Ann Surg Oncol (2018) 25:2374–2382
https://doi.org/10.1245/s10434-018-6543-1

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – GASTROINTESTINAL ONCOLOGY

Multicenter Study of Presentation, Management, and Postoperative and Long-Term Outcomes of Septegenerians and Octogenerians Undergoing Gastrectomy for Gastric Cancer

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ABSTRACT

Background. The optimal treatment strategy for elderly patients with gastric cancer is still controversial. This study aimed to assess the impact of age on short- and long-term outcomes after treatment for primary gastric cancer.

Methods. From January 2004 to December 2014, a total of 507 patients underwent gastrectomy for gastric adenocarcinoma at two high-volume upper gastrointestinal (GI) centers. The patients were classified into three groups as follows: group A (patients $\leq$ 69 years old, n = 266), group B (patients 70–79 years old, n = 166), and group C (patients $\geq$ 80 years old, n = 75). Clinicopathologic characteristics as well as, short- and long-term outcomes were compared between the groups.

Results. The patients in groups B and C had more comorbidities, whereas the younger subjects (group A) had more advanced tumor stages. Less extensive surgery was performed in the groups B and C. Older patients (age $\geq$ 70 years) had more postoperative medical complications. Moreover, group C had a higher postoperative mortality rate (8.1%) than group A (1.8%) or group B (1.9%). In the multivariable analysis, age older than 80 years (group C) was a negative independent factor for overall survival (OS) (hazard ratio [HR], 2.36) compared with group A, whereas group B seemed to have a comparable risk (HR, 1.37). Notably, the three groups did not show significant differences in disease-related survival (DRS).

Conclusion. The data suggest that patients 70–79 years of age show a risk of postoperative death comparable with that of younger subjects. However, patients older than 80 years should be carefully selected for surgical treatment due to the increased risk of postoperative mortality.

As the global population ages, the number of older patients with gastric cancer increases.[1] During the last two decades, many advances in surgical oncology for the elderly have been made by improved operative technique and technology,[2,3] greater knowledge of geriatric pathophysiology, advanced intensive care management, and the introduction of enhanced recovery programs. Therefore, old age currently is not considered an absolute contraindication to surgery for gastric cancer. Several recent studies have reported the feasibility of surgery for patients older than 70 years,[4,5] although it still is unclear whether surgery in octogenarians is safe.[6,7]

There is a major lack of information for patients age 80 years or older. The most recent studies investigating this aged population concluded that radical surgery for gastric cancer in an octogenarian is feasible and effective for certain subgroups of patients,[6] but reported higher morbidity and 90-day mortality rates than for younger patients.[7]

To elucidate the best treatment strategy for gastric cancer in the elderly, this study retrospectively compared clinicopathologic features, management, postoperative survival, overall survival, and oncologic outcomes after gastrectomy at two European upper gastrointestinal (UGI) cancer centers.

First Received: 14 October 2017;
Published Online: 4 June 2018

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PATIENTS AND METHODS

All information on patients undergoing gastrectomy for gastric cancer from January 2004 to December 2014 at two high-volume UGI centers (the Royal Marsden NHS Foundation Trust, London [RMH] and Verona University hospital) was retrospectively recorded from prospectively collected databases. Cancers of the esophagogastric junction (Siewert 1 and 2), remnant adenocarcinomas, and non-adenocarcinoma tumors were excluded.

The type of lymphadenectomy was classified according to the criteria of the Japanese Gastric Cancer Association.[8] Tumor invasion (pT) and lymph node status (pN) followed the criteria of the International Union Against Cancer (UICC) TNM Classification of Malignant Tumor, 7th edition.[9] Histologic type was classified as intestinal or diffuse-mixed in accordance with Lauren's classification.[10] Moreover, the rate of signet ring cell cancer (SRCC) according to the World Health Organization (WHO) histologic classification also was reported.[11]

Patients were classified into three groups: group A (GpA: patients $\leq$ 69 years old), group B (GpB: patients 70–79 years old), and group C (GpC: patients $\geq$ 80 years old). The data were analyzed to identify any differences between the groups in terms of patient and disease characteristics, treatment strategy, surgical outcome, overall survival, and oncologic outcome after gastrectomy.

Medical and surgical postoperative complications were considered separately because they may have not only different risk factors but also different clinical impacts as proposed by the Italian Research Group for Gastric Cancer.[12] Surgical complications were recorded according to the newly proposed classification,[12] whereas "medical complications" were recorded according to the classification of Low et al.[13] All the complications also were classified according to the Clavien-Dindo classification.[14] The patients were followed up for 5 years postoperatively. The survival rate was calculated from the date of the surgery until the date of death or last contact.

