Original Investigation

Influence of Physician Specialty on Treatment Recommendations in the Multidisciplinary Management of Soft Tissue Sarcoma of the Extremities

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IMPORTANCE Although prospective randomized data are available to guide the multidisciplinary management of soft tissue sarcoma (STS) of the extremities, controversy exists regarding adjuvant chemotherapy and radiation therapy.

OBJECTIVE To determine if clinical specialty introduces bias in recommendations for multimodality treatment of STS.

DESIGN Electronic survey.

SETTING Database of active members of the American Society of Clinical Oncology, the Society of Surgical Oncology, and the Connective Tissue Oncology Society.

PARTICIPANTS Members of specialty oncology societies with an active interest in STS.

EXPOSURE Physician specialty.

MAIN OUTCOMES AND MEASURES Survey responses regarding the multidisciplinary management of STS were scored on a 5-point Likert scale and analyzed using analysis of variance.

RESULTS The questionnaire was completed by 320 of 490 potential respondents (65%), including medical (18%), radiation (8%), orthopedic (22%), and surgical oncologists (45%). Respondents concurred on the use of radiation therapy for margins positive for tumor, for high-grade tumors, for improvement in local control, for tumors larger than 10 cm, and for tumors in close proximity to a neurovascular bundle. Respondents diverged on the use of radiation therapy for tumors 5 to 10 cm in size, for low-grade tumors, for radiation-associated STS, and for survival benefit. Only radiation oncologists felt that radiation therapy was underutilized as a treatment modality (mean [SEM] Likert scale score, 2.44 [0.12]; $P < .001$). There was agreement on the use of chemotherapy for synovial sarcoma, for high-grade tumors, for tumors larger than 10 cm, for patients younger than 50 years of age, and for survival benefit. Medical oncologists were more likely to recommend chemotherapy for margins positive for tumor (mean [SEM] score, 3.12 [0.12]; $P = .03$) and for improvement in local control (mean [SEM] score, 2.91 [0.12] $P = .08$). Surgical oncologists placed the least emphasis on chemotherapy in the overall treatment plan (mean [SEM] score, 2.60 [0.07]; $P = .001$).

CONCLUSIONS AND RELEVANCE Specialty bias exists in adjuvant treatment recommendations for STS. This highlights the importance of multidisciplinary STS tumor boards and interdisciplinary care to facilitate consensus decision making for individual patients.

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Invited Commentary
page 640

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The contemporary management of soft tissue sarcoma (STS) of the extremities requires coordinated multimodality treatment strategies involving several specialties in a multidisciplinary setting. For localized disease, surgical resection is the cornerstone of curative-intent therapy and, with the addition of radiation therapy, has been crucial in establishing limb-sparing surgery as the standard of care. This approach was validated in seminal randomized trials demonstrating equivalent survival outcomes between amputation and conservative limb-sparing surgery combined with radiation therapy.[1,2]

Although the magnitude of the benefit of adjuvant systemic chemotherapy for localized STS is modest, statistically significant improvements in disease-free and overall survival have been shown in some randomized phase III trials.[3,4] The Sarcoma Meta-analysis Collaboration[5] demonstrated an improvement in overall recurrence-free survival and a trend toward improved overall survival from pooled data. These findings were most notable for patients with STS of the extremities. Moreover, a more recent meta-analysis[6] demonstrated improvement in overall survival when doxorubicin hydrochloride was used in combination with ifosfamide.

Despite the availability of data from randomized trials, variation in the multimodality treatment of patients with STS of the extremities exists. Although patient-specific factors have been identified that contribute to the variation in treatment and outcome, physician-specific factors have not been well studied. Martinez et al[7] showed that African American patients with STS of the extremities receive lower rates of adjuvant radiation therapy and experience worse disease-specific survival than do white patients. Similarly, low socioeconomic status is associated with poorer overall survival for patients with STS.[8] Recently, our group showed that physician experience influences treatment sequencing in STS.[9]

The objective for our study was to assess the influence of physician specialty in the management of patients with STS of the extremities. We hypothesized that clinical specialty leads to bias in recommendations for adjuvant radiation therapy and systemic chemotherapy among patients undergoing curative-intent surgery for STS of the extremities. As secondary objectives, we sought to explore patient- and tumor-specific factors influencing physician recommendations for radiation therapy and chemotherapy, as well as the specialty-specific perceived benefits of these treatments.

