiologists. Bold P values represent significance.

Secondary Endpoints: 3-Year Conditional Survival, Postoperative Morbidity, Mortality, and Pathology Results

After univariable analysis and correction for multiple testing, no significant difference was found in postoperative morbidity, 30-day and 90-day mortality, length of hospital stay, readmissions, reinterventions, positive lymph node count, R0 resection rate, or median CRM between the esophagectomy and gastrectomy groups (Table 3). However, after univariable analysis a difference with a P < 0.1 between esophagectomy and gastrectomy groups was found in length of ICU stay [median 2 days (IQR 1–4) vs median 1 day (IQR 0–2); P < 0.001] and total lymph node count [median 17 (IQR 12–23) vs median 21 (IQR 16–31); P < 0.001]. A multivariable linear regression was performed including a correction for the possible confounders age, operation date, comorbidities (cardiac, diabetics, thrombotic), ASA classification, neoadjuvant therapy (yes/no and chemoradiation therapy or chemotherapy), surgical approach (open, hybrid or minimally invasive), adjuvant therapy (yes/no), (yp)T stage, and/or (yp)M stage. However, no significant difference was found between esophagectomy and gastrectomy in length of ICU stay (β = 3.6, 95% confidence interval (CI) −0.043 to 7.292, P = 0.053) or total lymph node count (β = −3.95% CI −6.446 to 0.165, P = 0.063) (Table 4). In addition, no significant difference was found in 3-year conditional survival between patients following an esophagectomy or a gastrectomy (36.9% vs 30.3%, P = 0.470) (Table 5 and Fig. 2B). The 3-year conditional survival was also not significantly different between a TTE, a THE, and a total gastrectomy (supplementary Figure 1B, http://links.lww.com/SLA/C753).
Furthermore, minimally invasive esophagectomy is associated with less pulmonary complications compared to open esophagectomy. Minimally invasive esophagectomy has become the preferred approach in the Netherlands, where 90.9% of all esophagectomies were performed minimally invasively in 2018. Also, in this study the majority of patients were operated

**FIGURE 2.** (A) Corrected 3-year overall survival of patients with gastroesophageal junction cancer after an esophagectomy or a total gastrectomy. (B) Corrected 3-year conditional survival of patients with gastroesophageal junction cancer after an esophagectomy.
TABLE 3. Secondary Endpoints (Postoperative Morbidity, Mortality and Pathology Results) of 871 Patients With Gastroesophageal Cancer After Esophagectomy or Total Gastrectomy

|                     | Transhiatal Esophagectomies | Transhiatal Gastrectomies | All Esophagectomies | All Gastrectomies | P*       | Corrected P *
|---------------------|-----------------------------|---------------------------|---------------------|------------------|----------|----------------
| Postoperative morbidity |                             |                           |                     |                  |          |                
| Yes                 | 155 (43.0)                  | 194 (46.2)                | 351 (44.7)          | 41 (50.6)        | 0.309    | 6.180          
| No                  | 208 (57.0)                  | 226 (53.8)                | 434 (55.3)          | 40 (49.4)        |          |                
| Anastomotic leakage | 58 (17.6)                   | 83 (20.1)                 | 14 (18.2)           | 14 (18.2)        | 0.861    | 17.220         
| Pulmonary complications | 104 (28.5)                 | 104 (24.8)                | 208 (26.5)          | 23 (28.4)        | 0.718    | 14.360         
| Chyle leakage       | 37 (10.3)                   | 4 (1.0)                   | 41 (5.3)            | 3 (3.8)          | 0.790    | 15.800         
| Cardiac complications | 37 (10.1)                  | 48 (11.5)                 | 85 (10.8)           | 23 (28.4)        | 0.541    | 10.820         
| Supraventricular arrhythmia | 7 (4.2)                  | 4 (2.0)                   | 11 (3.0)            | 1 (2.3)          | 0.801    | 16.020         
| Other               | 37 (10.1)                   | 36 (8.6)                  | 73 (9.3)            | 7 (8.6)          | 0.843    | 16.860         
| Re-interventions    |                             |                           |                     |                  |          |                
| Yes                 | 94 (25.8)                   | 71 (16.9)                 | 165 (21.0)          | 25 (31.3)        | 0.036    | 0.720          
| Radiologic          | 37 (39.8)                   | 31 (45.6)                 | 68 (42.2)           | 14 (56.0)        | 0.197    | 3.940          
| Endoscopic          | 38 (40.9)                   | 11 (16.4)                 | 49 (30.6)           | 8 (32.0)         | 0.890    | 17.800         
| Re-operation        | 55 (58.5)                   | 48 (69.6)                 | 103 (63.2)          | 14 (56.0)        | 0.490    | 9.800          
| Length of ICU stay, median (IQR), days | 2 (1–4)                   | 1 (1–3)                   | 2 (1–4)             | 1 (0–2)          | <0.001   | <0.001         
| Length of hospital stay, median (IQR), days | 12 (9–19)                  | 11 (9–16)                 | 12 (9–17)           | 10 (8–19)        | 0.094    | 1.880          
| Readmissions        | 58 (16.1)                   | 48 (11.4)                 | 106 (13.4)          | 12 (14.8)        | 0.687    | 13.740         
| 30-day/in-hospital mortality | 6 (1.6)                   | 13 (3.1)                  | 19 (2.4)            | 3 (3.7)          | 0.450    | 9.000          
| 90-day Mortality    | 6 (1.6)                     | 10 (2.4)                  | 16 (2.0)            | 2 (2.5)          | 0.680    | 13.600         
| Resection rate      |                             |                           |                     |                  |          |                
| R0                  | 335 (92.3)                  | 337 (90.0)                | 712 (91.0)          | 71 (87.7)        | 0.316    | 6.320          
| R1                  | 28 (7.7)                    | 39 (9.3)                  | 67 (8.6)            | 10 (12.3)        |          |                
| R2                  | 0 0                        | 0 0                      | 0 0                 | 0 0              |          |                
| Circumferential resection margin (median [IQR], mm) | 4 (2–8)                   | 3 (1–6.5)                 | 3 (1–7)             | 3.5 (1–10)       | 0.956    | 19.120         
| Total lymph node count, median (IQR) | 20 (15–27)                  | 15 (10–20)               | 17 (12–23)          | 21 (16–31)       | <0.001   | <0.001         
| Positive lymph node count, median (IQR) | 0 (0–3)                   | 0 (0–3)                   | 0 (0–3)             | 1 (0–5)          | 0.138    | 2.760          

