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Epidemiology of Small Gastrointestinal Stromal Tumors and Survival Outcomes Due To Surgical Options: A SEER-Based Population Retrospective Study

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Small gastrointestinal stromal tumors; SEER; Surgical options; Endoscopic resection; Gastrectomy; Treatment modalities

1. Abstract

1.1. Background: There is a dearth of population-based evidence regarding the role of surgery in the treatment of patients with small gastrointestinal stromal tumors (sGISTs)(<2cm). The purpose of this study was to describe the demographic features and investigate the impact of surgery treatment on survival outcome in patients with sGISTs.

1.2. Methods: The data of patients with sGISTs histologically diagnosed between 2001 and 2016, was extracted from the Surveillance, Epidemiology, and End Results (SEER) database registry. Kaplan-Meier analysis and Cox regression were performed to determine the effect of surgery on GIST-specific survival (GSS) and overall survival (OS) in the surgical group. The same methods were applied to assess effect of treatment modalities on overall survival (OS) between local tumor excision group and gastrectomy group.

1.3. Results: Among all sGISTs patients, the surgery resection group had a higher 5-year GSS (95.3% vs. 86.4%) and OS (78.5% vs. 71.5%) than the non-surgery group. In the stomach subgroup, the local tumor excision group had a higher 5-year OS (93.0% vs. 92.3%) than the gastrectomy group. The gastrectomy group had more increased survival hazard ratios than the local tumor excision group. (OS: HR:3.121, P=0.0075).

1.4. Conclusions: This study showed that operative management is associated with improved survival outcomes in patients with sGISTs. For gastric sGISTs, local tumor excision group might provide a better prognosis than gastrectomy, although now gastrectomy is more preferred.

2. Introduction

Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal neoplasms with a wide spectrum of clinical activities, ranging from virtually indolent tumors to rapidly progressive cancers [1]. GIST are a heterogeneous group of tumours includes that they can occur anywhere in the gastrointestinal tract, mostly located in stomach, followed by small intestine [2]. Approximately there were about 4000-6000 new cases in US every year, 10-30% indentified malignant [3] GIST have significant variation in size, more than half of them are greater than 5cm in diameter at diagnosis [4]. With the development of endoscopic technology, it is increasingly recognized that smaller tumors may appear in the gastrointestinal tract. Small Gastrointestinal stromal tumors (sGISTs) are defined as tumors no larger than 2 cm in diameter, frequently termed miniGIST (1-2cm) or micro-GIST (<1 cm). Given their smaller size, patients rarely have

symptoms and difficult to diagnose. There is a paucity of data on these GISTs, mainly based on pathological studies and small sample case studies [5], the diagnostic significance and optimal treatment strategy of which are unclear. The survival of patients with sGISTs is affected by two main variables, including whether surgical treatment was performed, and which surgical option was selected. Both open and minimally invasive procedures were determined to reduce recurrence rates and improve long-term survival for non-small GISTs [6]. However, the National Comprehensive Cancer Network (NCCN) and the European Society of Medical Oncology (ESMO) still do not have a consensus on the operation management of GIST <2 cm [7]. Because of the increased frequency of complications and the difficulty in identification of malignancy preoperatively, the risk of growth and progression to malignancy is unknown. Corless CL et al reported that even 1 cm GISTs are likely to carry a KIT mutation, about 11.4% of small GISTs are accompanied with local progression or even distant metastasis at the time of their first diagnosis [8,5]. Resection or follow-up are options for gastric sGISTs, considering the easiness of resection and patient's condition and opinion. In recent years more and more small GIST (between 0.5 and 1.0 cm in size) were reset under endoscopy [9], there are some controversial because of the risk of complications, including incomplete resection, peritoneal implantation due to tumour rupture, and difficulty in repairing any incidental perforation [10,11]. For patients with intestinal and colorectal sGISTs, surgery should be performed regardless of size. mini - GISTs without high risk features at other sites and all micro - GISTs require only regular endoscopic review [12]. Chi JL et al reported that surgery can provide a better prognosis and laparoscopic resection have a comparable long-term outcome with open procedure [13]. Nevertheless, there is still no consensus amongst clinicians as to which surgical treatment may be better suited for patients with gastric sGISTs. Data comparing the effects of different treatment modalities in gastric sGISTs patients are scarce. Therefore, the present study sought to explore the efficacy of surgical treatment for improved prognosis. we used the Surveillance, Epidemiology, and End Results (SEER) databases to evaluate the demographic characteristics of sGISTs and analyzed the impact of surgical interventions on patient survival time, with particular interest in the benefits versus risks associated with local tumor excision and gastrectomy procedures.

3. Methods

3.1. Study Population

A retrospective analysis was conducted using Surveillance, Epidemiology, and End Results (SEER) data from 2001-2016. The SEER database is a population-based cancer registry center that covers nearly 28% of the United States population [14]. The SEER data record includes the patients' registration number, personal information, location of the primary lesion, tumor size, tumor code, treatment, cause of death, etc. GIST was defined by GI tumor site codes (C150–C189, C199, C209– C212, C218, C220–C221, C239–C260, C268–C269, C480–C482, C488). The patients with GISTs were identified using a specific histology code ([ICD-O] code 8936). The flowchart of patient selection of the current study is depicted in Figure 1 and Figure 2. The University of California, San Diego's Institutional Review Board has deemed research of this nature exempt from review.

