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Improvement in postoperative mortality in elective gastrectomy for gastric cancer: Analysis of predictive factors in 1066 patients from a single centre

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Abstract

Background: Gastrectomy represents the main treatment for gastric adenocarcinoma. This procedure is associated with substantial morbidity and mortality. The aim of this study was to evaluate the postoperative mortality changes across the study period and to identify predictive factors of 30-day mortality after elective gastrectomy for gastric cancer.

Methods: This was a retrospective cohort study of a prospective database from a single centre. Patients treated with an elective gastrectomy from 1996 to 2014 for gastric adenocarcinoma were included. We compared postoperative mortality between four time periods: 1996–2000, 2001–2005, 2006–2010, and 2011–2014. Univariate and multivariate analyses were applied to identify predictors of 30-day postoperative mortality.

Results: We included 1066 patients (median age 65 years; 67% male). The 30-day mortality rate was 4.7%. Mortality decreased across the four time periods; from 6.5% to 1.8% ($P = 0.022$). In the univariate analysis, age, ASA score, albumin <3.5, multivisceral resection, splenectomy, intrathoracic esophagojejunal anastomosis, R status, and T status were significantly associated with postoperative mortality. In the multivariate analysis, ASA class 3 (OR 10.06; CI 1.97–51.3; $P = 0.005$) and multivisceral resection (OR 1.6; CI 1.09–2.36; $P = 0.016$) were associated with higher postoperative 30-day mortality; surgery between 2011 and 2014 was associated with lower postoperative 30-day mortality (OR 0.55; CI 0.33–0.15; $P = 0.030$).

Conclusion: There was a decrease in postoperative 30-day mortality during this 18-year period at our institution. We have identified ASA score and multivisceral resection as predictors of 30-day mortality for elective gastrectomy for cancer.

Keywords: Adenocarcinoma; Gastrectomy; Stomach neoplasms; Mortality; Risk factors

Introduction

Gastric cancer remains a leading cause of cancer-related mortality worldwide.[1] In South America, countries like Chile and Peru have a high incidence of gastric cancer.[2]

Surgical resection is the only curative treatment for gastric cancer. Gastrectomy and lymphadenectomy are complex procedures with morbidity rates between 19% and 63% and postoperative mortality rates ranging from 1% to 11%.[3]

Over the last 20 years, multiple improvements in gastric cancer management have been implemented. Outcomes in gastric cancer surgery have been affected by improvements in preoperative assessment, vessel-sealing devices, the use of circular and linear staplers, the development of

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laparoscopic surgery, and better postoperative care, among others. These factors have led to a decrease in postoperative mortality in gastric cancer. This is evident when we compare series from 20 years ago and more recent publications.[4–6]

Several groups have reported postoperative mortality predictors. However, specific factors associated with postoperative mortality have not been well characterised.[7]

The aim of this study was to evaluate the postoperative mortality changes across the study period and to identify predictive factors of 30-day mortality after elective gastrectomy for gastric cancer.

Methods and materials

This was a retrospective cohort study including data from a prospective institutional single-centre database. All consecutive patients treated with a gastrectomy for gastric cancer from 1996 to 2014 were selected. Only patients with stomach or esophagogastric junction adenocarcinoma were included and patients with other histology were excluded. Because the aim of this study was to assess postoperative mortality in elective gastrectomy, we excluded 23 patients who had emergency surgery for active bleeding or perforation due to gastric cancer.

The preoperative assessment consisted of upper gastrointestinal endoscopy, biopsy, complete blood count, liver function tests, electrocardiogram, and nutritional evaluation. Preoperative imaging included an abdominal ultrasound, chest X-ray, and a thorax-abdomen-pelvis CT scan. There was no preoperative adjuvant treatment protocol during the study period.

