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Original Research Article

Surgical resection of gastric gastrointestinal stromal tumors (GIST) in octogenarians☆

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ABSTRACT

Background: Localized gastrointestinal stromal tumors (GISTs) are rare tumors typically managed with surgery, but outcomes among octogenarians remain less studied.
Methods: Octogenarian patients with stage I-III gastric GISTs were identified from the National Cancer Database and classified by resection status. Cox regression and Kaplan-Meier survival analyses analyzed 5-year overall survival (OS). Ninety-day mortality was analyzed following 1:1 propensity score matching.
Results: Identified octogenarians (N = 949) who underwent resection (N = 632) had improved adjusted OS (71% vs 59.6%, HR 0.75, *p* 0.049) as compared to non-resected patients. Following matching, 90-day mortality was 5.7% and 11% in resected and non-resected patients (*p* 0.052), respectively. After exclusion of patients with 90-day mortality, resected patients maintained an OS advantage (77.3% vs 71.1%, HR 0.64, *p* 0.028).
Conclusions: The majority of octogenarians with localized gastric GIST are treated with surgery portending improved survival but an appreciable mortality, suggesting a necessity for careful selection of older patients for surgery.

Introduction

Gastrointestinal tumors are rare mesenchymal tumors, most commonly presenting in the stomach (60%).[1–5] While the median age of diagnosis is the sixth decade of life, these tumors may present across all age groups with a minority of patients presenting at ≥80 years of age.[6] Surgery remains the recommended treatment for localized disease, but surgical outcomes among octogenarians are not well-characterized.[7–12] Patient age, in addition to tumor factors such as tumor size and mitotic rate, has been associated with worse overall survival (OS) and recurrence-free survival (RFS) in all-site GISTs.[3,5,13–15] When considering tumor biology, particularly of low-risk indolent tumors, the responsiveness of gastric GISTs to targeted therapy, and the increased comorbidities and surgical risk in octogenarians, the relative value of surgical resection in this subpopulation is less clear.

Multiple studies have demonstrated the relative safety and favorable outcomes of oncologic surgery among octogenarians for various abdominal malignancies, including pancreatic, gastric, and colon cancers.[16–21] These results have likely contributed to a reported increase in complex oncologic surgeries among octogenarians for abdominal cancers.[22] In this study, we evaluate the practice patterns and outcomes in octogenarian patients diagnosed with gastric GIST utilizing a national cohort. Specifically, we describe the characteristics and outcomes of octogenarians with GIST who did and did not undergo surgical resection. This information may be particularly important for helping to guide decision-making in elderly patients with newly diagnosed gastric GIST tumors.

Material and methods

Data source and patient selection

The patients included in this study were identified from the

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2010–2016 American College of Surgeons Commission on Cancer (CoC) National Cancer Data Base (NCDB).[23–25] The NCDB is an oncologic clinical database containing patient data regarding demographic, tumor, treatment and survival that is accrued from over 1500 CoC-affiliated referring facilities. All patient data are obtained retrospectively and are without patient or facility identifiers; thus, this study was exempt from institutional review board approval and the data included are compliant with the Health Insurance Portability and Accountability Act.

Patients who met inclusion criteria for this study were octogenarian adults (≥80 and < 90 years of age) diagnosed with stage I-III gastric GIST between the years 2010 and 2016. Additionally, there were 66 patients who were ≥90 years of age for which a sub-analysis was performed. Patients with gastric GIST were identified by using the 2018 International Classification of Diseases for Oncology 3rd Edition (ICD-O-3) topography code class C16.x and the ICD-O-3 Histology Code and Behavior code 8936. Patients with unknown stage (N = 23 patients), unknown surgical status (N = 1 patients), and positive macroscopic or unknown margin status (N = 61 patients) were excluded.