Statistical analysis was performed using the Chi square test for any categorical variables and Levene's test or Student's *t* test for any continuous variables. Overall survival (OS) and disease-related survival (DRS) were calculated using Kaplan-Meier methods, and the significance of the test was evaluated using the log-rank test or the Tarone-Ware test. A multivariable survival analysis was performed using the Cox proportional hazard method. A *p* value lower than 0.05 was considered statistically significant, and 95% was used as the confidence interval (CI). The statistical analysis was performed using STATA 13.0 (StataCorp, College Station, TX) Statistics Software.

RESULTS

Clinicopathologic Features and Treatment Strategy

The study investigated 507 patients (266 GpA patients, 166 GpB patients, and 75 GpC patients). As expected, the GpB and GpC patients had a higher American Society of Anesthesiology (ASA) score[15] ($p = 0.001$) and a higher Charlson Comorbidity Index (CCI) [16] ($p < 0.001$) than the younger patients (Table 1). In particular, the incidence of hypertension and cardiovascular disease was significantly higher for the patients older than 70 years ($p < 0.001$).

The GpA patients were found to have a higher rate of clinical metastatic disease at diagnosis (9%), a clear prevalence of SRCC ($p < 0.001$), and a more diffuse histotype (45%) compared with the two older groups (Table 1). Considering the pathologic stage (pTNM), GpB was associated with more stage 2 disease than GpA or GpC (31.3%), whereas GpA had more advanced and metastatic disease (16.3%).

The GpA patients received neoadjuvant and perioperative treatments more frequently than the other two groups ($p < 0.001$). No differences were found regarding the tolerance for chemotherapy, the completion rate, or the response to the therapy between the groups (Table 1).

Surgery

The GpC patients underwent a less extensive surgery, with a higher rate of subtotal gastrectomies ($p = 0.03$), despite a comparable tumor distribution and fewer multivisceral resections ($p = 0.059$). Furthermore, the GpB and GpC patients underwent a less extended lymphadenectomy ($p < 0.001$) than the GpA patients. More than 30% of the GpA patients underwent an extended lymphadnectomy (D2 plus or more). A standard D2 gastrectomy was performed for 70% of the GpB patients, whereas almost half of the octogenarian patients received a D1 lymphadenectomy. The number of harvested nodes was higher in the GpA group than in the other groups ($p = 0.001$). Despite more limited surgery, the R0 margin rate was comparable between the groups (Table 2).

Surgical Outcome

The GpA patients were found to have a higher rate of surgical complications ($p = 0.011$), whereas the older patients (GpB and GpC) had more medical complications ($p = 0.021$). According to the Clavien-Dindo classification,[14] the GpA patients had, globally, more major complications (18%), whereas the GpB patients had more minor complications (21.6%). Moreover, specifically analyzing only the major complications, we found that the

TABLE 1 Clinicopathologic features and treatment strategy

Characteristic	GpA *n* = 266 (52.5%) *n* (%)	GpB *n* = 166 (32.7%) *n* (%)	GpC *n* = 75 (14.8%) *n* (%)	*p* Value
Age (years)				
Mean ± SD	56.7 ± 10.2	74.4 ± 2.7	82.8 ± 2.7	
Range	27–69	70–79	80–92	
Sex				0.000
Female	95 (35.7)	37(22.3%)	38 (50.7)	
Male	171 (64.3)	129(77.7%)	37 (49.3)	
Comorbidity				
Hypertension	50 (24.9)	54 (42.5)	26 (56.5)	0.000
Cardiovascular	40 (19.9)	43 (33.6)	20 (43.5)	0.001
Respiratory	18 (9)	16 (12.6)	6 (13)	0.500
Diabetes	21 (10.4)	21 (16.5)	8 (17.4)	0.200
Renal	7 (3.5)	5 (3.9)	2 (4.3)	0.952
Previous abdominal surgery	21 (10.2)	15 (11.8)	5 (10.9)	0.905
Previous malignancy	25 (12.3)	23 (18)	10 (20.8)	0.199
ASA				0.001
1–2	147 (70.7)	76 (58.5)	20 (40.5)	
3–4	61 (29.3)	52 (41.5)	26 (59.5)	
Mean CCI	4.8 ± 1.9	6.5 ± 1.2	7.5 ± 1.6	0.000
Location				0.506
Siewert 3	39 (14.8)	29 (17.5)	10 (13.5)	
Proximal	25 (9.5)	19 (11.4)	3 (4.1)	
Middle	80 (30.3)	43 (25.9)	18 (24.3)	
Distal	111 (42)	68 (41)	40 (54.1)	
Linitis	9 (3.4)	7 (4.2)	3 (4.1)	
cTNM stage				0.052
0	0 (0)	0 (0)	3 (0)	
1	52 (22.3)	37 (25.9)	12 (19.4)	
2	97 (41.6)	73 (51)	30 (48.4)	
3	63 (27)	30 (21)	18 (29)	
4	21 (9)	3 (2.1)	2 (3.2)	
SRCC	107 (41)	37 (22.7)	18 (24.3)	0.000
Lauren histotype				0.000
Intestinal	107 (43.3)	89 (62.7)	40 (56.3)	
Diffuse	113 (45.7)	34 (23.9)	18 (25.4)	
Mixed	25 (10.1)	17 (12)	13 (18.3)	
pTNM stage[a]				0.060
1	58 (22)	44 (26.5)	15 (20)	
2	60 (22.7)	52 (31.3)	19 (25.3)	
3	98 (37.1)	54 (32.5)	33 (44)	
4	43 (16.3)	13 (7.8)	8 (10.7)	
N status				0.359
N0	102(38.6)	73 (44)	25 (33.3)	
N1	32 (12.2)	27 (16.3)	14 (18.7)	
N2	41 (15.5)	27 (16.3)	13 (17.3)	
N3a	47 (17.8)	21 (12.7)	15 (20)	
N3b	42 (15.9)	18 (10.8)	8 (10.7)	