Methods

Study Design and Survey Instrument

We conducted our study using survey methods. The survey was developed by 2 of the authors (N.W. and R.J.C.) following a literature review and a small focus group discussion. Pilot testing of the survey was performed internally at the University of California at Davis Medical Center in Sacramento for face and content validity to develop the final construct of 16 questions. Commercially available software (QuestionPro) was used for digitization and electronic dissemination via the World Wide Web in November 2009, as has been discussed previously.[10] A cover paragraph explaining the purpose of our study accompanied the survey, and a reminder was sent to participants who did not respond to the initial request. No incentive was provided to complete the survey.

The complete survey questionnaire is provided in **Table 1**. The initial set of questions was structured to identify physician specialty. Subsequent modules addressed utilization of radiation therapy or systemic chemotherapy in the management of localized STS amenable to treatment with curative intent. Patient- and tumor-specific factors influencing the use of either radiation therapy or chemotherapy were queried. We did not specifically inquire about brachytherapy or intraoperative radiation therapy because these techniques are not widely available, even among academic, tertiary referral centers.

Study Population

A pool of potential respondents was identified from the database of active members of the American Society of Clinical Oncology, the Society of Surgical Oncology, and the Connective Tissue Oncology Society. Only physicians with a self-declared subspecialty interest in STS were chosen. No unique information that could potentially identify a respondent was collected, and all data were deidentified. Approval for our study was obtained from the institutional review board at the University of California at Davis. Completion of the survey was considered as implied consent for participation.

Statistical Analysis

Questions were scored on a 5-point Likert scale. For each question, mean values were calculated to generate a single response score. Mean values were compared using independent samples 1-way analysis of variance. The data were analyzed for homogeneity of variances, and the appropriate corrections were used for post hoc analysis. The significance level was set at $P < .05$ and adjusted as appropriate for multiple comparisons. For purposes of analyses, respondents were divided into groups by specialty. All tests were 2-tailed. Significance levels were set at $P < .05$, and confidence intervals at 95%. Statistical analysis was performed using SPSS version 16.0 statistical software (SPSS Inc).

Results

Demographics

The questionnaire was sent to 490 potential respondents and completed by 320 (65%). Data on the breakdown by specialty, by years in practice, and by percentage of clinical practice devoted to sarcoma care are outlined in **Table 2**. For specialty, "others" consisted primarily of pediatric hematologists/oncologists and pathologists.

Role of Radiation Therapy in Management of STS

Although respondents agreed that radiation therapy plays an important role in treatment overall (mean [SEM] Likert scale score, 3.81 [0.04]), significant variation in responses among specialties was observed. Radiation oncologists placed the most emphasis on the role of radiation therapy (mean [SEM] score,

Table 1. Complete Questionnaire[a]