3.2. Variable Declaration

Demographic variables, including age at diagnosis, gender, race, marital status, tumor site, tumor size, grade and tumor number were extracted from SEER. The patients were stratified by age of younger (<60years old) and elder (≥60 years old). Race was grouped as white, black, other (American India/AK Native, Asian/Pacific Islander) and unknown. Marital status was grouped as married (including common law), unmarried (including single, separated, divorced, widowed, or domestic partner) or unknown. Tumor location was defined by ICD-O site and was grouped as stomach, small intestine, large intestine and other digestive organs. Tumor size was grouped as < 1.0 cm(micro-GISTs), and 1.0 to 1.9 cm(mini-GISTs). Grade was grouped as poor differentiated or undifferentiated, moderately or well differentiated, or unknown. Tumor number was grouped as GIST only and with additional cancers. For all sGIST, Surgical resection is defined as the most definitive surgical procedure that removes some or all of the primary tumor or sites, with or without lymph nodes and/or distant metastasis, non-surgry group was defined no surgery was performed on the primary site or first course of treatment was active surveillance/watchful waiting. In the stomach subgroup, the surgical group was divided into two groups, local tumor excision and gastrectomy groups. Local tumor excision group included polypectomy, excisional biopsy (biopsies are most often diagnostic. Code as a surgical procedure only when the entire tumor is removed and margins free or only microscopic residual at the margin), and laser excision. Gastrectomy includes partial gastrectomy, subtotal gastrectomy (including sleeve resection, Billroth I, Billroth II), hemigastrectomy, near-total gastrectomy, and total gastrectomy.

4. Statistical Analysis

Demographic and baseline clinical characteristics were compared between surgery group and non-surgery group using $\chi 2$ tests for categorical variables. Overall survival status (OS)and GISTs-specific survival status (GSS) were respectively captured in SEER database, after limiting our cohort to include only those patients whose GIST was their first and only primary tumor, we were able to consider a cancer-related death as attributable to GIST. GIST-specific survival was determined using cumulative incidence analysis. Overall survival was determined using Kaplan-Meier analysis and comparisons were made using the log-rank test. In these analyses, patients were censored at death or date of last known follow-up. First, we applied univariate regression to obtain factors that have an impact on the prognosis of sGISTs. Next, stepwise regression was used to identify factors entering multivariate Cox regression, and adjusted HRs (hazard ratios) as well as 95% CIs were calculated after adjusting for age at diagnosis, sex, race, marital status, tumor size, and tumor number.

The same approach was applied to the subgroup of sGISTs in the stomach to determine the effect of screening treatment modality on OS and GSS. We analyzed gastric sGISTs patients and compared OS in patients who underwent local tumor excision and gastrectomy using multivariate Cox regression analysis, while adjusting for age at diagnosis, sex, race, marital status, tumor site, tumor size, and grade. All statistical analyses were two-sided, and $p<0.05$ was indicative of statistical significance. All the statistical analyses above were performed with SPSS software (Statistical Package for the Social Sciences, IBM SPSS Statistics, version 23 for Macintosh; IBM, Armonk, NY).

5. Results

5.1. Population Selection Criteria

After a thorough search in the SEER database, we identified 10771 SEER registry patients diagnosed with GISTs from 2001 to 2016. And we further screened out 870 patients with tumors less than 2 cm in size. Among these patients, 46 patients were excluded for the following reasons: no tissue diagnosis in 5, Incomplete survival data in 21, Insufficient surgical information in 24, Undetermined death causes in 3. Finally, a total of 824 eligible cases, including 704 patients are offerd surgery and 120 patients without surgery performed. The flow chart of selection process was shown in Figure 1. To figure out whether local tumor excision or gastrectomy provides a better prognosis with gastric sGISTs patients, we further screened out 559 gastric sGISTs patients. 252 patients were excluded for the following reasons: no surgery performed in 69, with another cites cancers in 211. Finally, a cohort of 307 patients was included. The flow chart of further selection process was shown in Figure 2.