TABLE 1 continued

Characteristic	GpA *n* = 266 (52.5%) *n* (%)	GpB *n* = 166 (32.7%) *n* (%)	GpC *n* = 75 (14.8%) *n* (%)	*p* Value
Neodjuvant chemotherapy	117 (44.0)	58 (34.9)	2 (2.7)	0.000
Adjuvant chemotherapy	139 (69.2)	62 (48.8)	4 (10%)	0.000

GpA group A, *GpB* group B, *GpC* group C, *ASA* American Society of Anesthesiology, *CCI* Charlson Comorbidity Index, *cTNM* clinical TNM, *pTNM* pathologic tumor-node-metastasis, *SRCC* signet ring cell cancer, *SD* standard deviation

[a]Six patients with a complete pathologic response were excluded from the analysis

TABLE 2 Surgery and surgical outcome

Characteristic	GpA *n* = 266 (52.5%) *n* (%)	GpB *n* = 166 (32.7%) *n* (%)	GpC *n* = 75 (14.8%) *n* (%)	*p* Value
Emergency	9 (3.4)	7 (4.2)	4 (5.3)	0.728
Surgery				0.030
TG	124 (46.6)	72 (43.4)	20 (26.7)	
STG	132 (49.6)	87 (52.4)	53 (70.7)	
PG	10 (3.8)	7 (4.2)	2 (2.7)	
Multivisceral resection	58 (21.8)	23 (13.9)	10 (13.3)	0.059
Lymphadenectomy				0.000
D1	38 (15)	28 (18.3)	34 (46.6)	
D2	138 (54.5)	108 (70.6)	36 (49.3)	
D2+	77 (30.4)	17 (11.1)	3 (4.1)	
Surgical margin status				0.096
R0	227 (88)	148 (89.2)	67 (90.5)	
R1	23 (8.9)	7 (4.2)	6 (8.1)	
R2	8 (3.1)	11 (6.6)	1 (1.4)	
Lymph nodes harvested				
Median (IQR)	35.7 (7–58)	31.1 (7–58)	28.8 (3–69)	0.001
Complication				
Surgical complications	63 (32.5)	23 (19.7)	7 (15.9)	0.011
Medical complications	46 (23.7)	45 (38.5)	14 (31.8)	0.021
Clavien-Dindo (<30 days)				0.419
Minor (1–2)	49 (18.4)	36 (21.6)	11 (14.6)	
Major (3– 4–5)	48 (18)	22 (13)	10 (13)	
Reoperations	25 (13)	12 (10.3)	3 (6.8)	0.464
Hospital stay				
Mean ± SD	16.34 ± 22.1	16.48 ± 16.9	14.4 ± 14.4	0.957
Early mortality				
In-hospital mortality	5 (1.9)	3 (1.8)	6 (8.1)	0.010
30-Day mortality	3 (1.1)	3 (1.8)	4 (5.4)	0.064
90-Day mortality	4 (1.5)	3 (1.8)	5 (7.4)	0.009

GpA group A, *GpB* group B, *GpC* group C, *TG* total gastrectomy, *STG* subtotal gastrectomy, *PG* partial proximal gastrectomy, *IQR* interquartile range, *SD* standard deviation

