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Risk factors for early postoperative morbidity and mortality in patients underwent radical surgery for gastric carcinoma: A single center experience

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ABSTRACT

Background: Aim of this study is to analyze the incidence and risk factors for early postoperative morbidity and mortality that occur after gastric carcinoma surgery.
Materials and methods: All consecutive patients with gastric adenocarcinoma resected with curative intent between 2005 and 2011 were included to a retrospective analysis. Patient, disease and operation related parameters were questioned as risk factors for postoperative morbidity and mortality.
Results: A total of 160 patients (103 [64.8%] male and the average age was 62.4 ± 11.5) were abstracted. Early postoperative morbidity, operation related morbidity and mortality were observed in 46 (28.7%), 31 (19.4%) and 19 (11.9%) cases, respectively. No other factors but ASA score was found to be a risk factor for overall morbidity ($p = 0.021$ and 0.033 in univariate and multivariate analyses, respectively). The incidence of anastomotic leak was increasing in patients who received a D2 dissection in univariate analysis ($p = 0.039$), but not in multivariate calculation. There were no factors effecting surgical site infection risk. Although univariate analysis revealed that age over 70 ($p = 0.008$), ASA score ($p = 0.018$), operation time ($p = 0.032$), D2 dissection ($p = 0.026$) and type of anastomosis ($p = 0.023$) were effecting the risk for early mortality, multivariate analysis showed that age was the only risk factor ($p = 0.005$).
Conclusion: Current study has revealed that early morbidity and mortality are not rare after gastric cancer surgery with curative intent. Since multivariate analyses have revealed that ASA score and older age may be only risk factors for postoperative morbidity and 30-day mortality, respectively; it may be logical to consider these factors during the preoperative decision making in patients with gastric cancer.

1. Introduction

Gastric carcinomas are the second mostly seen cause for cancer related death all around the world.[1] An R0 surgical resection is the only proven curative treatment modality in case of a gastric carcinoma.[2–4] However, in spite of all radical resection attempts and developing adjuvant oncologic treatment techniques, gastric carcinomas have a poor prognosis except for early stage gastric carcinomas, which is a rare condition. Although centers specialized on gastric surgery give better results, 5 year survival expectancy is as poor as 23% in European countries.[5] Since patients are generally being diagnosed at advanced stages in western world, only 30–60% of those are considered to be candidates for a curative surgery.[6–8] Even though 5 year survival expectancy has increased at a certain level with the help of screening programs and discovering early stage disease more often in some locations, particularly in Japan; prognosis of the gastric carcinomas at an advanced level is poor in these countries as well.[9,10] D2 dissection in gastric carcinoma treatment is accepted as a standard lymphadenectomy technique except for early period gastric carcinomas in the Far East, and this has showed survival advantages in many studies.[11–13] However, two prospective randomized studies have terminated the controversy on whether or not D2 dissection leads to a survival advantage, but generally revealed that extended dissection may be associated with higher morbidity and mortality.[14–18]

Gastric cancer surgery is associated with high risks for postoperative morbidity and mortality; two prospective

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Table 1
Postoperative complications and 30-day mortality.

	Occurrence of morbidity ($n = 46$)	Related deaths ($n = 19$)
Surgical complications	31(19%)	9(5.6%)
Leakage (anastomotic and duodenal stump)	17(10.6%)	9(5.6%)
Surgical site infection	8(5%)	0
Miscellaneous[a]	6(3.7%)	0
Non-surgical complications	15(9.4%)	10(6.2%)
Cardiac (infarction or insufficiency)	7(4.4%)	7(4.4%)
Pulmonary (emboli or infection)	4(2.5%)	2(1.2%)
Acute tubular necrosis	1(0.6%)	1(0.6%)
Toxic hepatitis	1(0.6%)	0
Miscellaneous[b]	2(1.2%)	0

[a] Pancreatic fistula ($n = 3$), prolonged ileus ($n = 2$), and postoperative prolonged hemorrhagic drainage ($n = 1$).
[b] Serebrovascular accident ($n = 1$) and infection of central venous catheter ($n = 1$).