Please review this questionnaire designed to assess multimodality treatment strategies for patients with localized extremity soft tissue sarcoma. Your responses are greatly appreciated.
1) What is your Specialization?
a) Medical Oncology
b) Orthopedic Oncology
c) Radiation Oncology
d) Surgical Oncology
e) Other
2) How much of your clinical practice is devoted to the treatment of soft tissue sarcoma?
a) Exclusively sarcoma >75%
b) Significant amount 25%-75%
c) Not a major component <25%
d) Almost never <5%
3) When did you complete your oncology training?
a) <5 years ago
b) 5-15 years ago
c) 15-25 years ago
d) >25 years ago
e) n/a
4) At your institution, are you able to access a multidisciplinary Sarcoma Tumor Board to present your sarcoma cases for discussion and review?
a) Yes
b) No
5) If you have access to a Sarcoma Tumor Board, how helpful are the discussions/recommendations in the management of your patients on a scale of 1-5 (1 = Never helpful and 5 = Always helpful)?
Likert scale 1 2 3 4 5
6) In patients with localized extremity soft tissue sarcoma, what is the importance of radiation therapy as a part of your treatment plan on a scale of 1-5 (1 = Not essential 5 = Essential)?
Likert scale 1 2 3 4 5
7) When making decisions regarding radiation therapy in localized extremity soft tissue sarcoma, which of the following patient or tumor characteristics would prompt you to recommend radiation on a scale of 1-5 (1 = Never and 5 = Always)?
a) Primary tumor size 5-10 cm Likert scale 1 2 3 4 5
b) Primary tumor size >10 cm Likert scale 1 2 3 4 5
c) Patient age <50 years Likert scale 1 2 3 4 5
d) ECOG 2/KPS 70% Likert scale 1 2 3 4 5
e) Low tumor grade Likert scale 1 2 3 4 5
f) Well-differentiated liposarcoma Likert scale 1 2 3 4 5
g) Myxoid liposarcoma Likert scale 1 2 3 4 5
h) Leiomyosarcoma Likert scale 1 2 3 4 5
i) MFH/Pleomorphic sarcoma Likert scale 1 2 3 4 5
j) Other histologic subtype (fill-in) Likert scale 1 2 3 4 5
k) Microscopically positive margin Likert scale 1 2 3 4 5
l) Tumor deep to fascial plane Likert scale 1 2 3 4 5
m) Tumor close to neurovascular bundle Likert scale 1 2 3 4 5
n) Local control benefit with radiation Likert scale 1 2 3 4 5
o) Survival benefit with radiation Likert scale 1 2 3 4 5
8) In patients with localized extremity soft tissue sarcoma who are candidates for radiation therapy, on a scale of 1-5 do you prefer preoperative or postoperative radiotherapy (1 = Always preoperative 5 = Always postoperative)?
Likert scale 1 2 3 4 5
9) When choosing between preoperative and postoperative radiation therapy, which of the following factors would influence you to recommend preoperative or postoperative radiation for localized extremity soft tissue sarcoma on a scale of 1-5 (1 = Never and 5 = Always)?
a) Tumor downstaging in preoperative setting Likert scale 1 2 3 4 5
b) Improved tissue perfusion in preoperative setting Likert scale 1 2 3 4 5
c) Well-defined treatment volume in preoperative setting Likert scale 1 2 3 4 5
d) Increased acute morbidity/wound complications Likert scale 1 2 3 4 5 with preoperative radiotherapy
e) Increased late tissue morbidity with Likert scale 1 2 3 4 5 postoperative radiotherapy

(continued)

Table 1. Complete Questionnaire[a] (continued)