GpA patients had more type 3 complications (21.1%), whereas the GpB patients had more type 4 complications (9.4%). The type 3 complications included bleeding, anastomotic fistula, or intraabdominal abscess and required surgical, endoscopic, or radiologic intervention. Most of the type 4 complications comprised severe medical complication such as pneumonia, with respiratory failure or heart failure. The 30-day mortality rate in the GpC group

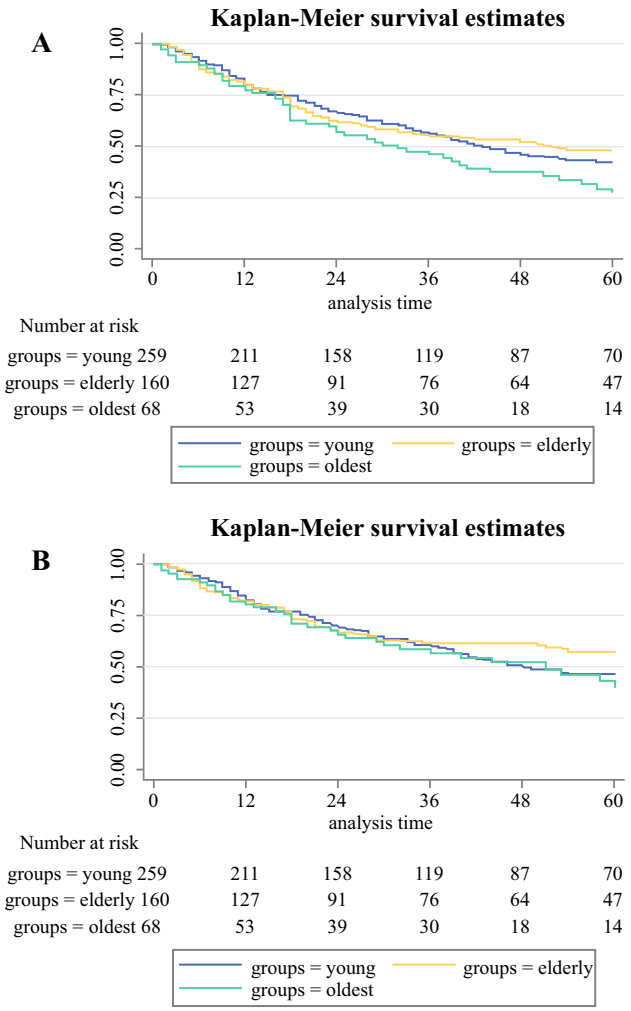

FIG. 1 **a** Overall survival curves according to the three groups (Young = Gp A; Elderly = Gp B; Oldest = Gp C). Tarone-Ware test = 4.46, $p = 0.107$. **b** Disease related survival curves according to the three groups (Young = Gp A; Elderly = Gp B; Oldest = Gp C). Log-rank test = 2.29, $p = 0.319$

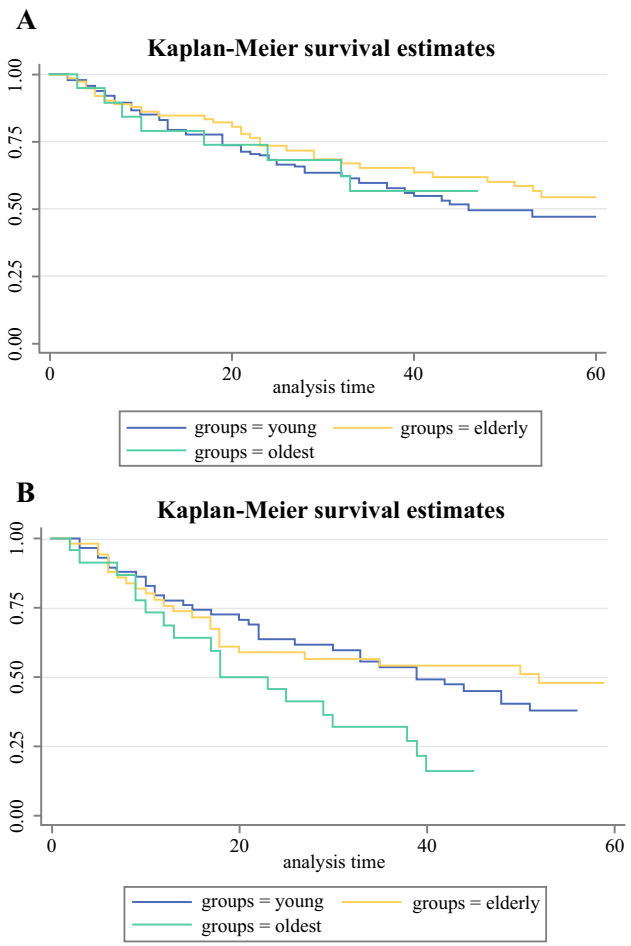

FIG. 2 **a** Overall Survival curves according to the three groups (Young = Gp A; Elderly = Gp B; Oldest = Gp C) in patients ASA 1-2. Log-rank test = 0.19, p = 0.907. **b** Overall Survival curves according to the three groups (Young = Gp A; Elderly = Gp B; Oldest = Gp C) in patients ASA 3–4. Log-rank test = 7.45, $p = 0.024$