randomized European studies evaluating the outcomes of D2 dissections reported the complication and death rates as 43 and 46%, and 10 and 13%, respectively.[14–18] Major complications may be stated as duodenal perforation and anastomotic leakage, bleeding, surgical site infections, pancreatitis, stenosis on the anastomotic line and functional problems. With the development of anesthesiology, postoperative care, interventional radiology and operation techniques, these complications have been reduced at a certain level; however, both surgical and non-surgical complications of gastric carcinoma operations still create severe problems after the operation. Thus, the aim of the current study is to evaluate the single institution outcomes regarding the postoperative complication and mortality incidences, and analyze the risk factors that may be associated with these results.

Table 2
Univariate and multivariate analyses of the risk factors that may affect overall morbidity.

	n (%)	Complication	No complication	Univariate p	Multivariate p	Wald	Odds ratio
Age							
≥70	50 (31.2%)	18 (36%)	32 (64%)	0.393			
<70	110 (68.7%)	28 (25.4%)	82(74.6%)				
Gender							
Male	103 (64.8%)	31 (30.1%)	72 (69.9%)	0.544			
Female	57 (35.2%)	15 (26.3%)	42 (73.7%)				
Albumin level							
≥3.5	37 (23.1%)	13 (35.1%)	24 (64.9%)	0.131	0.188	1.734	0.556
<3.5	123 (76.9%)	33 (26.8%)	90 (73.2%)				
Severe anemia							
Absent	43 (26.9%)	14 (32.5%)	29 (67.5%)	0.223	0.498	0.459	0.740
Present	117 (73.1%)	32 (27.3%)	85 (72.7%)				
ASA score							
1–2	91 (56.9%)	18 (19.8%)	73 (80.2%)	**0.021**	**0.033**	**4.544**	**2.285**
3–4	69 (43.1%)	28 (40.6%)	62 (59.4%)				
Neoadjuvant chemotherapy							
Required	15 (9.3%)	3 (20%)	12 (80%)	0.252			
Not required	145 (90.7%)	43 (29.6%)	102 (70.4%)				
DM							
Present	24 (15%)	8(33.3%)	16(66.7%)	0.939			
Absent	136 (85%)	38 (27.9%)	98 (72.1%)				
Hypertension							
Present	39 (24.4%)	8 (20.5%)	31 (79.5%)	0.4			
Absent	121 (75.6%)	37 (30.8%)	84 (69.2%)				
COPD							
Present	8 (5%)	3 (37.5%)	5 (62.5%)	0.430			
Absent	152 (95%)	43(28.3%)	109 (71.7%)				
Intraoperative transfusion							
Required	69 (43.2%)	24 (34.8%)	45 (65.2%)	0.114	0.547	0.363	1.277
Not required	91 (56.8%)	22 (22.2%)	69 (77.8%)				
Tumor localization							
Proximal	65 (40.6%)	20(30.8%)	45 (69.2%)	0.620			
Distal	95 (59.4%)	26(27.4%)	69(72.6%)				
Tumor stage							
I	23 (14.4%)	8 (34.8%)	15 (65.2%)	0.937			
II	38 (23.8%)	7 (18.4%)	31 (81.6%)				
III	48 (30%)	15 (31.2%)	33 (68.8%)				
IV	51 (31.8%)	16 (31.4%)	35 (68.6%)				
Operation time							
≥180	79 (49.4%)	18 (22.8%)	61 (78.2%)	0.240			
<180	81 (50.6%)	28 (34.6%)	53 (65.4%)				
Dissection width							
D1	118 (73.7%)	28 (23.7%)	90 (66.3%)	0.081	0.146	2.118	1.977
D2	42 (26.3%)	18 (42.9%)	24 (67.1%)				
Resection pattern							
Subtotal	62 (38.7%)	17 (27.4%)	45 (73.6%)	0.483			
Total	98 (61.3%)	29 (29.6%)	69 (70.4%)				
Additional organ resection							
Present	85 (53.1%)	31 (36.5%)	54 (63.5%)	0.058	0.377	0.779	1.488
Absent	75 (46.9%)	15 (25%)	60 (75%)				
Reconstruction type							
Roux-en Y	129 (80.6%)	34 (26.3%)	95 (73.7%)	0.665			
Omega	31 (19.4%)	7(22.6%)	24(78.4%)				

Abbreviations: ASA: anesthesia risk score defined by American Anesthesiology Association; DM: diabetes mellitus; and COPD: chronic obstructive pulmonary disease.
Bold font style represents statistically significant difference between groups, $p < 0.05$.

