Recurrence Patterns After Resection of Soft Tissue Sarcomas of the Chest Wall

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Background. **Soft tissue sarcoma (STS) of the chest wall is uncommon, and our knowledge is limited to small, single institutional case series. Although some series have examined prognostic factors for survival with this rare set of neoplasms, our knowledge of the patterns of relapse is limited.**

Methods. **We performed a retrospective review of a prospectively maintained database of consecutive patients treated for STS of the chest wall. Predictors of survival and recurrence were analyzed using Cox and competing-risk regression analyses.**

Results. **From 1989 to 2011, 192 patients underwent resection for STS of the chest wall. The most common histopathologic type was desmoid (33 [17%]), followed by undifferentiated pleomorphic sarcoma (32 [16%]), liposarcoma (22 [11%]), and myxofibrosarcoma (22 [11%]). The median follow-up was 50.9 months. The 5- and 10-year survival rates were 73% and 61%, respectively. Recurrences occurred in 45 patients (23%): 17 developed local recurrences, and 28 developed distant recurrences. Among the patients who developed recurrences, the median time to event was 11.6 months for local recurrences and 13.5 months for distant recurrences. The most common histologic type among recurrences was undifferentiated pleomorphic sarcoma (n = 12), and the most common site of distant recurrences was lung (n = 18). The primary treatment modality for both local and distant recurrences was surgical resection; median survival after recurrence was 19.4 months.**

Conclusions. **Recurrences of STS are common after surgical resection. Although local or distant recurrences can occur soon after surgery, both can often be treated with resection, producing reasonable outcomes.**

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Soft tissue sarcoma (STS) of the chest wall is rare, and our knowledge of surgical outcomes is limited to small case series. As a group, STS accounts for 6% to 10% of the 10,600 cases of sarcoma per year [1, 2]. Recent studies have examined predictors of survival, the effectiveness of biopsy in the diagnostic workup, and innovative methods of reconstruction after chest wall resection [3–7]. Surgical resection is considered the standard of treatment; however, despite complete resection, recurrence remains common. With large tumors, achieving adequate negative margins may be difficult, potentially raising the risk of recurrence. The subsequent defect can pose a challenge with soft tissue coverage, with or without bony chest wall reconstruction, and this can complicate subsequent surgical options if a recurrence occurs.

No study has examined the patterns of recurrence of STS of the chest wall in detail, and little guidance has been provided regarding the appropriate follow-up care for these patients or the need for postoperative surveillance. We conducted this study to improve our understanding of how and when these patients develop recurrences and to identify which factors predict recurrence.

Patients and Methods

We conducted a retrospective review of a prospectively maintained database for patients who were treated with surgery for primary STS of the chest wall and who received follow-up care at Memorial Sloan-Kettering Cancer Center (MSKCC) between January 1989 and December 2011. At MSKCC, all cases of STS undergo review by a pathologist subspecializing in sarcoma. A binary grading system (low versus high) was used, as described elsewhere [8]. The study was approved by the MSKCC institutional review board, which waived individual consent. Medical records were reviewed to confirm pathologic type, treatment, and recurrence details.

Survival outcomes were calculated using the Kaplan-Meier method. Disease-free survival outcomes were calculated using competing-risk regression analysis [9]; disease-free survival was defined as the interval between the surgical resection and documentation of recurrence. Variables for analysis included independent predictors of outcome identified in the published literature. Patients with a history of radiation therapy underwent radiation treatment for previous malignancies, such as breast

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Abbreviations and Acronyms

CI = confidence interval
CT = computed tomography
HR = hazard ratio
MSKCC = Memorial Sloan-Kettering Cancer Center
PNET = peripheral neuroectodermal tumor
SD = standard deviation
STS = soft tissue sarcoma

cancer or lymphoma. Regression analysis was performed on factors present in at least 10% of the study population.