was 5.4% compared with 1.1% in the GpA group and 1.8% in the GpB group. Moreover, the GpC also had a higher incidence of 90-day mortality and in-hospital mortality (8.1%) than the GpA group (1.9%) or the GpB group ($p < 0.01$) (Table 2).

Survival

The survival curves showed no significant difference in OS ($p = 0.107$) or DRS ($p = 0.319$). For the first 18 months after surgery, the mortality rate was the same in all three groups, but after the second year of follow-up evaluation, survival differences between the GpC group and the other two groups became apparent. This difference may be explained by the greater incidence of non-cancer deaths in the GpC group (Fig. 1).

A separate survival analysis of the ASA 1–2 and 3–4 subgroups showed no difference between the age classes in terms of low comorbidity patients ($p = 0.907$). On the other hand, in the ASA 3–4 patients, the oldest group, had a 5-year OS of 16% (95% CI, 4–35%), which was significantly lower ($p = 0.024$) than that of the young (GpA) patients (38%; 95% CI, 25–51%) or the elderly (GpB) patients (48%; 95% CI, 32–62%). (Fig 2).

Multivariable Analysis

The three groups were analyzed for potential significant confounding factors stratified for disease stage (pTNM). The findings showed ASA (1–2 vs 3–4), tumor location, type of surgery, multivisceral resections, presence of SRCC, Laurèn histotype, and surgical margin positivity to be independent prognostic factors ($p < 0.05$) for OS.

TABLE 3 Uni- and multivariable overall survival (OS) analyses stratified by pathologic tumor-node-metastasis (pTNM)

	Univariable analysis		Multivariable analysis	
OS	χ^2	*p* Value	HR (95% CI)	*p* Value
Sex (male/female)	0.01	0.925		
Aging group	4.46	0.107		
GpA			1 (ref)	
GpB			1.358 (0.919–2.008)	0.124
GpC			2.223 (1.361–3.630)	0.001
ASA (1–2/3–4)	4.51	0.034	1.448 (1.005–2.087)	0.046
Location	22.64	0.000		
Siewert 3			1 (ref)	
Fundus			0.599 (0.323–1.110)	0.104
Body			0.301 (0.167–0.542)	0.000
Antrum			0.766 (0.399–1.470)	0.424
Linites			0.425 (0.180–1.002)	0.051
NCT (no/yes)	0.41	0.520		
Type of operation	20.93	0.000		
TG			1 (ref)	
STG			0.590 (0.352–0.991)	0.046
PG			0.395 (0.131–1.191)	0.099
Lymphadenectomy	2.97	0.226		
D1				
D2				
D2+				
ACT (no/yes)	0.32	0.573		
Multivisceral resections (no/yes)	16.82	0.000	1.101 (0.717–1.689)	0.658
Complications (CD 0–1–2/3–4–5)	3.26	0.071		
Surgical complications (no/yes)	1.20	0.272		
Medical complications (no/yes)	2.66	0.103		
SRCC (no/yes)	7.22	0.007	1.012 (0.656–1.559)	0.956
Lauren histotype	17.44	0.000		
Intestinal			1 (ref)	
Diffuse			1.630 (1.010–2.631)	0.045
Mixed			1.029 (0.602–1.758)	0.915
Surgical margin status	214.52	0.000		
R0			1 (ref)	
R1			3.643 (2.048–7.478)	0.000
R2			5.531 (2.366–12.930)	0.000

Aging group sub-analysis: GpC vs GpB ($p = 0.0615$)

HR hazard ratio, *CI* confidence interval, *GpA* group A, *GpB* group B, *GpC* group C, *ref* reference category, *ASA* American Society of Anesthesiology, *NCT* neoadjuvant chemotherapy, *TG* total gastrectomy, *STG* subtotal gastrectomy, *PG* partial proximal gastrectomy, *ACT* adjuvant chemotherapy, *CD* Clavien-Dindo classification, *SRCC* signet ring cell cancer

A multivariable analysis including age and the other significant confounding factors showed that age older than 80 years is an independent prognostic factor for OS (hazard ratio [HR], 2.22; 95% CI, 1.36–3.63). Comparison of GpB and GpC showed a borderline significant difference in OS ($p = 0.0615$). Other significant independent prognostic factors were presence of ASA 3–4, tumor location, diffuse Lauren histotype, and residual disease after surgery (Table 3).