2. Materials and methods

Institutional Ethics Board approved the design and content of the study prior to data abstraction (Reference number: B104İSM4340029/1009/13). A retrospective chart review has been initiated for all consecutive patients with pathologically confirmed gastric adenocarcinoma, who received a resection with curative intent between 2005 and 2011 in our department. Patients who underwent a palliative resection or operation, were excluded.

Current study aims to evaluate the incidences and risk factors for postoperative early morbidity and mortality after gastric carcinoma surgery. Postoperative morbidity was categorized into two groups as surgical and non-surgical complications, and leakage and surgical site infections were analyzed in details. Anastomotic and duodenal stump leaks were included in the term of leakage; and wound infection, abscess and eviseration were defined as surgical site infection. Since it was a significant indicator for the success of the operation, factors lengthen the hospitalization were also analyzed. Finally, because it had the paramount significance, 30-day mortality was also evaluated regarding the incidence and risk factors. The following patient, disease or treatment related factors were questioned in univariate and multivariate analyses: age (over or below 70 years), gender, preoperative albumin level (below or over 3.5 gr/L), severe anemia (defined as 'present' if the patient required transfusion preoperatively), anesthesia risk score (as defined by American Anesthesiology Association [ASA]), requirement for neoadjuvant chemotherapy, having a medical disease (diabetes mellitus [DM], hypertension and chronic obstructive pulmonary disease [COPD]), requirement of intraoperative transfusion, tumor location (proximal or distal) and stage, operation time (less or more than 180 min), width of dissection (D1 or D2), resection pattern (total or subtotal), additional organ resection and reconstruction type (omega and Roux-en Y anastomosis).

The data were evaluated in computer environment by using the program SPSS 17 for Windows (Chicago; SPSS Inc.). Continuous variables were defined as means and standard deviations or medians and ranges. Countable variables were defined with numbers and percentages. The mean of the variables were compared by using Student's t test, countable data were compared by using Chi–Square test or by Fisher's test if appropriate. The variables, which had a p value lower than 0.25 found through the univariate analysis were accepted as candidates for multivariate analysis. Multivariate analyses were carried out by using logistic regression method. When p values were lower than 0.05, they were accepted as statistically significant.

Table 3
Univariate and multivariate analyses of the risk factors that may affect anastomotic leakage.

