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Pediatric Intestinal Foregut and Small Bowel Solid Tumors: A Review of 105 Cases

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Background. **The outcomes of pediatric intestinal foregut and small bowel solid tumors have never been studied on a population scale.**

Materials and Methods. **The Surveillance, Epidemiology, and End Results database (1973–2005) was queried for all patients under 20 y of age.**

Results. **A total of 105 cases of pediatric intestinal foregut and small bowel solid tumors were identified. Tumors occurred in the esophagus (8.6%), stomach (61%), and small bowel (30.5%). The most common histologies include sarcoma (43.8%), which consisted mostly of gastrointestinal stromal tumors (GIST), carcinoma (41.0%), which consisted mostly of adenocarcinomas, and neuroendocrine tumors (NET) (10.5%). Most tumors were poorly differentiated and presented with advanced disease. The overall median survival time was 207 mo. Gastric solid tumors had significantly worse 5- and 10-y survival compared with their small bowel counterparts, though this difference disappeared in those who received surgical resection. Patients with carcinoma had significantly worse survival compared with those with sarcoma or NET, regardless of site and surgical intervention. Univariate analysis identified race, differentiation, stage, and surgery as significant predictors of survival. Multivariate analysis revealed that African American race, advanced stage of disease, carcinoma histology, and failure to undergo surgical extirpation were all independent predictors of worse outcome. In patients with carcinoma, failure to undergo radiotherapy was also a predictor of worse outcome.**

Conclusion. **Surgery is associated with a significantly improved survival for pediatric patients with solid tumors of the intestinal foregut and small bowel. Radiotherapy appears to be an important adjuvant therapy for patients with carcinoma.**

Key Words: **pediatrics; foregut; small bowel; solid tumors; outcomes; SEER.**

INTRODUCTION

Primary tumors of the pediatric gastrointestinal (GI) tract are very rare, representing less than 5% of all pediatric neoplasms [1, 2]. The most common histologies in the United States and Europe include lymphoma, colorectal carcinoma, carcinoid tumor, gastrointestinal stromal tumor (GIST), leiomyoma, juvenile polyp, inflammatory pseudotumor, gastric tumor, and Peutz-Jeghers polyposis syndrome [1, 3].

Among these pediatric GI tumors, cancers arising from the upper GI tract are even rarer. For example, primary gastric carcinoma represents 0.05% of all pediatric malignancies [4–6]. Sarcomas of the GI tract account for 2% of soft tissue sarcomas, which in turn comprise only 7% of all pediatric malignancies [7, 8]. These low incidence rates do not allow for prospective review, and previous literature consists mostly of small case series. Similarly, due to the rarity of these cases, no standardized treatment protocols have been developed, and surgical and adjuvant therapy for these tumors is mostly mirrored from adult patient findings and practices. Surgical extirpation is considered the mainstay of therapy for pediatric patients with foregut and small bowel solid tumors, which entails complete resection with adequate margins and lymphadenectomy in certain tumor histologies.

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To date, there are no large population-based analyses of pediatric intestinal foregut and small bowel tumors, their outcomes, and prognostic factors. Therefore, we analyzed data from a national cancer registry, examining the effects of race, environmental factors, and clinical variables on outcomes for pediatric patients diagnosed with intestinal foregut and small bowel solid malignant tumors. We sought particularly to determine the relative benefits of surgical extirpation as well as radiation therapy.

MATERIALS AND METHODS

The Surveillance, Epidemiology, and End Results (SEER) April 2008 release was used to identify all incident cases of pediatric solid esophageal, gastric, and small bowel tumors diagnosed between 1973 and 2005. A total of 105 patients (0–19 y of age) were identified. Tumor histology was identified using morphology code from the International Classification of Disease for Oncology, 3rd edition. Only the percentages based on available data for each individual variable are given. Patients with missing data were excluded from each respective univariate and multivariate analysis.

SEER*Stat software (version 6.1.4, NCI, Bethesda, MD) was used to analyze incidence rates and trends from 1973 to 2005. All incidence data were age-adjusted and normalized to the 2000 U.S. Standard Population. Annual percentage change (APC) was calculated using the weighted least squares method. A P value of less than 0.05 was considered statistically significant.

The staging criteria used in this analysis consists of SEER summary staging and is different from the tumor, node, and metastasis (TNM) staging guidelines. In this study, local staging represents disease that does not extend beyond the primary organ, while regional disease includes tumor extension to adjacent organs, regional lymph nodes, or both. Documentation of distant metastases during the perioperative period led to classification of affected patients as having distant disease.

RESULTS

Patient Demographics and Tumor Characteristics

Over the 32-y study period, a total of 105 patients were identified. The annual incidence of pediatric foregut and small bowel solid tumors was approximately 0.027 cases per million in 2005. The mean age at diagnosis was 14.4 y of age. Patient demographics and tumors characteristics are summarized in Table 1.

There was approximately equal distribution of male (46.7%) and female (53.3%) patients. The majority of patients presenting with tumors of the foregut and small bowel were older than 10 y of age (84.8%), with 15- to 19-y-olds comprising the largest group (61.9%). Most of the patients were white (75.2%) and non-Hispanic (81%).

Tumors were identified mostly in the stomach (61%) and small bowel (30.5%), with the remaining tumors in the esophagus (8.6%). Female patients had significantly more esophageal and gastric solid tumors, whereas male patients had more small bowel tumors ($P = 0.034$). The most common histologies (Fig. 1) included sarcoma (43.8%) and carcinoma (41.0%), with neuroendocrine tumors (NET) accounting for 10.5% of patients. Subgroups of these three main histologic groups are shown in Table 2. Only three cases of squamous cell carcinoma were identified, all of which were located in the esophagus. Adenocarcinoma was the most common type of carcinoma identified, accounting for 53.5% of cases. Most of these tumors occurred in the stomach, more specifically, the cardia and non-antral portions of the stomach. There were three cases of adenocarcinoma arising from the small bowel, two of which were in the jejunum. While the distribution of patients with carcinoma diagnoses was similar before and after the year 2000, this was not

TABLE 1

Demographics, Social, and Clinical Characteristics

	Entire Cohort $n = 105$	
	14.4	
Mean age at diagnosis (y)	n	% of total
Sex		
Male	49	46.7
Female	56	53.3
Age		
<1 y old	4	3.8
1–4 y old	4	3.8
5–9 y old	8	7.6
10–14 y old	28	22.9
15–19 y old	65	61.9
Race		
White	79	75.2
African American	8	7.6
Other	18	17.1
Ethnicity		
Hispanic	20	19.0
Non-Hispanic	85	81.0
Tumor Site		
Esophagus	9	8.6
Stomach	64	61.0
Small bowel	32	30.5
Tumor Stage		
Local	31	29.5
Regional	28	26.7
Distant	39	37.1
Unknown	7	6.7
Tumor Grade		
Well differentiated; grade I	5	4.8
Mod differentiated; grade II	11	10.5
Poorly differentiated; grade III	33	31.4
Undifferentiated; grade IV	6	5.7
Unknown	50	47.6
Tumor Histology		
Carcinoma	43	41.0
Sarcoma	46	43.8
Neuroendocrine tumors	11	10.5
Others	5	4.7
Surgery		
Yes	77	73.3
No	27	25.7
Unknown	1	1.0
Radiation		
Yes	12	11.4
No	91	86.7
Unknown	2	1.9