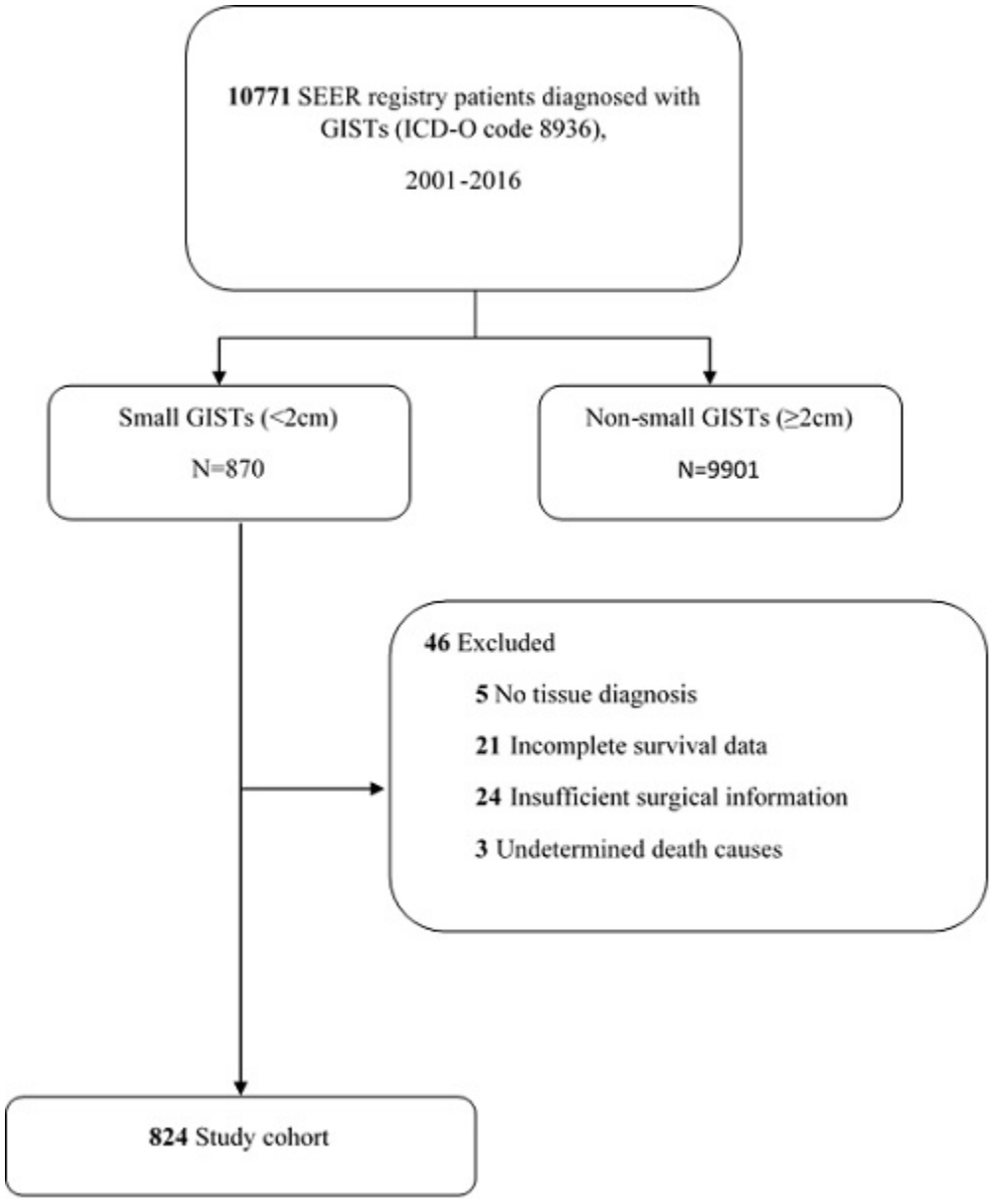


Figure 1. Flow chart of the sGISTs patient selection criteria.