The same analysis performed for DRS found that the presence of ASA 3–4 and residual disease after surgery were significant in the Cox multivariable analysis. Comparison of the three groups showed that age is not a significant prognostic factor for DRS ($p = 0.491$) (Table 4). The Shoenfeld residual test confirmed the Cox model proportional hazards assumption of both multivariable analyses.

TABLE 4 Uni- and multivariable disease-related survival analyses stratified by pathologic tumor-node-metastasis (pTNM)

	Univariable analysis		Multivariable analysis	
DRS	χ^2	*p* Value	HR (95% CI)	*p* Value
Sex (male/female)	0.82	0.365		
Aging group	2.29	0.318		
GpA			1 (ref)	
GpB			0.908 (0.523–1.579)	0.735
GpC			1.214 (0.585–2.519)	0.601
ASA (1–2/3–4)	5.02	0.025	1.717 (1.060–2.781)	0.028
Location	16.91	0.002		
Siewert 3			1 (ref)	
Fundus			0.469 (0.185–1.190)	0.111
Body			0.521 (0.249–1.089)	0.083
Antrum			0.743 (0.319–1.729)	0.491
Linites			0.484 (0.175–1.339)	0.163
NCT (no/yes)	0.46	0.498		
Type of operation	18.52	0.000		
TG			1 (ref)	
STG			0.606 (0.317–1.158)	0.130
PG			0.579 (0.108–3.100)	0.524
Lymphadenectomy	6.00	0.049		
D1			1 (ref)	
D2			0.918 (0.503–1.672)	0.780
D2+			0.608 (0.283–1.306)	0.203
ACT (no/yes)	0.18	0.673		
Multivisceral resections (no/yes)	16.14	0.000	0.815 (0.464–1.431)	0.477
Complications (CD 0–1–2/3–4–5)	3.87	0.049	0.910 (0.525–1.579)	0.739
Surgical complications (no/yes)	2.44	0.118		
Medical complications (no/yes)	1.97	0.160		
SRCC (no/yes)	10.40	0.001	0.948 (0.552–1.627)	0.847
Lauren histotype	23.59	0.000		
Intestinal			1 (ref)	
Diffuse			1.670 (0.903–3.086)	0.102
Mixed			1.080 (0.490–2.383)	0.847
Surgical margin status	252.11	0.000		
R0			1 (ref)	
R1			3.955 (1.990–7.863)	0.000
R2			6.266 (1.520–25.818)	0.011

Aging group subanalysis: GpC vs GpB ($p = 0.491$)

DRS disease-related survival, *HR* hazard ratio, *CI* confidence interval, *GpA* group A, *GpB* group B, *GpC* group C, *ASA* American Society of Anesthesiology, *NCT* neoadjuvant chemotherapy, *TG* total gastrectomy, *STG* subtotal gastrectomy, *PG* partial proximal gastrectomy, *ACT* adjuvant chemotherapy, *CD* Clavien-Dindo classification, *SRCC* signet ring cell cancer

DISCUSSION

With a global increase in aging, as described by the United Nations 2015 report, surgical oncology faces new management challenges. Octogenarians are predicted to form more than 20% of the world's population in 2050 compared with 14% in 2015.[17] The treatment strategy for gastric cancer in the elderly has changed over the decades, and progressive improvements in surgical and anaesthetic techniques have led to a decrease in postoperative mortality rates,[2] and higher resection rates have been reported.[3] Although many authors have reported in the last 10 years that surgery for the elderly is feasible and safe,[4,5] the recommended treatment for the elderly patient still is debated.

According to a general consensus in the literature, aging itself should not be considered as a major risk factor for surgery. The major concern and selection criteria for any oncologic treatment is frailty of the patient. Frailty identifies the recognized medical syndrome of decreased physiologic reserve,[18] a condition that results from the effect of comorbidities.

As expected, in this study, the patients older than 70 years had a higher ASA and a higher CCI rate than the younger patients. Nevertheless, the patients younger than 69 years presented with more advanced and aggressive disease in terms of staging and histologic features, with a high rate of SRCC, a diffuse histotype, and more metastatic disease at surgery. This is not discordant with the standard profile described in the literature.