*Data are presented as n (%) unless otherwise indicated. ICU, Intensive Care Unit; IQR, interquartile range. Bold P values represent significance.

A large difference in the number of patients with GEJ cancer treated with either an esophagectomy or a gastrectomy is seen in our data. Apparently, in the Netherlands, a preference for an esophagectomy exists for patients with GEJ cancer, although the reasons for this selection are unknown. This preference could be based on tumor characteristics (eg, slightly more ingrowth in the distal esophagus), on surgeon’s experience, or expert opinion; there are, however, no data to support this.

The present study has several limitations. It is a retrospective comparative cohort study of prospectively collected data and no propensity score matching could be performed as it would have highly reduced the number of included patients with GEJ cancer who underwent a total gastrectomy. Furthermore, the DUCA-VEKTIS database was merged on the 1st of September 2017, and therefore no survival data after this date were available. Also, no disease-specific survival could be analyzed as the cause of death is neither reported in the DUCA nor VEKTIS database. Since DUCA only recently added the Clavien-Dindo classiﬁcation, no systematic review where also no difference in total lymph node count and R0-resection rate was found between esophagectomy and gastrectomy in patients with GEJ cancer.

minimally invasively, perhaps that is why less postoperative morbidity than expected was observed in the esophagectomy group. The comparable postoperative morbidity results may also contribute to similar longterm survival, as has been shown that survival may impair in patients with severe complications.12
TABLE 4. Multivariable Linear Regression Analysis of Lymph Node Count and Length of ICU Stay of Patients With Gastroesophageal Cancer After Esophagectomy or Total Gastrectomy

| Covariates          | B     | Lower CI | Upper CI | P   |
|---------------------|-------|----------|----------|-----|
| Lymph node count    |       |          |          |     |
| Esophagectomy       | –3.1  | –6.446   | 0.165    | 0.063|
| Age                 | –0.1  | –0.198   | –0.062   | <0.001|
| Operation date      | 0.7   | 0.283    | 1.108    | 0.001|
| Cardiac comorbidity |       |          |          |     |
| Diabetes            |       |          |          |     |
| Thrombocytopenia    |       |          |          |     |
| ASA classification  |       |          |          |     |
| Neoadjuvant therapy | –1.9  | –3.018   | –0.857   | <0.001|
| Surgical approach   | 2.1   | 1.555    | 2.563    | <0.001|
| Adjuvant therapy    | 2.2   | 0.055    | 4.273    | 0.044|
| (yp)T stage         | 0.3   | 0.041    | 0.611    | 0.025|
| (yp)M stage         | –6.4  | –11.150  | –1.661   | 0.008|

TABLE 5. Cox Regression of the 3-year Conditional Survival of Patients With Gastroesophageal Cancer After an Esophagectomy or Total Gastrectomy

| Hazard Ratio | 95% CI | Lower CI | Upper CI | P   |
|--------------|--------|----------|----------|-----|
| Esophagectomy| 1.2    | 0.735    | 1.951    | 0.470|
| Age          | 1.0    | 0.985    | 1.006    | 0.366|
| Operation date|       |          |          | <0.001|
| 2011         | 1.1    | 0.697    | 1.590    | 0.806|
| 2012         | 1.4    | 0.914    | 2.092    | 0.125|
| 2013         | 2.1    | 1.439    | 3.031    | <0.001|
| 2014         | 5.1    | 3.454    | 7.514    | <0.001|
| 2015         | 10.9   | 7.189    | 16.468   | <0.001|
| Cardiac comorbidity|       |          |          |     |
| Diabetes     | 1.1    | 0.881    | 1.494    | 0.309|
| Thrombocytopenia| 1.2    | 0.793    | 1.870    | 0.369|
| 95% CI        |        |          |          |     |
| ASA classification|       |          |          |     |
| ASA 1        | 1.1    | 0.868    | 1.442    | 0.387|
| ASA 2        | 1.3    | 0.913    | 1.761    | 0.157|
| ASA 3        | 1.2    | 0.392    | 3.480    | 0.780|
| Neoadjuvant therapy|       |          |          |     |
| Surgical approach| 1.1    | 0.911    | 1.300    | 0.350|
| Adjuvant therapy| 1.0    | 0.966    | 1.122    | 0.290|
| (yp)T stage | 1.1    | 1.072    | 1.177    | <0.001|
| (yp)M stage | 1.1    | 0.554    | 2.072    | 0.837|

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