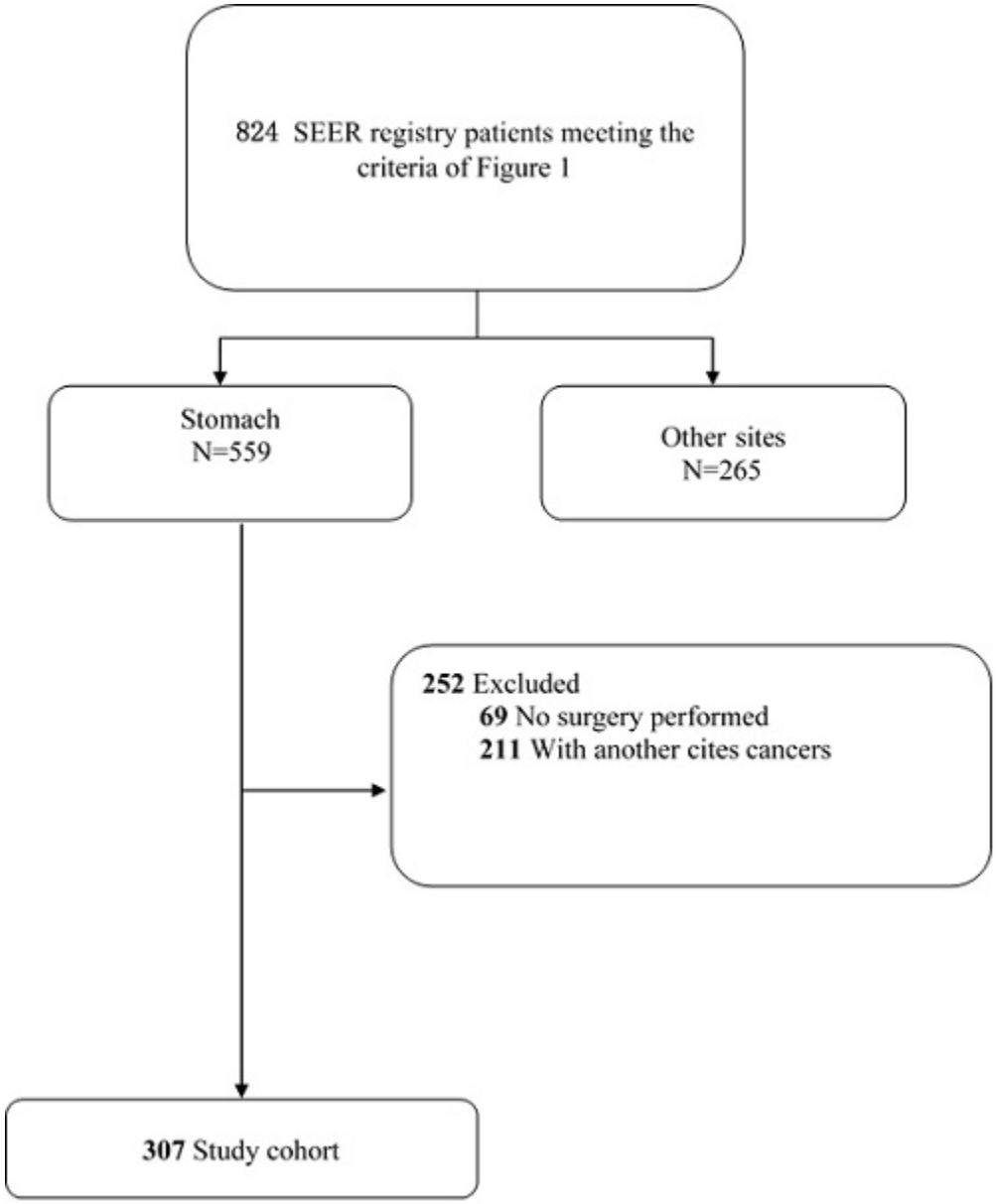


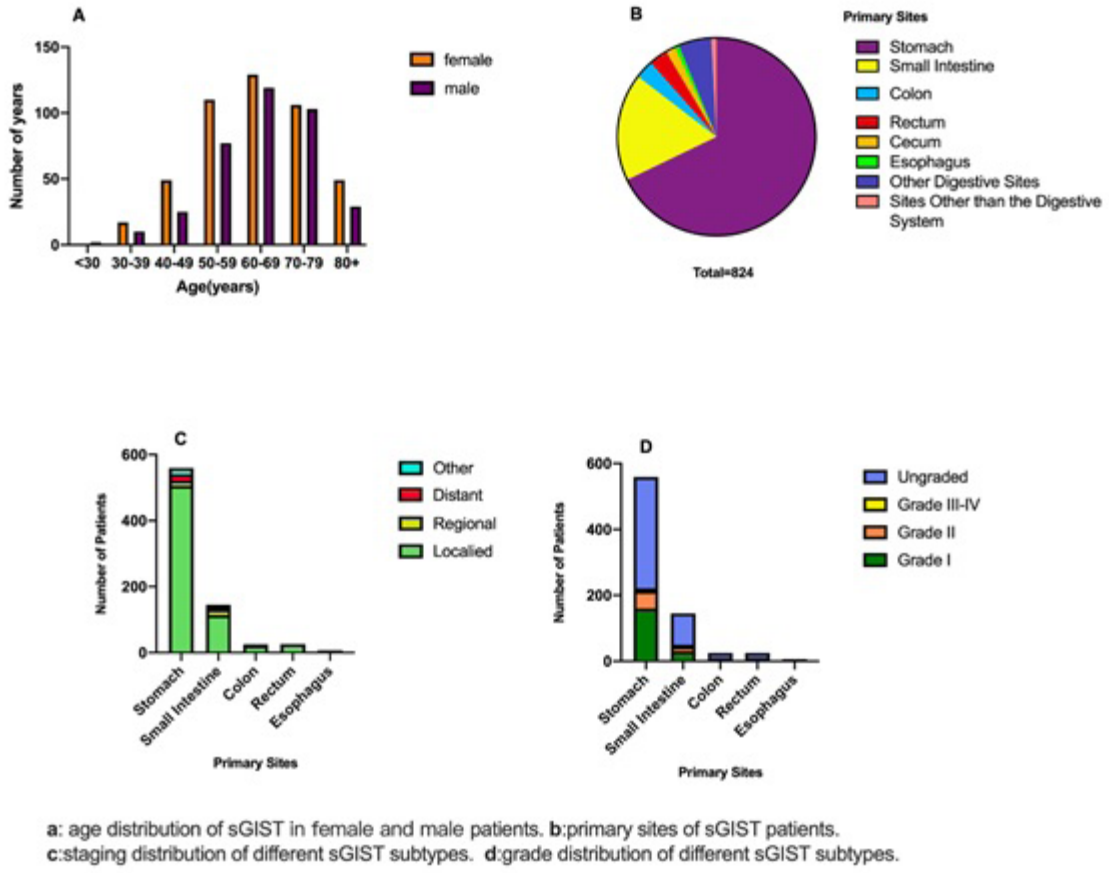
Figure 2. Flow chart of the stomach sGISTs patient selection criteria.