	n (%)	Present	Absent	Univariate p	Multivariate p	Wald	Odds ratio
Age							
≥70	50 (31.2%)	5 (10%)	45 (90%)	0.863			
<70	110 (68.7%)	12 (10.9%)	98 (89.1%)				
Gender							
Male	103 (64.8%)	12 (11.6%)	91 (88.4%)	0.571			
Female	57 (35.2%)	5 (8.8%)	52 (91.2%)				
Albumin level							
≥3.5	37 (23.1%)	3 (8.1%)	34 (91.9%)	0.571			
<3.5	123 (76.9%)	14 (11.4%)	109 (88.6%)				
Severe anemia							
Absent	43 (26.9%)	2 (4.6%)	41 (95.4%)	0.137	0.183	1.773	2.871
Present	117 (73.1%)	15 (12.8%)	102 (87.2%)				
ASA score							
1–2	91 (56.9%)	10 (11%)	81 (89%)	0.864			
3–4	69 (43.1%)	7 (10.1%)	62 (89.9%)				
Neoadjuvant chemotherapy							
Required	15 (9.3%)	0 (0)	15 (100%)	0.161	0.998	0.001	0.008
Not required	145 (90.7%)	17 (11.7%)	128 (88.3%)				
DM							
Present	24 (15%)	2 (8.3%)	22 (91.7%)	0.693			
Absent	136 (85%)	15 (11%)	121 (89%)				
Hypertension							
Present	39 (24.4%)	3 (7.7%)	36 (92.3%)	0.494			
Absent	121 (75.6%)	14 (11.6%)	107 (88.4%)				
COPD							
Present	8 (5%)	0 (0)	8 (100%)	0.317			
Absent	152 (95%)	17(11.2%)	135 (88.8%)				
Intraoperative transfusion							
Required	69 (43.2%)	6 (8.7%)	63 (91.3%)	0.49			
Not required	91 (56.8%)	11 (12.1%)	80 (87.9%)				
Tumor localization							
Proximal	65 (40.6%)	8 (12.3%)	57 (87.7%)	0.568			
Distal	95 (59.4%)	9 (9.5%)	86 (90.5%)				
Tumor stage							
I	23 (14.4%)	1 (4.3%)	22 (95.7%)	0.56			
II	38 (23.8%)	6 (15.8%)	32 (84.2%)				
III	48 (30%)	5 (10.4%)	43 (89.6%)				
IV	51 (31.8%)	5 (9.8%)	46 (90.2%)				
Operation time							
≥180	79 (49.4%)	5 (6.3%)	74 (94.7%)	0.082	0.319	0.995	1.881
<180	81 (50.6%)	12 (14.8%)	69 (85.2%)				
Dissection width							
D1	118 (73.7%)	9 (7.6%)	109 (92.4%)	**0.039**	0.382	0.763	1.734
D2	42 (26.3%)	8 (19%)	34 (81%)				
Resection pattern							
Subtotal	62 (38.7%)	5 (8.1%)	57 (91.9%)	0.403			
Total	98 (61.3%)	12 (12.2%)	86 (87.8%)				
Additional organ resection							
Present	85 (53.1%)	12 (14.1%)	73 (85.9%)	0.127	0.584	0.300	1.442
Absent	75 (46.9%)	5 (6.7%)	70 (93.3%)				
Reconstruction type							
Roux-en Y	129 (80.6%)	15 (11.6%)	114 (88.4%)	0.401			
Omega	31 (19.4%)	2 (6.4%)	29 (93.6%)				

Abbreviations: ASA: anesthesia risk score defined by American Anesthesiology Association; DM: diabetes mellitus; and COPD: chronic obstructive pulmonary disease.
Bold font style represents statistically significant difference between groups, $p < 0.05$.

3. Results

A total of 160 patients (103 [64.8%] male and the average age was 62.4 ± 11.5) fulfilled the inclusion criteria. A total number of 46 (28.7%) and 31 (19.4%) patients had postoperative morbidity and surgery related complications, respectively (Table 1).

The univariate and multivariate analyses revealed that no other factors but ASA score was the only risk factor for overall morbidity ($p = 0.021$ and 0.033 in analyses, respectively) (Table 2). An anastomotic leak was observed in 17 (10.6%). A univariate analysis showed that the incidence of an anastomotic leak was increasing in patients received a D2 dissection ($p = 0.039$), but there was not a statistically significant risk factor for this complication in multivariate analysis (Table 3). Current study denied exposing a significant risk factor for predicting the risk for surgical site infection with either a univariate or a multivariate analysis (Table 4). Hospitalization period was lengthened in patients who received a neoadjuvant chemotherapy ($p = 0.041$), a D2 dissection ($p = 0.028$) or additional organ resection ($p = 0.032$) in univariate analysis, but multivariate analysis did not confirm these findings (Table 5). Although univariate analysis revealed that age over 70 ($p = 0.008$), ASA score ($p = 0.018$), operation time ($p = 0.032$), D2 dissection ($p = 0.026$) and type of anastomosis ($p = 0.023$) were effecting the risk for 30-day mortality, multivariate analysis showed that age was the only risk factor for postoperative early deaths ($p = 0.005$) (Table 6).