All surgeries were performed at a single hospital. Epidural analgesia has been routinely used since 2005. Depending on the tumour's location, a total or subtotal gastrectomy was indicated. Surgery included omentectomy with bursectomy and D2 lymph node dissection according to the Japanese classifications in patients with curative gastrectomy.[8]

Splenectomy and pancreatectomy were not routinely performed. In the early years of this series, splenectomy and distal pancreato-splenectomy was performed to improve lymph node dissection in groups 11 and 10 of suspicious nodes and splenectomy was performed according to surgeon preference for upper third gastric cancers; this practice changed over time to a highly selective approach. Multivisceral resection (including spleen, pancreas, colon, and liver) was performed for direct tumour invasion. Partial distal esophagectomy with a transhiatal approach and mediastinal anastomosis was employed for Siewert type II and III cancers. Routine cholecystectomy was performed in curative cases and was not considered a multivisceral resection. A vessel-sealing device has been used for all cases since 2006. A reconstruction using Roux-en-Y was performed after a total gastrectomy; Roux-en-Y or Billroth II was used for subtotal gastrectomy based on the patient's age, R status, and surgeon preference. Esophagojejunal anastomosis has been performed with a circular stapler routinely since 2002, and in 2009 we added a second layer of running monofilament suture to reinforce this mechanical anastomosis. For total gastrectomies, a feeding jejunostomy tube was routinely employed at the beginning of the series, but this changed to selective use in 2006 and was abandoned in 2011. One or two prophylactic drains were used routinely. Starting in 2006, a laparoscopic approach was employed for patients with early gastric cancer (EGC).[9]

In the postoperative period, immediate extubation was favoured. Patients start physical and respiratory therapy as soon as possible, typically on day 1 postoperatively. Over the last 10 years there has been greater availability of physical and respiratory therapists assigned to our surgical ward. Epidural analgesia was generally maintained for 3 days. A nasogastric tube was kept in place for 3–5 days in subtotal gastrectomy. An oral contrast study was performed on postoperative day 5–7 for total gastrectomy; after this study, the patient starts an oral diet and prophylactic drains are removed. The patients were discharged when they were able to tolerate a soft diet for 24 h. All deviations from a normal postoperative course of elective gastrectomy were considered postoperative complications, were prospectively recorded by a dedicated nurse and were periodically reviewed at morbi-mortality meetings.

All of the above-mentioned changes in perioperative care were periodically reviewed by our surgical, anaesthesia, and physical therapy team. During the latter part of this study, we developed a local written guideline statement for managing these patients in a standardised manner and all patients were preoperatively discussed in a weekly meeting with an expert radiologist (FA). Since 2005, Chile has implemented a health care reform that increases the resources for the treatment of gastric cancer.[10,11]

Patients were staged using the TNM seventh edition.[12] A resection with macroscopic and microscopic tumour-free margins was defined as an R0, a microscopically positive resection margin as R1, and a macroscopically positive resection margin as R2.

The primary outcome of the study was 30-day postoperative mortality, defined as death by any cause within 30 days of surgery.

We compared postoperative mortality in four time periods with a logistic regression test: period 1 (1996–2000), period 2 (2001–2005), period 3 (2006–2010), and period 4 (2011–2014).

Data were analysed using the program Stata 13 for Windows (Texas; StataCorp LP). Continuous variables were described by means and standard deviations or medians and ranges. Categorical variables were described with frequencies and percentage. Means were compared using Student's t-test and categorical data were compared using the chi-square test or Fisher's test as appropriate. The T stage was grouped as EGC (T1) and advanced gastric cancer

(T2 or higher) for analysis. Univariate and multivariate analyses were performed to identify predictors of postoperative mortality. The variables with a *P* value under 0.25 in the univariate analysis were accepted for multivariate analysis, with two exceptions to avoid problems of collinearity. The number of organs in multivisceral resection was considered as a continuous variable for multivariate analysis. The final multivariate logistic regression model was refined through a stepwise process with 0.05 probability of retention, which was considered statistically significant.

The local ethics committee approved this study. Informed consent of patients was waived because of the retrospective nature of the study.