5.2. Overall Demographic and Clinicopathologic Characteristics

White people made up the majority of the cohort (70.1%). sGISTs can arise from all GI organs, with most cases arising from the stomach (67.8%) and small intestine (17.6%). The colon and rectum accounted for 3% each (Figure.3b). About over two third cases were with localized disease (84.8%), 4.9% with regional and 5.6% with distant disease. Most of the primary tumors in the stomach, small intestine, colon, and rectum had no lymph node metastasis, and the degree of differentiation was also dominated by grades 1 and 2. (Figure.3c,3d)

5.3. Characteristics of sGISTs Patients Stratified by Surgical Management

For all sGISTs patients, in the surgery group, over half (55.0%) were female, while 40.0% were male in the non-surgery group; over half (62.6%) patients in the surgery group were over 60 years, while 77.5% older patients in the non-surgery group. Two groups distributed almost the same between race (white patients (71.0% vs. 65.8%) black patients (18.0% vs 19.2%)) and marital status(married patients (61.2% vs. 55.8%)). Compared with the non-surgery group, the surgery group had more common sites in the stomach (69.3% vs. 58.2%, P <0.001), and the surgery group had a significantly higher proportion of localized patients. (93.0% vs. 58.5%, P <0.001) (Table 1). In the gastric sGISTs subgroup, 52(34.0%) patients under 60 years of age chose local tumor excision, and the remaining 101 (66.0%) patients chose gastrectomy. The distribution of sex was nearly equal between local tumor excision group (male 33.7 %; female 66.3%) and gastrectomy group (male 37.9 %; female 62.1 %). Finally, most patients presented with localized disease in the two groups. (92.3 and 91.6 %, respectively) (Table 2).



a: age distribution of sGIST in female and male patients. **b**:primary sites of sGIST patients. **c**:staging distribution of different sGIST subtypes. **d**:grade distribution of different sGIST subtypes.

Figure 3. Overall demographic and clinicopathologic characteristics of sGIST.

Table 1: Characteristics of small GISTs Patients (< 2cm) Stratified by Surgical Management.

Characteristic	Number of Patients		*P* value
	Resection (n=704)	No Resection (n=120)	
Age at diagnosis, y			0.002
<60	263 (37.4%)	27(22.5%)	
≥60	441(62.6%)	93(77.5%)	
Gender			0.305
Male	317(45.0%)	48(40.0%)	
Female	387(55.0%)	72(60.0%)	
Race			0.534
White	500(71.0%)	79(65.8%)	
Black	127(18.0%)	23(19.2%)	
Other[a]	71(10.1%)	16(13.3%)	
Unknown	6(0.9%)	2(1.7%)	
Marital status			0.498
married	431(61.2%)	67(55.8%)	
Unmarried[b]	237(33.7%)	45(37.5%)	
Unknown	36(5.1%)	8(6.7%)	
Tumor site			0.000
Stomach	495(69.3%)	71(58.2%)	

Small intestine	134(18.8%)	14(11.5%)	
Other digestive organs[c]	82(11.5%)	32(26.2%)	
Non-digestive organs[d]	3(0.4%)	5(4.1%)	
Tumor size, cm			0.676
<1.0	290(41.2%)	47(39.2%)	
1.0-1.9	414(58.8%)	73(60.8%)	
Grade			0.000
Poor differentiated or undifferentiated	15(2.1%)	2(1.7%)	
Well or moderately differentiated	287(40.0%)	6(5.0%)	
Unknown	402(57.1%)	112(93.3%)	
Tumor number			0.549
GIST only	431(61.2%)	70(58.3%)	
With additional cancers	273(38.8%)	50(41.7%)	
Tumor stage			
Distant	19(2.7%)	37(31.4%)	
Localizedl	630(93.0%)	69(58.5%)	0.000
Regional	29(4.1%)	5(4.2%)	
Unknow	22(3.1%)	7(5.9%)	

Table 2: Characteristics of Small Stomach GISTs Patients (< 2cm) Stratified by Different Surgeries Modalities.

Characteristic	Number of Patients		*P* value
	Local tumor excision (n=104)	Gastrectomy (n=203)	
Age at diagnosis, y			0.967
<60	52(50.0%)	101(49.8%)	
≥60	52(50.0%)	102(50.2%)	
Gender			0.461
Male	35(33.7%)	77(37.9%)	
Female	69(66.3%)	126(62.1%)	
Race			0.278
White	69(66.3%)	145(71.4%)	
Black	21(20.2%)	44(21.7%)	
Other[a]	12(11.5%)	11(5.4%)	
Unknown	2(1.9%)	3(1.5%)	
Marital status			0.818
married	64(61.5%)	132(65.0%)	
Unmarried[b]	35(33.7%)	63(31.0%)	
Unknown	5(4.8%)	8(3.9%)	
Tumor size, cm			0.097
<1.0	56(53.8%)	89(43.8%)	
1.0-1.9	48(46.2%)	114(56.2%)	
Grade			0.110
Poor differentiated or undifferentiated	0(0.0%)	5(2.5%)	