In elderly patients, gastric cancer frequently is located in the proximal stomach, with an intestinal histotype and a tendency to be well-differentiated,[3] and the estimated percentage of SRCC is lower.[19] The less advanced disease at diagnosis in the elderly might be explained by a less aggressive cancer behavior,[20] but because the current study was a surgical series, these findings may have been the result of a selection bias by the surgeons. Indeed, surgeons often avoid performing major surgery for high-risk patients in the setting of advanced disease.

In this study, elderly patients underwent less extensive surgery at the expense of a compromised lymphadenectomy, especially octogenarian patients, half of whom underwent a D1 dissection. For these reasons, younger patients were susceptible to a higher rate of surgical complications, particularly Clavien-Dindo grade 3 complications that required surgical, endoscopic, or radiologic intervention. In contrast, the presence of medical comorbidities in the older groups could explain the increased Clavien-Dindo grade 2 complications managed with pharmacologic treatments.

Similar results have been reported by other authors, although few have considered octogenarian patients.[21–23] Takama et al.[24] compared the outcomes between patients older than 70 years and patients older than 80 years. The findings showed a similar incidence of complications. These authors suggested that less extensive surgery should be preferred for patients older than 80 years.

Other studies have described a high rate of morbidity and mortality after surgery. Hayashi et al.[25] reported that the general morbidity rate after D2 or modified D2 lymphadenectomy was acceptable at 18%, but that severe complications were more frequent (16%) among the elderly, suggesting that surgery for gastric cancer in patients older than 80 years has risks and should be limited.

Recently, Ruspi et al.[26] reviewed seven studies focused on morbidity and mortality to determine the role of lymphadenectomy for gastric cancer in elderly patients. They concluded that a standard D2 lymphadenectomy is safe, conferring an oncologic benefit in overall survival for fit elderly patients as well as young patients. This advantage is lost for high-risk elderly patients, resulting in more postoperative complications. For these patients, a limited lymphadenectomy would be a better option. Many other authors conclude the same, suggesting that less aggressive surgery should be the most appropriate treatment for patients older than 80 years.[4,5]

With regard to survival outcomes, the current study showed significant differences in overall survival between the groups classified according to age but no differences in the oncologic outcomes in terms of DRS. These results were concordant not only with the results of studies investigating patients older than 70 years,[5,6,27] but also with the findings specifically for patients older than 80 years.[5,7,22,28–31] In the current study, ASA score, and not ageing, was a prognostic factor in DRS. This could be explained by the difficulty in actively treating patients with high comorbidity in favor of palliative treatments. However, the similar rates of DRS support active cancer treatment for those elderly patients with good performance status and minimal comorbidity.

Many physicians specializing in care of the elderly currently are emphasizing that the optimal surgical management for elderly patients should start preoperatively. In a recent article, Parks et al.[32] describes how patients older than 80 years are complex and need specific assessments. These authors have proposed that to improve the current care of elderly patients, a multidisciplinary team should include a geriatrician dedicated to preoperative assessment and optimization followed by postoperative involvement in patient recovery.

CONCLUSION

Currently, patients 70–79 years old should be considered as having a risk comparable with that of younger patients and patients older than 80 years as having a higher risk. Despite this, radical surgery for some octogenarian patients fit for surgery is feasible and oncologically justified by good long-term outcomes in terms of OS and DRS. The majority of patients older than 80 years will not be in this category, however, and for these patients, a less aggressive approach is appropriate.

REFERENCES

1. Howlader N, Noone AM, Krapcho M, et al. *SEER Cancer Statistics Review, 1975–2012*. National Cancer Institute, Bethesda, 2015. http://seer.cancer.gov/csr/1975_2012/, based on November 2014 SEER data submission, posted to the SEER web site April 2015.