Results

A total of 1066 consecutive patients were included in this study. Patient characteristics are summarised in Table 1. Seven hundred and nineteen (67.4%) were males; the median age was 65 years old (24–93). ASA class was I, II, and III in 41.5%, 50.9%, and 7.4% of patients, respectively. The median albumin was 4.0 (range 2.1–5.8) and was greater than 3.5 mg/dL in 85.8%. The main tumour location was the upper third of the stomach or esophagogastric junction in 51.8%.

Total gastrectomy was performed in 729 (68.4%) patients. Forty (4%) patients had a laparoscopic resection. A multivisceral resection was performed in 353 cases (33.1%). The most frequently resected organs were the spleen (21.9%), the distal pancreas (9.1%), and the distal esophagus (8.5%) (Table 1).

An R0 and R1-2 resection was achieved in 856 patients (80.3%) and 210 (19.7%) patients, respectively. An EGC was confirmed in 178 (16.7%) patients. In 167 (15.7%) patients, distant metastasis was diagnosed in the preoperative study or during surgery and a resection was carried out for palliation (Table 1).

Postoperative complications were recorded in 335 (31.1%) of patients. The main intra-abdominal complications were esophagojejunal anastomosis leak (8.5%), subphrenic abscess (4.3%), pancreatic fistula (2.8%), and abdominal fluid collection-abscess (2.1%). In 33 (3.1%) there were wound complications. The main medical complications were respiratory events in 74 (6.9%) patients (Table 2).

The overall mortality in our series was 4.7%. Postoperative 30-day mortality was associated with respiratory complications in 15 patients, esophagojejunal anastomosis leak in 13 patients, cardiac complications in 9 patients, and duodenal stump leak in 5 patients (Table 2).

The postoperative mortality analysis across the four time periods had a decreasing trend: 6.5% (1996–2000), 5.3% (2001–2005), 5.1% (2006–2010), and 1.8% in the last period of the study (2011–2014) (Table 3). This difference was statistically significant between the first and last periods ($P = 0.022$).

Table 1
Patient characteristics, surgery variables, pathology results, and rate of postoperative mortality.

	Variable N (%)	30-day mortality N (%)	*P*
Sex			
Male	719 (67.4)	38 (5.3)	0.270
Female	347 (32.6)	13 (3.7)	
Age (years)			
<65	528 (49.5)	12 (2.3)	<0.0001
65–69	162 (15.2)	7 (4.3)	
70–74	190 (17.8)	14 (7.4)	
75–79	119 (11.2)	9 (7.6)	
80 or older	67 (6.3)	9 (13.4)	
ASA			
1	(41.6)	(2.7)	0.004
2	(51.0)	(5.6)	
3	(7.4)	(13.5)	
Albumin (gr/dl)			
Albumin <3.5	(14.2)	(8.0)	0.045
Albumin ≥3.5	(85.8)	(3.6)	
Tumour location			
EGJ-Superior	(51.8)	(5.6)	0.097
Middle-Inferior	(48.2)	(3.4)	
Gastrectomy			
Total gastrectomy	729 (68.4)	40 (5.5)	0.114
Subtotal gastrectomy	337 (31.6)	11 (3.3)	
Gastrectomy			
Open	1026 (96.2)	50 (4.9)	0.490
Laparoscopic	40 (3.8)	1 (2.5)	
Multivisceral resection			
No	713 (66.9)	27 (3.8)	0.030
Yes	353 (33.1)	24 (6.8)	
Number of organs			
1	212 (19.9)	12 (5.7)	0.048
2	105 (9.8)	12 (8.5)	
3 more	37 (3.5)	51 (4.8)	
Splenectomy	233 (21.9)	17 (7.3)	0.042
Pancreatectomy	97 (9.1)	7 (7.2)	0.239
Distal esophagectomy	91 (8.5)	9 (9.9)	0.017
Colon resection	34 (3.2)	0 (0)	0.184
Liver resection	31 (2.9)	3 (9.7)	0.195
Total esophagogastrectomy	20 (1.9)	1 (5)	0.964
Diaphragm resection	10 (0.9)	2 (20)	0.024
Intrathoracic EJ anastomosis	91 (8.5)	9 (9.9)	0.017
Resection result			
R0	856 (80.3)	35 (4.1)	0.001
R1	18 (1.7)	4 (22)	
R2 local or M1	192 (18)	12 (6.2)	
pT[a]			
pT1A	97 (9.1)	1 (1.0)	0.049
pT1B	81 (7.6)	3 (3.7)	
pT2	73 (6.8)	4 (5.5)	
pT3	218 (20.5)	9 (4.1)	
pT4A	541 (50.8)	27 (5.0)	
pT4B	55 (5.2)	7 (12.7)	
Lymph node count[b]			
Lymph node count ≥ 25	620 (58.9)	27 (4.4)	0.467
Lymph node count < 25	432 (41.1)	23 (5.3)	
pN[b]			
pN0	331 (31.4)	14 (4.2)	0.892
pN1	134 (12.7)	6 (4.5)	
pN2	174 (16.5)	7 (4.0)	
pN3A	228 (21.7)	12 (5.3)	
pN3B	186 (17.7)	11 (5.9)	