Study endpoints and variables

The primary end point of this study was 5-year overall survival (OS), defined as the time from date of diagnosis to either the date of death within a 5-year period or time of last contact. The secondary end point of this study was 90-day mortality. The patient characteristics included in this study were: sex, race, education above the median (defined as above or below the median number of people with a high-school degree in that zip code), income above the median, type of insurance, and Charlson Deyo score. Characteristics of the facility included geographic location, the patient's distance from the referring facility, the hospital type, and the surgical volume quartile of the facility. Tumor characteristics included tumor site within the stomach, clinical AJCC 8th edition stage, tumor size (<5 cm, 5–10 cm, and >10 cm), tumor mitotic count (low, classified as ≤5/50 high powered fields [HPF], and high, classified as >5/50 HPF), and grade of disease (well-differentiated, moderately differentiated, poorly differentiated, and undifferentiated). Factors related to the treatment of patients included surgical procedure type and receipt of systemic therapy (neoadjuvant therapy [NAT], adjuvant therapy [AT], neoadjuvant and adjuvant therapy [NAT + AT], no systemic therapy, and unknown). Surgical procedure type was classified based on the Surveillance, Epidemiology, and End Result Program Coding and Staging Manual 2018 surgery codes: no surgery or local excision (i.e. endoscopic) only (0, 20–24), partial gastrectomy (30–33), total gastrectomy (40–42), total gastrectomy with partial esophagectomy (50–52), total gastrectomy with resection of contiguous organs (60–63), and gastrectomy not otherwise specified (NOS) (80).

Statistical analysis

Univariate analyses were performed by using Pearson's χ2. Unadjusted and adjusted 5-year OS comparing patients ≥80 years of age who did and did not undergo surgical resection were analyzed by using Cox proportional hazards regression analyses. Covariates included in survival regressions were variables noted to be significantly associated with survival ($p < 0.05$) on univariate Cox regression analyses. Patients who did and did not undergo surgical resection were 1:1 propensity score matched with caliper distance 0.05 of the standard deviation of the logit of the propensity score. All controls were used only once during matching and matching was performed using all demographic, facility, tumor, and treatment characteristics with the exception of surgical procedure type due to collinearity. Adjusted 90-day mortality was analyzed using univariate analyses with additional stratification by surgical procedure type. Adjusted five-year OS was analyzed using Kaplan-Meier survival estimates compared with log-rank analysis. All unknown variables were categorized as such and retained for multivariable and survival analyses. The tests performed in this study were two-sided; all p values < 0.05 were considered statistically significant. Statistical analyses were performed by using Stata for Windows version 13.1.[26]

Results

Characteristics associated with undergoing surgery in octogenarians

From January 1, 2010 to December 31, 2015, 949 patients ≥80 years of age were diagnosed with clinical AJCC 8th edition stage I-III gastric GIST (Table 1). The median age of patients was 83

Table 1
Patient and facility demographics for octogenarian patients with who did and did not undergo surgical resection.

Covariates	No surgery, N(%) 317 (33.4)	Surgery, N(%) 632 (66.6)	*p* value
Sex			0.20
Male	126 (39.8)	279 (44.2)	
Female	191 (60.3)	353 (55.9)	
Race			0.36
White	225 (71.0)	464 (73.4)	
Black	66 (20.8)	102 (16.1)	
Asian	14 (4.4)	30 (4.8)	
Hispanic	7 (2.2)	22 (3.5)	
Other/unknown	5 (1.6)	14 (2.2)	
Education			0.70
Above median	166 (52.4)	342 (54.1)	
Below median	150 (47.3)	286 (45.3)	
Unknown	1 (0.3)	4 (0.6)	
Income			0.97
Above median	185 (58.4)	371 (58.7)	
Below median	129 (40.7)	256 (40.5)	
Unknown	3 (1.0)	5 (0.8)	
Insurance status			0.35
No insurance	1 (0.3)	2 (0.3)	
Private	24 (7.6)	52 (8.2)	
Medicare	285 (89.9)	544 (86.1)	
Medicaid	3 (1.0)	18 (2.9)	
Government	1 (0.3)	4 (0.6)	
Unknown	3 (1.0)	12 (1.9)	
Charlson Deyo score			0.91
0	202 (63.7)	399 (63.1)	
1	77 (24.3)	161 (25.5)	
≥2	38 (12.0)	71 (11.4)	
Geographic location			0.15
Northeast	27 (8.5)	35 (5.5)	
Mid-Atlantic	46 (14.5)	124 (19.6)	
Southeast	76 (24.0)	145 (22.9)	
Midwest	128 (40.4)	260 (41.1)	
West	40 (12.6)	68 (10.8)	
Hospital type			0.69
Academic	119 (37.5)	229 (36.2)	
Non-academic	198 (62.5)	403 (63.8)	
Unknown	0 (0.0)	0 (0.0)	
Distance from facility			0.45
0–10 miles	184 (58.0)	375 (59.3)	
11–20 miles	57 (18.0)	98 (15.5)	
21–30 miles	26 (8.2)	45 (7.1)	
31–40 miles	10 (3.2)	35 (5.5)	
≥40 miles	40 (12.6)	79 (12.5)	
Surgical volume			0.32
0–25% quartile	18 (5.7)	44 (7.0)	
26–50% quartile	47 (14.8)	81 (12.8)	
51–75% quartile	52 (16.4)	130 (20.6)	
76–100% quartile	200 (63.1)	377 (59.7)	