2. Kranenbarg EK, van de Velde CJ. Gastric cancer in the elderly. *Eur J Surg Oncol.* 1998;24:384–90.
3. Saif MN, Makrilia N, Zalonis A, Merikas M, Syrigos K. Gastric cancer in the elderly: an overview. *Eur J Surg Oncol.* 2010;36:709–717.
4. Katai H, Sasako M, Sano T, Fukagama T. Gastric cancer surgery in the elderly without operative mortality. *Surg Oncol.* 2004;13:235–8.
5. Takeshita H, Ichikawa D, Komatsu S, et al. Surgical outcomes of gastrectomy for elderly patients with gastric cancer. *World J Surg.* 2013;37:2891–8.
6. Konishi H, Daisuke I, Hiroshi I, et al. Surgery for gastric cancer patients of age 85 and older: multicenter survey. *World J Gastroenterol.* 2017;23:1215–23.
7. Casella F, Sansonetti, Zanoni A, Vincenza C, Capodacqua A, Verzaro R. Radical surgery for gastric cancer in octogenarian patients. *Updates Surg.* 2017;69:389–95
8. Japanese Gastric Cancer Association. Japanese classification of gastric carcinoma. 2nd English ed. *Gastric Cancer.* 1998;1:10–24.
9. Sobin LH, Gospodarowicz MK, Wittekind C. *International Union Against Cancer (UICC) TNM Classification of Malignant Tumors.* 7th ed. Wiley-Blackwell, Oxford, 2010.
10. Laurén PA, Nevalainen TJ. Epidemiology of intestinal and diffuse types of gastric carcinoma: a time-trend study in Finland with comparison between studies from high- and low-risk areas. *Cancer.* 1993;71:2926–33.
11. Fléjou JF. WHO Classification of Digestive Tumors, 4th ed. *Ann Pathol.* 2011;31:S27–31.
12. Baiocchi GL, Giacopuzzi S, Marrelli D, et al. Complications after gastrectomy for cancer: Italian perspective. Italian Research Group for Gastric Cancer (GIRCG). *Updates Surg.* 2017;69:285–8.
13. Low DE, Alderson D, Cecconello I, et al. International consensus on standardization of data collection for complications associated with esophagectomy: Esophagectomy Complications Consensus Group (ECCG). *Ann Surg.* 2015;262:286–94.
14. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg.* 2004;240:205–13.
15. Saklad M. Grading of patients for surgical procedures. *Anesthesiology.* 1941;2:281–4.
16. Charlson M, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. *J Clin Epidemiol.* 1994;47:1245–51.
17. World Health Organization. World report on ageing and health. (2015). Retrieved at http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf.
18. Huisingh-Scheetz M, Walston JJ. How should older adults with cancer be evaluated for frailty? *Geriatr Oncol.* 2017;8:8–15.
19. de Manzoni G, Roviello F, Siquini W (eds) *Surgery in the Multimodal Management of Gastric Cancer.* Springer-Verlag Italia, Milan, Italy, 2012.
20. Liang YX, Deng JY, Guo HH et al. Characteristics and prognosis of gastric cancer in patients aged C70 years. *World J Gastroenterol.* 2013;19:6568–78.
21. Orsenigo E, Tomajer V, Palo SD, Carlucci M, Vignali A, Tamburini A, Staudacher C. Impact of age on postoperative outcomes in 1118 gastric cancer patients undergoing surgical treatment. *Gastric Cancer.* 2007;10:39–44.
22. Kunisaki C, Akiyama H, Nomura M, Matsuda G, Otsuka Y, Ono HA, Shimada H. Comparison of surgical outcomes of gastric cancer in elderly and middle-aged patients. *Am J Surg.* 2006;191:216–24.
23. Saidi RF, Bell JL, Dudrick PS. Surgical resection for gastric cancer in elderly patients: is there a difference in outcome? *J Surg Res.* 2004;118:15–20.
24. Takama T, Okano K, Kondo A, Akamoto S, Fujiwara M, Usuki H, Suzuki Y. Predictors of postoperative complications in elderly and oldest old patients with gastric cancer. *Gastric Cancer.* 2015;18:653–66.
25. Hayashi T, Yoshikawa T, Aoyama T, Ogata T, Cho H, Tsuburaya A. Severity of complications after gastrectomy in elderly patients with gastric cancer. *World J Surg.* 2012;36:2139–45.
26. Ruspi L, Galli F, Pappalardo V, et al. Lymphadenectomy in elderly/high-risk patients: should it be different? *Transl Gastroenterol Hepatol.* 2017;21:2–5.
27. Kitamura K, Sugimachi K, Saku M. Evaluation of surgical treatment for patients with gastric cancer who are over 80 years of age. *Hepatogastroenterology.* 1999;46:2074–80.
28. Kim MS, Kim SJ. Outcome of gastric cancer surgery in elderly patients. *Gastric Cancer.* 2016;16:254–9.
29. Tran TB, Worhunsky DJ, Squires MH, et al. Outcomes of gastric cancer resection in octogenarians: a multi-institutional study of the U.S. gastric cancer collaborative. *Ann Surg Oncol.* 2015;22:4371–9.
30. Kim JH, Chin HM, Jun KH. Surgical outcomes and survival after gastrectomy in octogenarians with gastric cancer. *J Surg Res.* 2015;198:80–6.
31. Sasada S, Ikeda Y, Saitsu H, Saku M. Characteristics of gastric cancer in patients over 80 years old. *Hepatogastroenterology.* 2008;55:1931–4.
32. Parks RM, Rostoft S, Ommundsen N, Cheung KL. Perioperative management of older adults with cancer: the roles of the surgeon and geriatrician. *Cancers (Basel).* 2015;7:1605–21.