Well or moderately differentiated	42(40.4%)	96(47.3%)	
Unknown	62(59.6%)	102(50.2%)	
Metastasis			
Localized	96(92.3%)	185(91.6%)	0.207
Regional	2(1.9%)	5(2.5%)	
Distant	0(0.0%)	6(3.0%)	
Unknow	6(5.8%)	6(3.0%)	

a: Other including American Indian/AK Native, Asian/Pacific Islander

b: unmarried including widowed, single, divorced, separated

5.4. Survival Analysis

Among all sGISTs patients, the non-surgery group had a lower 5-year GSS (86.4% 95% CI: 79.1–93.7% vs. 95.3%, 95% CI: 93.3–97.3%) and OS (71.5%, 95% CI: 62.7 –80.3% vs. 78.5%, 95% CI: 74.8–82.2%) than the surgery group. The non-surgery group had more increased survival hazard ratios (OS: HR: 2.314 95% CI: 1.442-3.713, P<0.0001; GSS: HR:4.711 95% CI: 1.770-12.54, P<0.0001) (Figure 4). Multivariate Cox regression analysis showed that non-surgery management was associated with a more increased risk of death (GSS: HR 2.460, 95%CI 1.060-5.710, P =0.036; OS: HR 1.967, 95%CI 1.354-2.858, P =0.000) after adjusting for age, gender, race, marital status, and tumor sites, sizes, and tumor number. Patients who were older were at increased risk of GIST-specific death (HR:5.125, 95%CI 2.292-11.457; P <0.001) and overall death (HR: 3.289, 95%CI 2.195-4.927; P <0.001). Patients who were unmarried were at increased risk of GIST-specific death compared with those married ones (HR:2.543 ,95%CI 1.292-5.007; P =0.007) and overall death (HR:1.842, 95%CI 1.349-2.15; P <0.001). Tumor presented as small intestine were at increased risk of GIST-specific and overall death compared with those presented as stomach (OS: HR :1.732, 95%CI 1.232-2.434, P =0.002; GSS: HR:2.004, 95%CI 0.861-4.667, P =0.107). Besides, we also found that patients with white race were at decreased risk of GIST-specific and overall death (Table 3). In the stomach subgroup, the gastrectomy group had a lower 5-year OS (92.3%, 95% CI: 88.4-96.2% vs. 93.0%, 95% CI: 86.9-99.1%) than the local tumor excision group. The gastrectomy group had more increased survival hazard ratios than the local tumor excision group. (OS: HR:3.121 95% CI: 1.517-6.419, P=0.0075) (Figure 4). Interestingly, gastrectomy group was associated with a higher risk of death,which was about more than 2-fold compared with local tumor excision group (HR :2.88, 95%CI 1.16-7.14, P =0.02). It demonstrated that local tumor excision might provide a better prognosis than gastrectomy. Besides, the patients who were female, married, and younger than 60 years were at a decreased risk of overall death (Table 4).

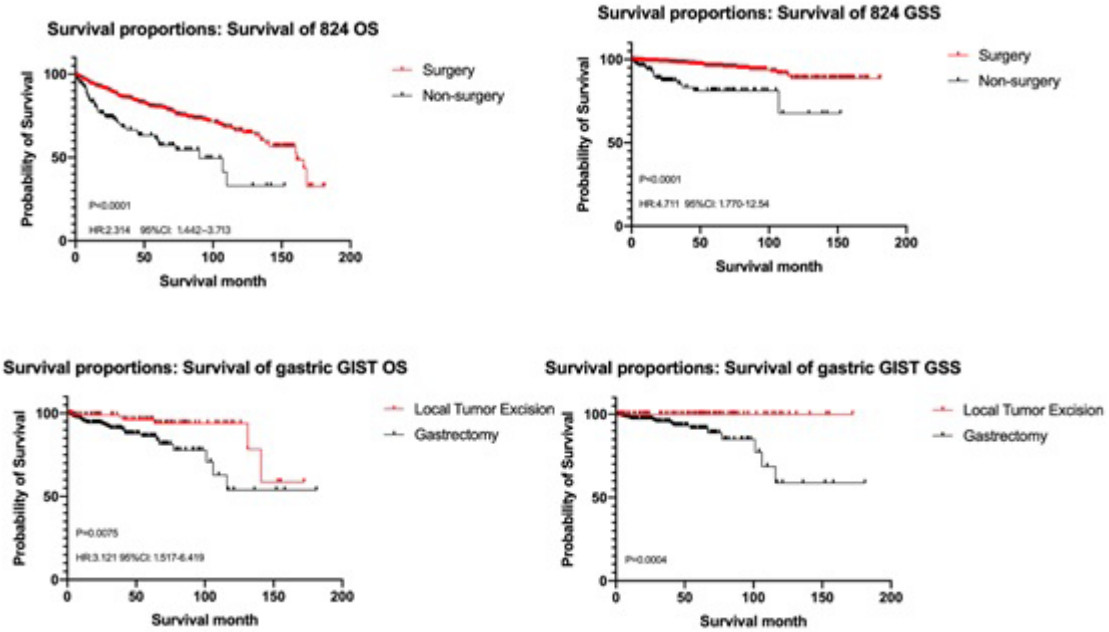


Figure 4: GIST-specific survival and Overall survival among sGISTs patients stratified by surgery management.
GIST-specific survival and Overall survival among stomach sGISTs patients stratified by treatment modalities.
OS: overall survival; GSS: GIST-special survival

Table 3: Multivariable Analysis of the Risk of GSS and OS in Small Gastrointestinal Stromal Tumor patients.