(interquartile range [IQR] 5) years and 57.3% of patients were female. Of all octogenarian patients, 632 (66.6%) underwent surgical resection for gastric GIST.

There were no differences in octogenarians who did (N = 532) and did not (N = 317) receive surgery with respect to sex, race, insurance type, Charlson Deyo score, and facility characteristics. Octogenarian patients who underwent surgical resection were more likely to have tumors in the body, including greater or lesser curvature of the stomach, (37.3% vs 30.3%, *p* 0.023) or the antrum/pylorus (9.5% vs 6.3%, *p* 0.023) when compared to those who did not undergo surgical resection (Table 2). Of those who underwent surgical resection, the majority of octogenarian patients underwent partial gastrectomy (86.6%). Octogenarian patients who underwent surgical resection were more likely to have tumors 5–10 cm (34.8% vs 24.3%, *p* 0.004), as compared to tumors <5 cm and >10 cm, when compared to those who did not undergo surgical resection. Additionally, patients who underwent surgical resection were less likely to receive systemic therapy (79.9% vs 68.8%, $p < 0.0001$) as compared to octogenarians who did not undergo surgical resection.

Unadjusted and adjusted survival outcomes among octogenarians

Factors associated with 5-year OS among octogenarians included sex, Charlson Deyo score, surgical volume, stage of disease, tumor size, tumor mitotic count, grade of disease, receipt of systemic therapy, and surgical resection (Table 3). When comparing patients with gastric GIST ≥80 years old who did and did not undergo surgical resection, unadjusted 5-year OS was significantly improved (71% vs 59.6%, hazard ratio [HR] 0.59, $p < 0.0001$) for those who underwent surgical resection. Median follow-up among surviving patients was 37.8 months (IQR 36.3 months) for octogenarians who underwent surgical resection and 30.8 months (IQR 44 months) for octogenarians who did not undergo surgical resection. On multivariate analysis, sex, Charlson Deyo score, surgical volume, and surgical resection remained significantly associated with 5-year survival. Following adjustment for factors associated with OS and receipt of surgery in octogenarians with gastric GIST, adjusted 5-year OS remained significantly improved for those who underwent surgical resection as compared to those who did not undergo surgical resection (HR 0.59, *p* 0.049).

The overall 90-day mortality rate among those who underwent surgical resection was 4.9% when examining the entire study cohort. There were no patient, tumor, or treatment factors that were significantly different between those with and without 90-day mortality on univariate analyses among all of those who underwent surgical resection, but surgical procedure type demonstrated a clinically meaningful though statistically insignificant difference in postoperative mortality rates. Specifically, patients who underwent a variation of total gastrectomy as compared to partial gastrectomy demonstrated a higher rate of 90-day mortality (8.5% vs 4.4%, p 0.106) following resection. The overall 90-day mortality rate of those undergoing total gastrectomy approaches the overall rate of patients who did not undergo surgical resection at all (9.9%). Additionally, 299 (31.5%) were specified as undergoing minimally invasive procedures (either robotic or laparoscopic); of these patients, the 90-day mortality rate following surgical resection was 3.4%.

To further understand survival outcomes in older patients, we analyzed 90-day mortality among octogenarians from time of diagnosis following 1:1 matching of those who did (N = 210) and did not (N = 210) undergo surgical resection with appropriate balance of covariates (Supplemental Table 1). Following matching, the overall mortality rate 90 days from diagnosis of octogenarians who did and did not undergo surgical resection was 5.7% and 11%, respectively (*p* 0.052). Additionally, the mortality rate 30 days from diagnosis of octogenarians who did and did not undergo surgical resection was 3.8% and 5.2%, respectively (*p* 0.48). When comparing those who expired within 90 days of diagnosis and those who did not, there were no differences in sex, race, education level, income level, insurance type, miles from facility, Charlson Deyo score, hospital type, surgical volume, tumor site, tumor size, and grade of disease. Additionally, there were no differences in presence of positive surgical margins, receipt of systemic therapy, or type of surgical procedure between those with did and did not expire within 90 days of diagnosis. Octogenarian patients who expired within 90 days of diagnosis were more likely to have stage II (20% vs 15.6%, *p* 0.033) or stage III (25.7% vs 11.7%, *p* 0.033) disease.