Please review this questionnaire designed to assess multimodality treatment strategies for patients with localized extremity soft tissue sarcoma. Your responses are greatly appreciated.
f) Survival benefit for preoperative radiation Likert scale 1 2 3 4 5
g) I always prefer preoperative radiation therapy Likert scale 1 2 3 4 5
10) What is your assessment of the utilization of radiation therapy in the multimodality treatment of localized extremity soft tissue sarcoma on a scale of 1-5 (1 = Overutilized 5 = Underutilized)?
Likert scale 1 2 3 4 5
11) In patients with localized soft tissue extremity sarcoma, what is the importance of systemic chemotherapy as a part of your treatment plan on a scale of 1-5 (1 = Not essential 5 = Essential)?
Likert scale 1 2 3 4 5
12) When making decisions regarding systemic chemotherapy in localized extremity soft tissue sarcoma, which of the following patient or tumor characteristics would prompt you to recommend chemotherapy on a scale of 1-5 (1 = Never and 5 = Always)?
a) Primary tumor size 5-10 cm Likert scale 1 2 3 4 5
b) Primary tumor size >10 cm Likert scale 1 2 3 4 5
c) Patient age <50 years Likert scale 1 2 3 4 5
d) ECOG 2/KPS 70% Likert scale 1 2 3 4 5
e) High tumor grade Likert scale 1 2 3 4 5
f) Well-differentiated liposarcoma Likert scale 1 2 3 4 5
g) Myxoid liposarcoma Likert scale 1 2 3 4 5
h) Leiomyosarcoma Likert scale 1 2 3 4 5
i) MFH/Pleomorphic sarcoma Likert scale 1 2 3 4 5
j) Other histologic subtype (fill-in) Likert scale 1 2 3 4 5
k) Microscopically positive margin Likert scale 1 2 3 4 5
l) Tumor deep to fascial plane Likert scale 1 2 3 4 5
m) Tumor close to neurovascular bundle Likert scale 1 2 3 4 5
n) Local control benefit with chemotherapy Likert scale 1 2 3 4 5
o) Survival benefit with chemotherapy Likert scale 1 2 3 4 5
13) In patients with localized extremity soft tissue sarcoma who are candidates for systemic chemotherapy, on a scale of 1-5 do you prefer preoperative or postoperative chemotherapy (1 = Always preoperative 5 = Always postoperative)?
Likert scale 1 2 3 4 5
14) When choosing between preoperative and postoperative systemic chemotherapy, which of the following factors would influence you to recommend preoperative chemotherapy for localized extremity soft tissue sarcoma on a scale of 1-5 (1 = Never and 5 = Always)?
a) Potential to initiate early treatment of micrometastases Likert scale 1 2 3 4 5
b) Time delay to surgery allows declaration of occult disease Likert scale 1 2 3 4 5
c) Treatment with measurable disease allows determination of effectiveness of chosen regimen Likert scale 1 2 3 4 5
d) Downstaging of tumor with preoperative therapy Likert scale 1 2 3 4 5
e) Treatment delay or dose reduction greater in postoperative setting Likert scale 1 2 3 4 5
f) Survival benefit for preoperative chemotherapy Likert scale 1 2 3 4 5
15) What is your assessment of the utilization of chemotherapy in the multimodality treatment of localized extremity soft tissue sarcoma on a scale of 1-5 (1 = Overutilized 5 = Underutilized)?
Likert scale 1 2 3 4 5
16) What is your assessment of the utilization of repeat surgical resection following an incomplete/marginal resection of a localized extremity soft tissue sarcoma on a scale of 1-5 (1 = Overutilized 5 = Underutilized)?
Likert scale 1 2 3 4 5

Abbreviations: ECOG 2/KPS, Eastern Cooperative Oncology Group 2/Karnofsky Performance Score; MFH, malignant fibrous histiocytoma; n/a, not applicable.

[a] Reprinted with permission from the *Annals of Surgical Oncology*.

4.26 [0.10]) (**Figure 1**A). Similarly, radiation oncologists were also more likely to think that radiation therapy was underutilized in the management of localized STS (mean [SEM] score, 2.44 [0.12]; $P < .001$) (Figure 1B).

Factors Influencing Use of Radiation Therapy

The variables most likely to influence a treatment recommendation in favor of radiation therapy were the presence of margins positive for tumor (mean [SEM] Likert scale score, 4.50 [0.04]), the presence of a high-grade tumor (mean [SEM] score, 4.35 [0.04]), improvement in local control (mean [SEM] score, 4.29 [0.04]), the presence of a tumor larger than 10 cm (mean [SEM] score, 4.22 [0.05]), and the presence of a tumor close to a neurovascular bundle (mean [SEM] score, 4.07 [0.04]), ranked in order of importance (**Table 3**). Survival benefit was the least important consideration (mean [SEM] score, 2.67 [0.06]). A tumor size of 5 to 10 cm and patient age younger than 50 years ranked low as indications for adjuvant radiation therapy.