Variable	OS			GSS	
	Adjusted HR, 95%CI	***P* value**		**Adjusted HR, 95%CI**	***P* value**
Surgery					
Yes	1[Reference]	NA		1[Reference]	NA
No	1.967(1.354-2.858)	0.000		2.460(1.060-5.710)	0.036
Gender					
female	1[Reference]	NA		1[Reference]	NA
Male	1.739(1.288-2.348)	0.000		2.205(1.144-4.248)	0.018
Race					
White	1[Reference]	NA		1[Reference]	NA
Black	1.709(1.202-2.430)(5.131)	0.003		2.732(1.306-5.713)	0.008
Other	0.715(0.403-1.271)	0.274		0.382(0.089-1.638)	0.195
Marital status					
married	1[Reference]	NA		1[Reference]	NA
unmarried	1.842(1.349-2.515)	0.000		2.543(1.292-5.007)	0.007
Tumor site					
Stomach	1[Reference]	NA		1[Reference]	NA
Small intestine	1.732(1.232-2.434)	0.002		2.004(0.861-4.667)	0.107
Large intestine	0.556(0.288-1.074)	0.081		0.553(0.159-1.922)	0.351
Other digestive organs	1.892(1.136-3.153)	0.014		3.692(1.520-8.965)	0.004
Age at diagnosis					
<60	1[Reference]	NA		1[Reference]	NA
≥60	3.289(2.195-4.927)	0.000		5.125(2.292-11.46)	0.000
Size					
<1	1(Reference)	NA		1[Reference]	NA
1.0 -1.9	1.098(0.815-1.480)	0.538		1.641(0.820-3.284)	0.162
Tumor Number					
GIST only	1(Reference)	NA		1[Reference]	NA
With additional cancers	1.133(0.834-1.539)	0.426		-	-

Abbreviations: NA, not applicable; HR, hazard ratio.

[a], Month of diagnosis was included as continuous variables; all other covariates were categorical.

*, adjusted for gender, age at diagnosis, race, marital status, site of the tumor, tumor size, surgery and tumor number. OS, overall survival; GSS, GIST-specific survival; GIST, gastrointestinal stromal tumor; SEER, Surveillance, Epidemiology, and End Results.

Table 4: Multivariable Analysis of the Risk of OS in Small Stomach Gastrointestinal Stromal of stomach Tumor patients with Surgical Treatment [a]

Variable	OS	
	Adjusted HR, 95%CI	*P* value
Age at diagnosis, y		
<60	1[Reference]	NA
≥60	9.888(3.525-27.333)	0.000
Gender		
Male	1[Reference]	NA
female	0.293(0.138-0.622)	0.001
Race		
White	1[Reference]	NA
Black	1.255(0.557-2.829)	0.584
Other	0.288(0.037-2.246)	0.235
Marital status		
married	1[Reference]	NA
unmarried	5.538(2.432-11.806)	0.000
Surgical options		
Lcoal tumor excision	1[Reference]	NA
Gastrectomy	2.880(1.161-7.142)	0.022
Tumor size, cm		
<1.0	1[Reference]	NA
1.0-1.9	1.640(0.739-3.640)	0.224
Grade		
Well or moderately differentiated	1[Reference]	NA
Poor differentiated or undifferentiated	2.480(0.471-13.068)	0.284

Abbreviations: NA, not applicable; HR, hazard ratio.

[a], Month of diagnosis was included as continuous variables; all other covariates were categorical.

*, adjusted for gender, age at diagnosis, race, marital status, site of the tumor, tumor size, surgery, and tumor number. OS, overall survival; GSS, GIST-specific survival; GIST, gastrointestinal stromal tumor; SEER, Surveillance, Epidemiology, and End Results.