Notably, 30.6% of patients without resection received systemic therapy; of these patients (N = 97), the 90-day mortality rate was 10.3%, comparable to the overall 90-day mortality rate among non-resected patients. Factors associated with receipt of systemic therapy in this group as compared to those who received no

Table 2
Tumor and treatment characteristics of octogenarian patients with stage I-III gastric GIST who did and did not undergo surgical resection.

Tumor Characteristics	*No surgery*	*Surgery*	*p* value	Treatment characteristics	*No surgery*	*Surgery*	*p* value
AJCC 8th Ed. stage			0.088	Tumor site			0.023*
Stage I	212 (66.9)	456 (72.2)		Cardia or fundus	77 (24.3)	133 (21.0)	
Stage II	65 (20.5)	94 (14.9)		Body	96 (30.3)	236 (37.3)	
Stage III	40 (12.6)	82 (13.0)		Antrum or pylorus	20 (6.3)	60 (9.5)	
Tumor size			0.004*	Other/unknown	124 (39.1)	203 (32.1)	
<5 cm	192 (60.6)	327 (51.7)		Surgical procedure			<0.0001*
5–10 cm	77 (24.3)	220 (34.8)		No surgery/local excision	317 (100.0)	0 (0.0)	
>10 cm	48 (15.1)	85 (13.5)		Partial gastrectomy	0 (0.0)	547 (86.6)	
Mitotic count			<0.0001*	Total gastrectomy	0 (0.0)	16 (2.5)	
≤5/50 HPF	180 (56.8)	490 (77.5)		Total gastrectomy with PE	0 (0.0)	34 (5.4)	
>5/50 HPF	34 (10.7)	105 (16.6)		Total gastrectomy with CR	0 (0.0)	32 (5.1)	
Unknown	103 (32.5)	37 (5.9)		Gastrectomy NOS	0 (0.0)	3 (0.5)	
Grade			<0.0001*	Systemic therapy			<0.0001*
Well-differentiated	75 (23.7)	231 (36.6)		None	218 (68.8)	505 (79.9)	
Mod. differentiated	22 (6.9)	105 (16.6)		AT	0 (0.0)	91 (14.4)	
Poorly diff.	7 (2.2)	20 (3.2)		NAT	0 (0.0)	15 (2.4)	
Undifferentiated	5 (1.6)	21 (3.3)		NAT + AT	0 (0.0)	11 (1.7)	
Unknown	208 (65.6)	255 (40.4)		Systemic therapy, no surgery	97 (30.6)	0 (0.0)	
				Unknown	2 (0.6)	10 (1.6)	

AJCC, American Joint Committee on Cancer. *HPF*, high-powered field. *PE*, partial esophagectomy. *CR*, contiguous resection. *NOS*, not otherwise specified. *AT*, adjuvant therapy. *NAT*, neoadjuvant therapy.
*indicates significance.

Table 3
Unadjusted and adjusted 5-year overall survival (OS) of patients ≥80 years with stage I-III gastric GISTs who underwent surgical resection as compared to those who did not undergo surgical resection.