4. Discussion

It is important for a surgeon to estimate morbidity and mortality risks of gastric carcinoma surgeries before the surgery. This

Table 4
Univariate and multivariate analyses of the risk factors that may affect surgical site infections.

	n (%)	Present	Absent	Univariate *p*	Multivariate *p*	Wald	Odds ratio
Age							
≥70	50 (31.2%)	2 (4%)	49 (96%)	0.696			
<70	110 (68.7%)	6 (5.4%)	81 (94.6%)				
Gender							
Male	103 (64.8%)	6 (6.8%)	96 (93.2%)	0.161	0.130	2.295	0.18
Female	57 (35.2%)	2 (1.7%)	56 (98.3%)				
Albumin level							
≥3.5	37 (23.1%)	2(5.4%)	35 (94.6%)	0.465			
<3.5	123 (76.9%)	6 (4.9%)	117 (95.1%)				
Severe anemia							
Absent	43 (26.9%)	1 (2.3%)	42 (97.7%)	0.079	0.997	0.001	0.008
Present	117 (73.1%)	7 (6%)	110 (94%)				
ASA score							
1–2	91 (56.9%)	3(1.1%)	88 (98.9%)	0.293			
3–4	69 (43.1%)	5 (10.1%)	64 (89.9%)				
Neoadjuvant chemotherapy							
Required	15 (9.3%)	1 (6.7%)	14 (93.3%)	0.756			
Not required	145 (90.7%)	7 (4.2%)	138 (95.8%)				
DM							
Present	24 (15%)	2 (8.3%)	22 (91.7%)	0.067	0.054	3.724	5.011
Absent	136 (85%)	6 (4.4%)	130 (95.6%)				
Hypertension							
Present	39 (24.4%)	1 (2.6%)	38 (97.4%)	0.966			
Absent	121 (75.6%)	7 (5.8%)	114 (94.2%)				
COPD							
Present	8 (5%)	1 (12.5%)	7 (87.5%)	0.318			
Absent	152 (95%)	7 (4.6%)	145 (95.4%)				
Intraoperative transfusion							
Required	69 (43.2%)	4 (5.8%)	65 (94.2%)	0.742			
Not required	91 (56.8%)	4 (4.4%)	87 (95.6%)				
Tumor localization							
Proximal	65 (40.6%)	4 (6.1%)	61 (93.9%)	0.854			
Distal	95 (59.4%)	4 (4.2%)	91 (95.8%)				
Tumor stage							
I	23 (14.4%)	2 (8.7%)	21 (91.3%)	0.821			
II	38 (23.8%)	2 (5.3%)	36 (94.7%)				
III	48 (30%)	2 (4.2%)	46 (95.8%)				
IV	51 (31.8%)	2 (3.9%)	49 (96.1%)				
Operation time							
≥180	79 (49.4%)	2 (2.5%)	77 (97.5%)	0.971			
<180	81 (50.6%)	6 (7.4%)	75 (92.6%)				
Dissection width							
D1	118 (73.7%)	3 (2.5%)	115 (97.5%)	0.934			
D2	42 (26.3%)	5 (11.9%)	37 (88.1%)				
Resection pattern							
Subtotal	62 (38.7%)	2 (3.2%)	60 (96.8%)	0.503			
Total	98 (61.3%)	6 (6.1%)	92 (93.9%)				
Additional organ resection							
Present	85 (53.1%)	7 (8.2%)	78 (91.8%)	0.856			
Absent	75 (46.9%)	1 (1.3%)	74 (98.7%)				
Reconstruction type							
Roux-en Y	129 (80.6%)	7 (5.4%)	122(94.6%)	0.183	0.162	1.96	3.129
Omega	31 (19.4%)	1 (3.2%)	30(96.8%)				

Abbreviations: ASA: anesthesia risk score defined by American Anesthesiology Association; DM: diabetes mellitus; and COPD: chronic obstructive pulmonary disease.