Table 1 (*continued*)

	Variable N (%)	30-day mortality N (%)	*P*
M			
M0	899 (84.3)	41 (4.6)	
pM1	167 (15.7)	10 (6.0)	0.427
pM1 Peritoneal disease	97 (9.1)	4 (4.1)	0.749
pM1 Liver disease	60 (5.6)	5 (8.3)	0.185
Stage[a]			
pIA	165 (15.5)	4 (2.4)	0.509
pIB	40 (3.8)	1 (2.5)	
pIIA	80 (7.5)	5 (6.2)	
pIIB	116 (10.9)	6 (5.2)	
pIIIA	113 (10.6)	6 (5.3)	
pIIIB	126 (11.9)	3 (2.4)	
pIIIC	257 (24.3)	16 (6.2)	
pIV	167 (15.5)	10 (6.1)	

EGJ: esophagogastric junction. EJ: esophagojejunal.
[a] 2 missing data.
[b] 14 missing data.

Table 2
Postoperative complications in patients after elective gastrectomy.

	Complications N (%)	30-day mortality N (%)
Intra-abdominal complications		
Esophagojejunal anastomosis leak	60 (8.5)	13 (21.6)
Subphrenic abscess[a]	46 (4.3)	4 (8.7)
Pancreatic fistula	30 (2.8)	2 (6.7)
Abdominal fluid collection/abscess[b]	22 (2.1)	3 (13.6)
Duodenal stump leak	17 (1.6)	5 (29.4)
Prolonged postoperative ileus	16 (1.5)	1 (6.3)
Abdominal wall dehiscence	15 (1.4)	2 (13.3)
Gastrojejunal anastomosis leak	4 (1.2)	1 (25)
Intra-abdominal bleeding	8 (0.8)	3 (37.5)
Postoperative pancreatitis	8 (0.8)	3 (37.5)
Biliary complications	5 (0.5)	0 (0)
Jejunostomy site obstruction	5 (0.5)	1 (20)
Other intra-abdominal	19 (1.8)	4 (21.1)
Wound complications	33 (3.1)	0 (0)
Medical complications		
Respiratory complications	74 (6.9)	15 (20.3)
Cardiac complications	19 (1.8)	9 (47.4)
Urinary tract infection	14 (1.3)	0 (0)
Thromboembolic disease (DVT-PE)	13 (1.2)	3 (23.1)
Pseudomembranous colitis	10 (0.9)	1 (10)
Catheter sepsis	5 (0.5)	3 (20)
Other medical	15 (1.4)	1 (6.7)
Total complications	335 (31.1)	

DVT: deep venous thrombosis. PE: pulmonary embolism.
[a] 20/46 cases associated with leak or fistula.
[b] 6/22 cases associated with leak or fistula.