Covariates	Univariate HR (CI)	*p* value	Multivariate HR (CI)	*p* value
Surgery vs. no surgery	0.59 (0.47–0.74)	<0.0001[a]	0.75 (0.56–1.00)	0.049[a]
Sex				
Male	1.63 (1.43–1.87)	<0.0001[a]	1.54 (1.22–1.93)	<0.0001[a]
Female	Ref.		Ref.	
Charlson Deyo score				
0	Ref.		Ref.	
1	1.50 (1.29–1.75)	<0.0001[a]	1.50 (1.16–1.94)	0.002[a]
≥2	2.36 (1.94–2.87)	<0.0001[a]	1.62 (1.15–2.27)	0.005[a]
Surgical volume				
0–25% quartile	1.84 (1.40–2.42)	<0.0001[a]	1.40 (0.90–2.17)	0.14
26–50% quartile	1.36 (1.12–1.66)	0.002[a]	1.41 (1.02–1.95)	0.038[a]
51–75% quartile	1.34 (1.13–1.59)	0.001[a]	1.27 (0.95–1.70)	0.11
76–100% quartile	Ref.		Ref.	
Stage				
Stage 1	Ref.		Ref.	
Stage 2	1.09 (0.90–1.32)	0.37	0.85 (0.56–1.28)	0.43
Stage 3	2.09 (1.77–2.46)	<0.0001[a]	1.56 (0.89–2.73)	0.12
Tumor size				
<5 cm	Ref.		Ref.	
5–10 cm	1.21 (1.04–1.41)	0.015[a]	1.14 (0.86–1.52)	0.36
>10 cm	1.71 (1.44–2.04)	<0.0001[a]	1.40 (0.91–2.16)	0.12
Mitotic count				
≤5/50 HPF	Ref.		Ref.	
>5/50 HPF	1.53 (1.29–1.82)	<0.0001[a]	1.34 (0.82–2.21)	0.25
Unknown	2.32 (1.95–2.75)	<0.0001[a]	1.81 (1.29–2.55)	0.001[a]
Grade				
Well-differentiated	Ref.		Ref.	
Mod. differentiated	1.13 (0.90–1.42)	0.30	1.06 (0.70–1.59)	0.79
Poorly diff.	1.68 (1.20–2.35)	0.002[a]	0.64 (0.29–1.39)	0.26
Undifferentiated	1.96 (1.39–2.78)	<0.0001[a]	0.95 (0.46–1.97)	0.89
Unknown	1.45 (1.24–1.70)	<0.0001[a]	0.98 (0.74–1.31)	0.90
Tumor site				
Cardia or fundus	1.10 (0.91–1.32)	0.34	1.02 (0.74–1.40)	0.90
Body	Ref.		Ref.	
Antrum or pylorus	1.10 (0.84–1.43)	0.48	1.09 (0.70–1.69)	0.70
Other/unknown	1.43 (1.22–1.67)	<0.0001[a]	1.11 (0.85–1.47)	0.44
Systemic therapy				
None	1.34 (1.10–1.64)	0.004[a]	3.78 (0.92–15.51)	0.07
AT	Ref.		Ref.	
NAT	1.32 (0.88–1.99)	0.18	2.25 (0.52–9.66)	0.28
NAT + AT	1.04 (0.56–1.94)	0.89	1.60 (0.22–11.53)	0.64
ST, no surgery	2.56 (1.99–3.29)	<0.0001[a]	4.21 (0.99–17.89)	0.052
Unknown	0.66 (0.27–1.62)	0.37	2.48 (0.40–15.31)	0.33

HPF, high-powered field. *AT*, adjuvant therapy, *NAT*, neoadjuvant therapy. *ST*, systemic therapy. *HR*, hazards ratio. *CI*, confidence interval.
[a] Indicates significance.

systemic therapy were tumor size 5–10 cm (39.2% vs 17.9%, $p < 0.0001$), or stage II (28.9% vs 16.5%, $p < 0.0001$) or III disease (26.8% vs 6.4%, $p < 0.0001$). When examining 5-year OS among the matched cohorts, surgical resection continued to be significantly associated with improved OS (72.9% vs 63.3%, HR 0.60, *p* 0.004).

Among those patients who underwent surgery, the median and mean days from diagnosis to surgery was 3 and 28.6 days, respectively. Of those who did undergo surgical resection, the 90-day mortality rate from the date of surgery (rather than date of diagnosis) remained 5.7%. Patients who underwent partial gastrectomy (N = 181) only had a 90-day mortality rate of 4.4% following surgical resection, but those who underwent total gastrectomy with or without partial esophagectomy or contiguous resection (N = 29) had a 90-day mortality rate of 13.8% following surgical resection. There were no patients who underwent a partial gastrectomy for a tumor within the fundus or cardia who had 90-day mortality, but the 90-day mortality rates for those undergoing partial gastrectomy for tumors of the body and antrum/pylorus were 1.6% and 6.8%, respectively.