Table 5
Univariate and multivariate analyses of the risk factors that may affect hospitalization period.

	n (%)	<10 days	≥10 days	Univariate *p*	Multivariate *p*	Wald	Odds ratio
Age							
≥70	50 (31.2%)	24 (48%)	26 (52%)	0.230	0.763	0.091	1.126
<70	110 (68.7%)	64 (59.1%)	46 (40.9%)				
Gender							
Male	103 (64.8%)	57 (56.3%)	46 (43.7%)	0.908			
Female	57 (35.2%)	31 (54.4%)	26 (45.6%)				
Albumin level							
≥3.5	37 (23.1%)	17 (45.9%)	20 (54.1%)	0.207	0.468	0.528	0.739
<3.5	123 (76.9%)	71 (58.5%)	52 (41.5%)				
Severe anemia							
Absent	43 (26.9%)	21 (48.8%)	22 (51.2%)	0.342			
Present	117 (73.1%)	67 (58.1%)	50 (41.9%)				
ASA score							
1–2	91 (56.9%)	54 (60.4%)	37 (39.6%)	0.205	0.465	0.534	1.308
3–4	69 (43.1%)	34 (49.3%)	35 (50.7%)				
Neoadjuvant chemotherapy							
Required	15 (9.3%)	12 (80%)	3 (20%)	**0.041**	0.053	3.756	3.946
Not required	145 (90.7%)	76 (52.4%)	69 (47.6%)				
DM							
Present	24 (15%)	13 (54.2%)	11 (45.8%)	0.929			
Absent	136 (85%)	75 (55.9%)	61 (44.1%)				
Hypertension							
Present	39 (24.4%)	20 (51.3%)	19 (48.7%)	0.591			
Absent	121 (75.6%)	68 (57.1%)	53 (42.9%)				
COPD							
Present	8 (5%)	4 (50%)	4 (50%)	0.771			
Absent	152 (95%)	84 (55.9%)	68 (44.1%)				
Intraoperative transfusion							
Required	69 (43.2%)	32 (46.4%)	37 (53.6%)	0.056	0.214	1.544	1.581
Not required	91 (56.8%)	56 (62.6%)	35 (37.4%)				
Tumor localization							
Proximal	65 (40.6%)	36 (55.4%)	29 (44.6%)	0.936			
Distal	95 (59.4%)	52 (55.8%)	43 (44.2%)				
Tumor stage							
I	23 (14.4%)	14 (60.9%)	9 (39.1%)	0.559			
II	38 (23.8%)	22 (57.9%)	16 (42.1%)				
III	48 (30%)	24 (52.1%)	24 (47.9%)				
IV	51 (31.8%)	28 (54.9%)	23 (45.1%)				
Operation time							
≥180	79 (49.4%)	44 (56.9%)	35 (43.1%)	0.861			
<180	81 (50.6%)	44 (54.3%)	37 (45.7%)				
Dissection width							
D1	118 (73.7%)	71 (60.1%)	47 (39.9%)	**0.028**	0.068	3.324	2.212
D2	42 (26.3%)	17 (40.5%)	25 (59.5%)				
Resection pattern							
Subtotal	62 (38.7%)	37 (61.3%)	25 (38.7%)	0.344			
Total	98 (61.3%)	51 (52.1%)	47 (47.9%)				
Additional organ resection							
Present	85 (53.1%)	40 (48.2%)	45 (51.8%)	**0.032**	0.203	1.621	1.665
Absent	75 (46.9%)	48 (64%)	27 (36%)				
Reconstruction type							
Roux-en Y	129 (80.6%)	75 (58.9%)	54 (41.1%)	0.103	0.072	3.237	2.269
Omega	31 (19.4%)	13 (41.9%)	18 (58.1%)				

Abbreviations: ASA: anesthesia risk score defined by American Anesthesiology Association; DM: diabetes mellitus; and COPD: chronic obstructive pulmonary disease.
Bold font style represents statistically significant difference between groups, $p < 0.05$.

estimation is important to define whether the patient is suitable for surgery or not, if a surgery is necessary which procedure should be applied and how to give the information about the risks of the surgery to the patients when receiving approval. Moreover, classifying patients based on operative risks leads the surgeon to choose preoperative and postoperative cares. Accordingly, an operation with the possible lowest postoperative morbidity risk may be considered to be appropriate for a patient who has serious comorbidity. Yet, the important point here is that the operation to be carried out should not lower the life expectancy of the patient more than other operation options. The surgeon's art is important to strike the right balance.[19]