In the univariate analysis, age over 70 years ($P < 0.0001$), ASA score ($P = 0.004$), albumin <3.5 ($P = 0.045$), multivisceral resection ($P = 0.03$), splenectomy ($P = 0.042$), intrathoracic esophagojejunal anastomosis ($P = 0.017$), R status ($P = 0.001$), T status ($P = 0.049$), and the period of surgery were significantly associated with postoperative mortality (Table 1).

Table 3
Postoperative mortality in the study periods.

Period of surgery	Surgeries N (%)	30-day mortality N (%)	OR	95% CI	*P*
1996–2000	232 (21.8)	15 (6.5)	1.00		
2001–2005	262 (24.6)	14 (5.3)	0.81	0.3–1.6	0.597
2006–2010	353 (33.1)	18 (5.1)	0.77	0.38–1.5	0.484
2011–2014	219 (20.5)	4 (1.8)	0.26	0.08–0.82	0.022

Table 4
Multivariate analysis of predictive factors for 30-day postoperative mortality after elective gastrectomy.

Variable	OR	*P*	CI
ASA 3[a]	10.06	0.005	1.97–51.31
Number of organs resected[b]	1.60	0.016	1.09–2.36
Surgery between 2011 and 2014	0.55	0.030	0.32–0.94

ASA: American Society of Anesthesiologists physical status classification system.
[a] Comparison between ASA 3 versus ASA 1.
[b] Number of organs resected in multivisceral resection as continuous variable.

In the multivariate analysis, the ASA 3 score (OR 10.06; CI 1.97–51.31) and the number of organs resected in a multivisceral resection (OR 1.6; CI 1.09–2.36) were identified as predictors of 30-day mortality after elective gastrectomy for cancer. Surgery in the last period of the study (2011–2014) was identified as a protective factor for postoperative 30-day mortality in the multivariate analysis (OR 0.55; CI 0.32–0.94) (Table 4).

Other than postoperative mortality, there were other significant differences across the periods of the study. We observed an increasing population of patients with comorbidities, from 41% to 81% ($P < 0.001$). There was also a significant reduction in multivisceral resection from 62% to 21% ($P < 0.001$), mainly due to a lower rate of splenectomy (55.2% in period 1 vs 9.6% in period 4, $P < 0.001$), pancreatectomy (15.9% in period 1 vs 7.3% in period 4, $P = 0.001$), and distal esophagectomy (10.3% in period 1 vs 8.2% in period 4, $P = 0.023$) (Table 5). There were no changes in the rate of EGC or in the R0 resection rate. In addition, there was a significant reduction of the two leading complications associated with postoperative mortality, esophagojejunal anastomosis leak (8.7% in period 1 vs 6.9% in period 4, $P = 0.006$) and respiratory complications (12.1% in period 1 vs 4.6% in period 4, $P = 0.001$) (Table 5).

Discussion

Surgery is the main treatment of gastric cancer. However, it carries a significant morbidity and mortality. Published series differ widely in postoperative mortality after gastrectomy, with rates ranging from 1% to 10%.[3,6,13–17]

In two large recently published multicentre Western studies from Europe and North America, the postoperative

Table 5
Main changes in patient characteristics, surgery, complications, and pathology results across the study periods.

Period	1	2	3	4	*P*
N	232	262	353	219	
Cases/year	46	50	70	63	
Age ≥70 (%)	29.7	35.1	38.0	37.0	0.211
ASA score ≥2 (%)	41.8	62.1	62.6	81.5	<0.001
Albumin ≥3.5 (%)	77.1	82.7	80.7	86.67	0.178
Total gastrectomy (%)	73.7	63.7	68.6	68	0.129
Multivisceral resection (%)	62.9	21.8	28.9	21.9	<0.001
Splenectomy (%)	55.2	16.0	11.9	9.6	<0.001
Pancreatectomy (%)	15.9	6.5	7.6	7.3	0.001
Distal esophagectomy (%)	10.3	4.2	10.7	8.2	0.023
R0 (%)	75	82	81.6	81.7	0.152
Early gastric cancer (%)	15	18	15	19	0.462
Postoperative morbidity (%)	42.7	28.2	21.8	38.8	<0.001
Esophagojejunal leak (%)	8.7	14.7	5.0	6.9	0.006
Duodenal stump leak (%)	2.2	1.5	1.1	1.8	0.795
Respiratory complications (%)	12.1	8.4	4.0	4.6	0.001
Cardiac complications (%)	3.4	1.1	1.1	1.4	0.134