Following exclusion of patients who expired within 90 days from diagnosis (N = 35, 8.3%) within the matched sample, there was a significant difference in 5-year OS survival noted after adjusted Cox regression analysis and Kaplan-Meier survival estimate analysis between octogenarian patients who did and did not undergo surgical resection (77.3% vs 71.1%, HR 0.64, *p* 0.028) (Fig. 1).

Characteristics and survival associated with undergoing surgery in nonagenarians

Sixty-six patients ≥90 years of age were diagnosed with clinical AJCC 8th edition stage I-III gastric GIST. Of nonagenarian patients, 36 (54.6%) patients underwent surgical resection. There were no differences in nonagenarian patients who did and did not receive surgery with respect to sex, race, education and income level, insurance type, and facility characteristics. Nonagenarian patients who underwent surgical resection were significantly more likely to have Charlson Deyo score 1 (41.7% vs 23.3%, *p* 0.049) or 2 or greater (13.9% vs 3.3%, *p* 0.049) compared to non-surgical patients, but were less likely to have scores of 0 (44.4% vs 73.3%). There was no difference with respect to location of the tumor for nonagenarians who did and did not undergo surgical resection, but nonagenarians who underwent surgical resection were more likely to have stage I

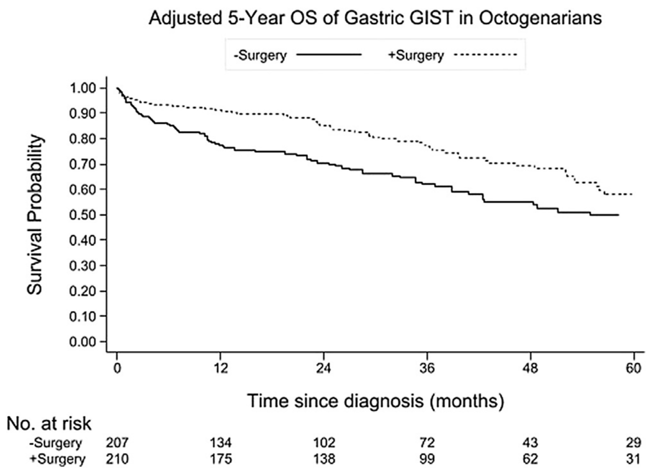

Fig. 1. Adjusted 5-year overall survival (OS) among octogenarian patients who did and did not undergo surgical resection for gastric GIST.

(80.6% vs 56.7%, $p < 0.0001$) or III (19.4% vs 6.7%, $p < 0.0001$) disease and less likely to have stage II (0% vs 36.7%, $p < 0.0001$) disease. Of nonagenarians, 91.7% (N = 33) of patients who underwent surgical resection received a partial gastrectomy with no systemic therapy, and of patients who did not undergo surgical resection, 40% (N = 12) received systemic therapy only. When comparing nonagenarian patients with gastric GIST who did and did not undergo surgical resection, adjusted 5-year OS was not significantly different (HR 1.32, p 0.675). Ninety-day mortality from the time of diagnosis among those who did not undergo resection was 20% (N = 6) among nonagenarians, and 90-day mortality from the time of surgical resection among those who did undergo resection was 8.3% (N = 3). There were no demographic or clinical differences between nonagenarians who did and did not have 90-day mortality.

Discussion

With an increasingly aged population, there has been an increase in volume of cancer surgery in the octogenarian population.[22] It is particularly important to understand practice patterns and outcomes in this patient population to help inform clinical decision making. GIST are rare tumors which may have a very indolent course when small and low risk, and, when high risk, can respond to effective targeted therapies that can maintain disease control for long periods.[27–29] The relative value of surgery in octogenarians with other potential health risks in this setting is therefore not well-defined. In this study, we examined patient and tumor characteristics in octogenarians with localized gastric GIST and found that surgery was associated with improved 5-year survival, despite an approximately 6% 90-day mortality rate in this population.