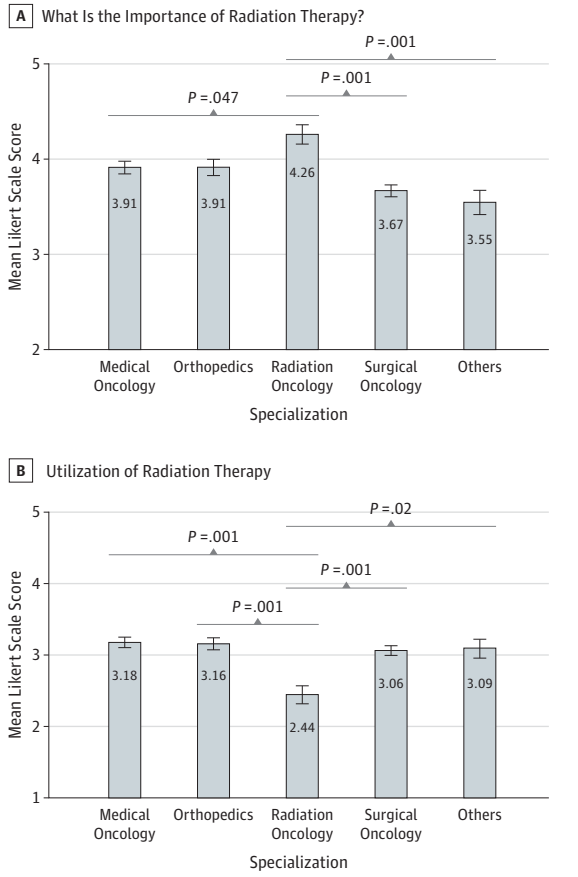
Variation in Responses to Use of Radiation Therapy

Interspecialty variation was observed in responses for all variables except for margins positive for tumor (Table 3). In par-

Table 2. Characteristics of Respondents

Characteristic	Respondents, No. (%)
Specialty	
Surgical oncology	144 (45)
Orthopedic oncology	70 (22)
Medical oncology	58 (18)
Radiation oncology	26 (8)
Others	22 (7)
Total	320 (100)
Years in practice	
<5	67 (22)
5-15	118 (38)
>15	122 (40)
Total	307 (100)
% of practice devoted to sarcoma care	
<25	39 (12)
25-75	124 (39)
>75	157 (49)
Total	320 (100)

Figure 1. Questions About the Importance of Radiation Therapy



Questions about the importance of radiation therapy in the treatment of soft tissue sarcoma (A; 320 respondents) and the utilization of radiation therapy in the treatment of soft tissue sarcoma (B; 317 respondents), stratified by physician specialty. Questions were scored on a 5-point Likert scale. For each question, mean values were calculated to generate a single response score (a range from 1 indicating not essential to 5 indicating essential). Error bars indicate SEM.

ticular, both radiation oncologists (mean [SEM] Likert scale score, 4.33 [0.14]) and medical oncologists (mean [SEM] score, 4.04 [0.08]) favored radiation therapy for tumors 5 to 10 cm in size compared with other specialists. For patients younger than 50 years of age, radiation oncologists were more likely to consider radiation therapy to be important (mean [SEM] score, 3.81 [0.18]) compared with surgical and medical oncologists. For tumors deep to the fascial plane, radiation oncologists were again more inclined to offer radiation therapy (mean [SEM] score, 4.46 [0.11]). Interestingly, radiation oncologists most strongly disagreed that radiation therapy was not indicated for low-grade tumors (mean [SEM] score, 2.13 [0.14]) or radiation-associated sarcoma (mean [SEM] score, 2.44 [0.22]). Of all respondents, radiation oncologists showed the highest agreement with an improvement in local control with adjuvant radiation therapy (mean [SEM] score, 4.63 [0.10]), whereas surgical oncologists showed the highest disagreement with a survival benefit from adjuvant radiation therapy (mean [SEM] score, 2.55 [0.09]).

Influence of Years in Practice and Percentage of Clinical Practice Devoted to Sarcoma Care on Use of Radiation Therapy

We stratified respondents by years of practice (<5, 5-15, and >15 years) and percentage of clinical practice devoted to sarcoma care (<25%, 25%-75%, and >75%) to assess the effect of experience on factors influencing the use of radiation therapy. In all of the variables listed in Table 3, no significant difference in aggregate response was seen for respondents when considering percentage of clinical practice (<25%, 25%-75%, and >75%) independent of specialty. For years of practice, those respondents who had been in practice for 5 to 15 years were more likely to recommend radiation therapy for tumors larger than 10 cm than were those in practice for more than 15 years (mean [SEM] Likert scale score, 4.39 [0.06] vs 4.09 [0.08]; P = .011). A survival benefit for radiation therapy was more important for respondents in practice for more than 15 years than for those in practice for less than 5 years (mean [SEM] score, 2.86 [0.1] vs 2.35 [0.1]; P = .007).