mortality was 4.2% and 4.7%.[7,18] In our study, there was a 4.7% 30-day mortality after elective gastrectomy for cancer; this is comparable to previously published western series and very similar to these two large trials.[7,18] However, the results from Asian centres have a significantly lower rate of postoperative mortality, in a range between 0.4% and 1.1%.[19–22] Our results of postoperative mortality in the last 5 years of the study are closer to this Asian series, with 1.8% postoperative mortality. Unlike other publications that include patients from multiple institutions, our data were obtained from a single institution; this allows an accurate reporting of pre-, intra-, and post-operative data and a low chance of missing information or the exclusion of patients.

Previous publications have identified independent risk factors for postoperative mortality, such as age, need for total assistance in activities of daily living, weight loss, ASA score, medical comorbidities, hypoalbuminemia, anemia, location of the tumour, metastatic disease, uncontrolled ascites, poor tolerance of neoadjuvant treatment, multivisceral resection, extent of lymph node dissection, palliative resection, and low hospital volume.[3,7,18,21–25] Many of these studies have focused specifically on total or subtotal gastrectomy or have included other surgical approaches like esophagectomy,[18,21,22] and the applicability to a wider set of patients is difficult. We believe that our study represents a broader spectrum of gastric cancer patients being submitted to gastrectomy.

According to our multivariate analysis, a patient's comorbidities, specifically an ASA 3 score and the extent of surgery, with multivisceral resection are the most important variables affecting postoperative mortality.

There are previously published data supporting the higher mortality rate with a higher ASA score in large patient cohorts.[22] The ASA score has been criticised because of its subjectivity and wide interobserver variability. However, this is the most commonly used scoring system and has the advantages of its simplicity and universal use.[26,27] These findings support the stratification of patient at higher risk who should be more closely and meticulously evaluated to detect and compensate associated comorbidities before surgery. We regularly admit those with ASA 3 as inpatients to facilitate a multidisciplinary evaluation.

When gastric cancer invades adjacent organs such as the spleen, pancreas, esophagus, diaphragm, duodenum, or liver, a combined en bloc resection can be performed to achieve clear margins.[28] Our findings support a higher postoperative mortality with an increasing number of adjacent organs resected. Other studies support our findings.[13,29]

The higher rate of postoperative mortality was clinically and statistically significant for splenectomy (7.3% postoperative mortality, $P = 0.042$) and for distal esophagectomy with intrathoracic esophagojejunal anastomosis (9.9% postoperative mortality, $P = 0.017$), compared to patients without a multivisceral resection (3.8% postoperative mortality).

The value of performing splenectomy has long been discussed for gastric cancer, with contradicting results.[30] The JCOG 0110 (presented at ASCO 2015), a large randomised controlled trial, has demonstrated the absence of long-term survival benefits for prophylactic splenectomy (HR 0.88; CI 0.67–1.16) and has a proven higher rate of postoperative morbidity (30% vs 17%) with equivalent postoperative mortality (0.4% vs 0.8%, $P = 0.62$). In our series, the practice of routine splenectomy has changed over time to a highly selective approach, reflected in a lowering splenectomy rate from 55% to 9.6% in the first and last period of this study. However, it is difficult to draw firm conclusions from our study about this issue because the precise indication for splenectomy was not available.

For patients with esophagogastric junction (EGJ) cancer, Siewert type II and III, one of the most common surgical options is a total gastrectomy with a partial distal esophagectomy and mediastinal esophagojejunal anastomosis.[31,32] However, this surgical approach in our study was associated with high mortality. We believe this was due to excessive tension and less irrigation of the jejunal loop ascending into the mediastinum, with a higher leak rate. And these results suggest that other options with lower than 9.9% mortality, like Ivor-Lewis esophagogastrectomy or total esophagogastrectomy with colonic interposition, must be considered in a tailored approach for each patient with EGJ cancer.[32,33]

Contrary to other publications,[3,7,18,21–25] our multivariate analysis did not demonstrate a higher risk of postoperative mortality in older age, hypoalbuminemia, total gastrectomy and palliative surgery.