A series of scoring systems were used to define the preoperative morbidity and mortality risks of gastric carcinoma. The most frequently used scoring system is ASA score which has been developed by anesthesiologists and actually defines the risks of anesthesia. It has been proven that ASA score is a really good indicator to estimate postoperative mortality in gastric carcinomas. In gastric carcinomas, the other two valid scoring systems which are highly complicated are POSSUM (Physiologic and Operative Severity Score for the enumeration of Mortality and Morbidity) and E-PASS (Estimation of Physiologic Ability and Surgical Stress) scoring systems. However, the precise value of these scoring systems remains controversial. Bollschweiler et al., have evaluated POSSUM scoring system in a group of patients undergoing a D2 dissection for gastric cancer and have concluded that this system is not useful to estimate postoperative conditions before the surgery.[20] In contrast, others have found that postoperative POSSUM score and postoperative early period mortality was correlated with each other.[21] In addition, E-PASS scoring system was adapted for gastric carcinoma surgery and concluded to be helpful in order to

Table 6
Univariate and multivariate analyses of the risk factors that may affect mortality.

	n (%)	Dead	Alive	Univariate *p*	Multivariate *p*	Wald	Odds ratio
Age							
≥70	50 (31.2%)	11 (22%)	39 (78%)	**0.008**	**0.05**	**3.811**	**3.170**
<70	110 (68.7%)	8 (7.3%)	81 (92.7%)				
Gender							
Male	103 (64.8%)	12 (11.6%)	91 (88.4%)	0.906			
Female	57 (35.2%)	7 (12.3%)	50 (87.7%)				
Albumin level							
≥3.5	37 (23.1%)	6 (16.2%)	31 (83.8%)	0.352			
<3.5	123 (76.9%)	13 (10.6%)	110 (89.4%)				
Severe anemia							
Absent	43 (26.9%)	6 (13.9%)	37 (86.1%)	0.622			
Present	117 (73.1%)	13 (11.1%)	104 (88.9%)				
ASA score							
1–2	91 (56.9%)	6 (6.6%)	85 (93.4%)	**0.018**	0.105	2.625	2.726
3–4	69 (43.1%)	13 (18.8%)	56 (81.2%)				
Neoadjuvant chemotherapy							
Required	15 (9.3%)	1 (6.7%)	14 (93.3%)	0.512			
Not required	145 (90.7%)	18 (12.4%)	127 (87.6%)				
DM							
Present	24 (15%)	5 (20.8%)	19 (79.2%)	0.141	0.288	1.129	2.061
Absent	136 (85%)	14 (10.3%)	122 (89.7%)				
Hypertension							
Present	39 (24.4%)	4 (10.2%)	35 (89.8%)	0.719			
Absent	121 (75.6%)	15 (12.4%)	106 (87.6%)				
COPD							
Present	8 (5%)	2 (25%)	6 (75%)	0.239	0.873	0.026	1.168
Absent	152 (95%)	17 (11.2%)	135 (88.8%)				
Intraoperative transfusion							
Required	69 (43.2%)	10 (14.5%)	59 (85.4%)	0.373			
Not required	91 (56.8%)	9 (9.9%)	82 (91.1%)				
Tumor localization							
Proximal	65 (40.6%)	11 (16.9%)	54 (83.1%)	0.103	0.639	0.220	0.768
Distal	95 (59.4%)	8 (8.4%)	87 (91.6%)				
Tumor stage							
I	23 (14.4%)	4 (17.4%)	19 (82.6%)	0.470			
II	38 (23.8%)	5 (13.1%)	33 (86.9%)				
III	48 (30%)	4 (8.3%)	44 (91.7%)				
IV	51 (31.8%)	6 (11.8%)	45 (88.2%)				
Operation time							
≥180	79 (49.4%)	5 (6.3%)	74(93.7%)	**0.032**	0.098	2.731	2.841
<180	81 (50.6%)	14 (17.3%)	67 (82.7%)				
Dissection width							
D1	118 (73.7%)	10 (8.5%)	108 (91.5%)	**0.026**	0.307	1.044	0.936
D2	42 (26.3%)	9 (21.4%)	33 (78.6%)				
Resection pattern							
Subtotal	62 (38.7%)	5 (8.1%)	57 (91.95)	0.236	0.759	0.094	1.442
Total	98 (61.3%)	14 (14.3%)	84 (85.7%)				
Additional organ resection							
Present	85 (53.1%)	13 (15.3%)	72 (84.7%)	0.155	0.679	0.171	0.762
Absent	75 (%46.9)	6 (%8)	69 (%92)				
Reconstruction type							
Roux-en Y	129 (80.6%)	19 (14.7%)	110 (85.3%)	**0.023**	0.998	0.001	0.001
Omega	31 (19.4%)	0 (0)	31 (100%)				