Several prior studies have evaluated surgical outcomes in octogenarians undergoing surgery.[16–21] Across several abdominal malignancies, including pancreatic, esophageal, gastric, and colorectal, octogenarians have been noted to be able to safely undergo surgical resections with acceptable post-operative morbidity and mortality outcomes, potentially explaining an observed increase in surgery among octogenarians for various cancers.[16–22] In contrast, studies examining the impact of age in gastric GIST, specifically, have noted significantly improved five-year GIST-specific survival (83.3% vs 75.4%) among young and adolescent patients as compared to older (40 years of age or older) patients, with disease-specific survival rates in the older cohort similar to the octogenarian population undergoing surgery in the current study.[27] Other studies classifying patients into elderly (65 years of age or older) and non-elderly cohorts have additionally noted significantly improved disease-specific survival among non-elderly patients (88.1%) as compared to elderly patients (81.4%).[14] There has been relatively little data comparing outcomes of resected and non-resected octogenarians with GIST or specifically examining post-operative mortality in this population, and important consideration in clinical decision-making for this patient group where various clinical approaches may exist. In this study, we found an appreciable 90-day perioperative mortality rate in octogenarians undergoing surgery for gastric GIST. This rate is congruent with prior studies on gastric resections for gastric cancer with reported 30-day mortality rates of 4–7.2% vs 0.3–2.5% among octogenarians and non-octogenarians, respectively.[16,17]

In this study, we found that those octogenarians who underwent surgical resection were more likely to have tumors in the body of the stomach or antrum/pylorus and not present in the fundus or cardia, which may necessitate a lengthier or more complex surgery. Octogenarian patients were also more likely to have intermediate size tumors. Smaller tumors were perhaps more likely to be observed with conservative management and larger tumors may have been considered prohibitively morbid in this patient population. Notably, there was no difference in pre-existing comorbidities between those who did and did not receive surgery, congruent with prior evidence.[6] Even so, among octogenarians who underwent a variation of total gastrectomy for complete resection, the 90-day postoperative mortality rate was noted to be 8.5%, similar to those who did not undergo resection at all. This may represent a subgroup of patients in whom careful consideration should be given for nonoperative management. Conversely, in patients who underwent minimally invasive procedures (i.e., robotic or laparoscopic), the 90-day postoperative mortality rate was 3.4%, lower than the general study population. Octogenarians with gastric GIST that is amenable to minimally invasive resection appear to represent a subgroup of patients who are lower risk for post-operative mortality, which can be considered when making decisions for surgical resection in this population.

This study has several limitations, notwithstanding its retrospective design with inherent biases. Missing data for certain patient and tumor factors were present in the database, but there did not appear to be a particular imbalance between patient groups (i.e. resected versus unresected) and missing values were excluded from multivariable and survival analyses, thereby likely mitigating impact. The NCDB does not contain data regarding disease recurrence or disease-specific mortality; these oncologic outcomes would be valuable in further assessing the impact of surgical resection on disease course. Even so, this does not detract from the findings regarding overall survival in this elderly population with other health risks. Data were not available regarding specific type, duration, and dosing of adjuvant therapy, although most patients who received this therapy presumably underwent therapy with imatinib.[28–30] Additionally, the decision to proceed with surgery and the surgical approach (i.e., open versus minimally invasive) are not clearly delineated in the NCDB database, factors which could impact the study results. Unfortunately, data on surgical approach from the NCDB database is limited due to the unspecified nature of various procedures that were grouped together as either open or unspecified. Presumably, some of these included hybrid approaches, but this cannot be definitively ascertained. Minimally invasive approaches were nonetheless found to be associated with improved post-operative mortality, and further study using institutional datasets could further delineate postoperative outcomes stratified by procedure type. Additionally, we were unable to discern from the database whether patients were symptomatic from their tumor (i.e., tumors associated with bleeding, obstruction, or pain) or if the lesion was incidentally discovered. This may have impacted outcomes in the study in unmeasurable ways. Importantly, given the database's limitations, we were not able to determine specific patient factors associated with early mortality to better select patients for surgery. Data were not available regarding toxicity associated with systemic therapy in patients undergoing non-surgical management. Finally, cost data with respect to surgical and non-surgical management, particularly targeted therapies, was not available. All these data elements could further inform the optimal approach for gastric GIST in this patient population.

Conclusions

Despite these limitations, this study provides important data regarding the outcomes of octogenarian patients diagnosed with gastric GIST. While surgery remains the standard approach for localized GIST in this population and appears to be associated with improved long-term as compared to non-surgical management, careful patient selection for surgery is important to minimize postoperative mortality. Further study to delineate the optimal approach in this elderly population for these rare tumors is warranted.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjsurg.2021.03.062.

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