The worldwide population is ageing and life expectancy is increasing. The number of patients 75 years and older diagnosed with gastric cancer is growing.[34,35] In our data, not age, but significant comorbidity (ASA class 3) increased postoperative mortality. This supports that age

should not by itself represent a contraindication for surgical resection, especially for fit older patients.

A generalised consensus exists that a palliative resection can be recommended only for patients of reasonable health status, with limited metastatic disease and with the aim of symptom palliation.[36] Although we did not find a significant increase in mortality, this might be related to a selective approach to palliative gastrectomy, selecting younger patients and those with reasonable physical conditions and avoiding large multivisceral resections in this patient group.

Another important finding in this study is the reduction in postoperative mortality across the study periods, from 6.8% to 1.8% ($P = 0.022$). In the multivariate analysis, patients operated on between 2011 and 2014 had a significantly lower rate of postoperative mortality, with an OR of 0.55. As we compared the four time periods of this study, we found a significant reduction in some of the most lethal complications after gastrectomy, namely esophagojejunal anastomosis leak and respiratory complications. These complications have been closely associated with more than 50% of causes of postoperative mortality after gastrectomy in other trials as well.[6,18] However, in the last period of the study, postoperative morbidity increased and mortality decreased. We believe this has multiple reasons, like early diagnosis of complications, greater expertise in their treatment, intensive care management, and the care of gastric cancer patients in a dedicated esophagogastric surgery unit.

The rate of esophagojejunal anastomosis leak decreased from 8.7%-14.7% in the first two periods of the study, to 5%-6.9% in the latter periods ($P = 0.006$). There are multiple techniques to perform this anastomosis and a lack of high-quality trials comparing the different options. However, the use of circular staplers has been widely adopted and has shown a consistent decline in the leak rate.[22,37,38] Our results are in accordance with this because we observed a lower rate of leak after the introduction and routine use of mechanical circular stapler anastomosis by all operating surgeons in this series in a standard fashion.

Respiratory complications represent another serious mortality risk after gastrectomy and major abdominal surgery.[6,18] In our data, the rate of respiratory complications was reduced from 12.1% to 4.6% ($P = 0.001$). Some of the strategies proposed in previous publications are the routine use of epidural analgesia, which we have been using since 2005, and intensive physical and respiratory therapy.[39–42]

Study limitations

There are some limitations to our study. First, not including the 60- or 90-day mortality,[21] as some patients may have died from complications of surgery in that period. But we chose our main outcome at the 30-day postoperative mortality rate because it is a universally comparable and widely used[7,13,18] parameter for defining postoperative mortality and is more reliable in a retrospective study.

Another limitation of this study is the validity of the ASA score as there is a level of subjectivity in the classification between ASA 2 and 3. Again, we chose the ASA score because it is widely used in daily clinical practice.

Finally, because of the retrospective nature of this study and the large patient cohort, accurate reporting and grading of postoperative adverse events may not be as precise as a prospective study.

Conclusions

Gastrectomy for cancer represents a major abdominal surgery with a postoperative mortality of 4.7%. In our centre, there was a decrease in postoperative 30-day mortality during this 18-year period from 6.5% to 1.8%. Postoperative mortality during the last 4 years of the study was significantly lower. We identified ASA score and multivisceral resection as predictors of 30-day mortality for elective gastrectomy for cancer. This risk stratification allows a more precise decision-making process for patient selection, evaluation, and optimisation, as well as improved counselling about the risks of surgery.

Conflict of interest

The authors declare that they have no conflict of interest.

There was no funding source.

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 a substitute for it was obtained from all patients for inclusion in this study.

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