Abbreviations: ASA: anesthesia risk score defined by American Anesthesiology Association; DM: diabetes mellitus; and COPD: chronic obstructive pulmonary disease.
Bold font style represents statistically significant difference between groups, $p < 0.05$.

estimate postoperative results before the surgery.[22] The complexity of these scoring systems remains the major limitation on the widespread use of them, thus many studies have decided to calculate the risk factors for complications and mortality. In English MRC data, which was a prospective randomized multicenter study, the relationships between the width of dissection and postoperative morbidity and mortality were evaluated. These data revealed that postoperative early period mortality and morbidity were increasing in patients who had D2 dissection or wider resections including splenectomy and/or distal pancreatectomy.[16] Similar results were also shown in other prospective randomized trials or retrospective large volume analyses comparing the outcomes of D1 and D2 dissections, and width of dissection, older age, additional organ resection, Billroth 2 reconstruction pattern, ASA score, hypoalbuminemia, resection for palliation were stated as the independent risk factors for mortality and morbidity.[23–26]

In our study postoperative general morbidity rate was found as around 29% and early mortality rate was approximately 12%, which may be accepted as compatible with two important European studies.[14–17] In the current study, although D2 dissection was an independent risk factor in univariate analysis as it increased surgery related complications, particularly anastomotic leakage, hospitalization period and 30-day mortality, multivariate analysis denied revealing disadvantages of wider dissection, which was consistent with the Italian study and most of the retrospective broad series.[14–17] Current study also questioned the factors which lengthen the hospitalization period, and revealed that although additional organ resection, which was an indicator correlated with the width of

surgery, was an independent factor in univariate analysis, multivariate calculation did not confirm this finding. In addition, multivariate analyses revealed that higher ASA scores and older age were associated with increased overall morbidity and 30-day mortality rates, respectively. In our opinion, these are significant findings, which are also consistent with the other studies and may have a key role for the surgeon during the decision making for the patients with gastric cancer.

Current study may be criticized to include some limitations, mostly related to its retrospective design and since include the data of a single institution compared with studies conducted in Far East. However, we believe that similar studies as ours belonged to non-specialized centers with acceptable volumes of patients are needed to be discussed, since for most of the patients in our country and all over the world gastric carcinoma surgeries have been carried out in this kind of institutions.

Considering the information regarding this single center retrospective study, we may conclude that early morbidity and mortality are not rare after gastric cancer surgery with curative intent. We believe that it may be logical for the surgeons to consider patient related factors including age and ASA score during the decision making for the treatment in patients with gastric cancer, since these parameters were shown to be independent risk factors for postoperative 30-day mortality and overall morbidity in multivariate analyses in the current study.

Ethical approval

Kartal Education and Research Hospital Ethics Board (Reference number: B104İSM4340029/1009/13).

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Author contribution

Selahattin Vural: Conception and design, acquisition of data, participated in drafting the article, have given final approval.

Osman Civil: Conception and design, interpretation of data, participated in drafting the article, have given final approval.

Metin Kement: Conception and design, critical revisions during the creation of the manuscript, have given final approval.

Yunus E Altuntas: Acquisition of data, interpretation of data, have given final approval.

Nuri Okkabaz: Interpretation of data, critical revisions during the creation of the manuscript, have given final approval.

Fazli C Gezen: Interpretation of data, critical revisions during the creation of the manuscript, have given final approval.

Mustafa Haksal: Acquisition of data, participated in drafting the article, have given final approval.

Ersin Gündogan: Conception and design, participated in drafting the article, have given final approval.

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Conflict of interest

The authors do not have any disclosures.

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