The rate of recurrence was calculated in mutually exclusive 12-month intervals after surgery. The recurrence rate in each interval was calculated by dividing the number of patient recurrences observed during that 12-month period by the total follow-up time in the interval. Follow-up time for all patients at risk of recurrence at the beginning of an interval was included in the interval. Follow-up time was quantified in person-years, and recurrence rates were quantified in events per 100 patients observed for 1 year. The level of statistical significance for all tests was set at $p < 0.05$, and all confidence intervals (CIs) were 95%. STATA version 12 (StataCorp LP, College Station, TX) was used to perform all statistical analyses.

Results

During the study period, 192 patients were treated with surgery for primary STS of the chest wall. A total of 109 patients (57%) had tumors with high histologic grade, and 83 patients (43%) had tumors with low histologic grade; 115 patients (60%) had tumors larger than 5 cm, and 77 patients (40%) had tumors 5 cm or smaller. Baseline patient characteristics are noted in Table 1. The most common histopathologic types were desmoid (33 [17%]), undifferentiated pleomorphic sarcoma (32 [16%]), liposarcoma (22 [11%]), and myxofibrosarcoma (22 [11%]) (Table 2). The median follow-up time was 50.9 months. The cohort had a 5-year survival of 73% and a 10-year survival of 61%. The median survival was 14 years (Fig 1).

Recurrences developed during follow-up in approximately 1 in 4 patients (45 [23%]). The estimated 5-year cumulative incidence of recurrence was 31%; at 10 years it was 37% (Fig 2). Of the patients who developed recurrences, 17 (38%) had local recurrence alone and 28 (62%) had distant recurrences (9 of these 28 patients had both local and distant recurrences). The median time to recurrence was 11.6 months among patients with local recurrences and 13.5 months among patients with distant metastases. Approximately half of all recurrences occurred during the first year, and the vast majority (89%) of recurrences occurred during the first 3 years after surgery. The rate of recurrence was the highest in the first year after surgery (16 recurrences per 100 patients observed); it declined each year thereafter during years 2 to 5 after surgery (Fig 3).

Table 1. Baseline Patient and Treatment Characteristics

Characteristic	n (%)
Total patients	192
Women	89 (46)
Age, years, median (range)	51 (14–88)
Tumor histologic grade	
High grade	109 (57)
Low grade	83 (43)
Tumor size	
>5 cm	115 (60)
≤5 cm	77 (40)
Incomplete resection	35 (18)
Bone invasion by tumor	22 (11)
History of radiation therapy	16 (8)
Treatment type	
Surgery only	127 (66)
Induction chemotherapy + surgery	11 (6)
Surgery + intraoperative radiation therapy	2 (1)
Surgery + adjuvant chemotherapy	8 (4)
Surgery + adjuvant radiation	26 (14)
Induction chemotherapy + surgery + adjuvant radiation	10 (5)
Surgery + intraoperative radiation therapy + adjuvant chemotherapy	2 (1)
Surgery + adjuvant chemotherapy + adjuvant radiation	6 (3)

Information on detection of local recurrences was available for 15 of the 17 patients who had local recurrence alone. With the exception of two local recurrences detected by computed tomography (CT) scan, all local recurrences were identified on physical examination after patients presented with symptomatic masses or skin excoriation. In one of the two cases detected by imaging,

Table 2. Histopathologic Subtypes (N = 192)

Subtype	n (%)
Desmoid	33 (17)
Undifferentiated pleomorphic sarcoma	32 (16)
Liposarcoma	22 (11)
Myxofibrosarcoma	22 (11)
Dermatofibrosarcoma protuberans	19 (10)
Leiomyosarcoma	19 (10)
Malignant peripheral nerve sheath tumor	8 (4)
Ewing's/PNET	7 (4)
Fibrosarcoma	6 (3)
Extraskeletal chondrosarcoma	6 (3)
Synovial sarcoma	5 (3)
Solitary fibrous hemangiopericytoma	4 (2)
Angiosarcoma	3 (1.5)
Extraskeletal osteosarcoma	3 (1.5)
Rhabdomyosarcoma	2 (1)
Alveolar soft part sarcoma	1 (1)

PNET = peripheral neuroectodermal tumor.