6. Discussion

In general, smaller diameter tumors are an understudied group due to their insidious onset and lack of symptoms. Demographic characteristics of patients with sGISTs are comparable to those reported in patients with GISTs. GISTs <2 cm have an undifferentiated distribution between the sexes and most commonly seen localized in the stomach [5, 15]. The 5-year overall mortality rate for GIST <2 cm was 30.9 %, which is comparable to the mortality rate of 35 % for GIST of all sizes [16]. In our study, the overall 5-year mortality rate for patients with sGISTs was 21.5% in the surgical group and 28.5% in the non-surgical group. This data is generally consistent with previous studies. Small GISTs have a high prevalence [17] and underestimated mortality, however, their treatment choice remains controversial. In this study, based the data from 824 patients with sGISTs, we draw a conclusion that surgery may provide a better survival outcome, that the surgery resection group had a higher 5-year GSS (95.3%vs. 86.4%) and OS (78.5% vs. 71.5%) than the non-surgery group. To our knowledge, our study is the first to assess the effect of surgical approach on the prognosis of gastric sGISTs in the SEER database, although there are previous studies comparing the effect of surgery or expectant management on the prognosis of sGISTs patients in the SEER database [5]. Currently, there is still no consensus on whether surgery should be the first choice for the treatment of sGISTs. European Society for Medical Oncology (ESMO) guidelines recommend endoscopic ultrasound and follow-up, rather than preferably performing the surgery procedure, reserving excision only for those esophageal nodules that increase in size [18]. The most recent guidelines from Canada are radical and suggest that all GISTs, even micro-GISTs should be excised, considering the risk of metastases [19]. Some studies showed that there was no significant difference in survival between surgery and expectant management in patients with non-gastric GIST [20], and the actual overall survival benefit of surgical resection remains to be determined [21]. Based on the evidence that Several retrospective studies have shown that even small GISTs have malignant potential, the proportion varies from 2.6% to 22.2%(22, 23), aggressive surgical resection seems necessary [23,24]. In our study, we reported that the 5-year GSS (86.4% vs. 95.3%) and OS (71.5% vs. 78.5%) were lower and the survival hazard ratio increased more in the non-surgical group than in the surgical group (OS: HR: 2.314, $P < 0.0001$), which seem to support surgical treatment rather than expectant management for sGISTs patients. The management of gastric sGISTs is also controversial, and surgical resection is recommended for gastric sGISTs in Japan [25], while the National Comprehensive Cancer Network (NCCN) guidelines recommend resection only for small gastric GISTs that are symptomatic or have high-risk characteristics (irregular borders, cystic spaces, ulceration, echogenic foci, or ultrasound heterogeneity) [7]. Surgical methods include local tumor resection (laparoscopic or endoscopic) and gastrectomy (laparotomy). The standard operation for GIST is complete resection with sufficient surgical margins by laparotomy and recently laparoscopic surgery is also considered the standard procedure for surgery in cases of sGISTs [12]. Many retrospective studies have shown that laparoscopic resection is better than laparotomy in the way of average hospital stay and postoperative recovery. In terms of long-term efficacy, it's also not inferior to laparotomy [13,26-28]. GIST tumors are often covered by pseudomembranes, and advances in instrumental modifications and endoscopic suture techniques have made endoscopic radical resection possible. Several studies have demonstrated the effectiveness of endoscopic minimally invasive treatment in GISTs [29,30]. However, endoscopic treatment also has some risks, such as residual postoperative lesions, tumor dissemination due to tumor rupture, intraoperative bleeding and gastrointestinal perforation [31]. In our

study, We analyzed sGISTs derived from the stomach and concluded that compared with the local tumor resection group, the gastrectomy group had a lower 5-year OS (92.3% vs 93.0%), accompanied by a higher survival risk (OS: HR: 3.121, P = 0.0075). In a review of the Surveillance, Epidemiology, and End Results (SEER) database, many scholars' observations focus differently from ours. Coe screened 378 patients diagnosed with malignant sGISTs from the SEER database, stratified by tumor status and whether surgery was undertaken, and calculated the overall mortality rate [5]. He did not investigate the effect of whether surgery was performed and to choose different surgical modalities on the prognosis of sGISTs at different sites. For each size of non-metastasis GISTs, Guller reported the three years overall and cancer-specific survivals of a total of 5138 patients diagnosed with GISTs between 1998 and 2011 within the SEER database [32]. Guller also reported the distribution of patients with GIST < 2 cm at different sites from SEER database [33], with no focus on exploring the survival of small GISTs after surgical treatment. There are several limitations to our study that warrant mention. This is a retrospective study of a large dataset subject to selection bias and omitted variable bias. When we investigated patients, we found that patients who had undergone surgery had significantly better GSS and OS than patients who had not undergone surgery, which may have potential selection bias. Limited by the level of detail of information in the SEER database, individual symptom differences are not well recorded, which may affect the patient's treatment options. Similarly, surgical details are not well documented, so it is still necessary to determine whether local resection of the tumor is in the form of laparoscopic or endoscopic surgery, and prospective studies are still needed in the future to confirm the degree of benefit of these two surgical methods on survival time. Tumors originating from different parts of the gastrointestinal tract can affect the choice of surgical approach for physicians. For example, extraluminal tumors are more amenable to anastomotic non-anatomical wedging, whereas intraluminal tumors are usually better accomplished using endoscopy. Studies have shown that for GIST surgery near the esophagogastric junction (EGJ) or pylorus, the operator is more suitable for selecting laparoscopic endoscopic cooperative surgery (LECS) [34], which is feasible and safe in terms of short-term outcomes [35]. However, our data refer to tumors at the gastroesophageal junction, and the details of the surgical information are missing to draw more in-depth conclusions.

7. Conclusion

Our study results supported that in appropriately selected patients, surgical treatment is recommended for patients with sGISTs because it improves survival endpoints. Moreover, local tumor resection improves overall survival in patients with gastric sGISTs compared with gastrectomy, although gastrectomy is now preferred more often. This provides a reference for treatment options for patients with gastric sGISTs.

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