Role of Chemotherapy in Management of STS

Systemic chemotherapy was considered a less important factor than radiation therapy in the overall management strategy for STS of the extremities (mean [SEM] Likert scale score, 2.78 [0.05]). Again, variation in response by specialty was observed. Medical oncologists (mean [SEM] score, 3.00 [0.09]) placed the greatest emphasis on systemic chemotherapy, and surgical oncologists the least (mean [SEM] score, 2.60 [0.07]; P = .001) (**Figure 2**A). Overall, specialists agreed that systemic chemotherapy was appropriately utilized (mean [SEM] score, 3.17 [0.05]) (Figure 2B).

Factors Influencing Use of Chemotherapy in Treatment

No single variable was rated as greater than 4.0 in the recommendation to utilize systemic chemotherapy. The presence of synovial sarcoma (mean [SEM] Likert scale score, 3.67 [0.12]),

Table 3. Factors Influencing Recommendation for Radiation Therapy by Respondents Stratified by Specialty

Variable	Specialty, Mean (SEM) Likert Scale Score					*P* Value[a]
	Overall	Medical Oncology	Orthopedic Oncology	Radiation Oncology	Surgical Oncology	
Tumor 5-10 cm in size (n = 313)	3.81 (0.05)	4.04 (0.08)	3.93 (0.10)	4.33 (0.14)	3.62 (0.08)	<.001
Tumor >10 cm in size (n = 312)	4.22 (0.05)	4.30 (0.09)	4.25 (0.10)	4.59 (0.11)	4.20 (0.07)	<.001
Age <50 y (n = 312)	3.45 (0.05)	3.59 (0.12)	3.74 (0.12)	3.81 (0.18)	3.22 (0.08)	<.001
High-grade tumor (n = 315)	4.35 (0.04)	4.27 (0.10)	4.34 (0.90)	4.63 (0.12)	4.40 (0.05)	.005
Not for low-grade tumor (n = 314)	3.29 (0.06)	3.07 (0.15)	3.44 (0.13)	2.31 (0.14)	3.46 (0.09)	<.001
Margins positive for tumor (n = 314)	4.50 (0.04)	4.46 (0.08)	4.35 (0.12)	4.74 (0.10)	4.55 (0.05)	.08
Deep to fascial plane (n = 314)	3.94 (0.05)	4.07 (0.10)	4.00 (0.10)	4.46 (0.11)	3.81 (0.08)	<.001
Close to neurovascular bundle (n = 313)	4.07 (0.04)	4.11 (0.09)	4.14 (0.09)	4.38 (0.16)	4.02 (0.06)	.001
Not for radiation-induced sarcoma (n = 314)	3.35 (0.06)	3.18 (0.14)	3.54 (0.13)	2.44 (0.22)	3.51 (0.09)	<.001
Improvement in local control (n = 315)	4.29 (0.04)	4.39 (0.08)	4.26 (0.10)	4.63 (0.10)	4.20 (0.06)	.03
Survival benefit (n = 313)	2.67 (0.06)	3.04 (0.12)	2.47 (0.14)	3.04 (0.19)	2.55 (0.09)	.006

[a] Indicating significant results of analysis of covariance. Between-group differences are further discussed in the text.

the presence of a high-grade tumor (mean [SEM] score, 3.54 [0.06]), and the presence of a tumor larger than 10 cm (mean [SEM] score, 3.24 [0.06]) were the most important variables identified by respondents in their decision to recommend systemic chemotherapy (**Table 4**). Improvement in local control (mean [SEM] score, 2.54 [0.06]), the presence of surgical margins positive for tumor (mean [SEM] score, 2.84 [0.06]), and the presence of tumors 5 to 10 cm in size (mean [SEM] score, 2.85 [0.05]) were the least important. The survival benefit from chemotherapy was considered to be more substantial than that for radiation therapy (mean [SEM] score, 3.17 [0.06]).

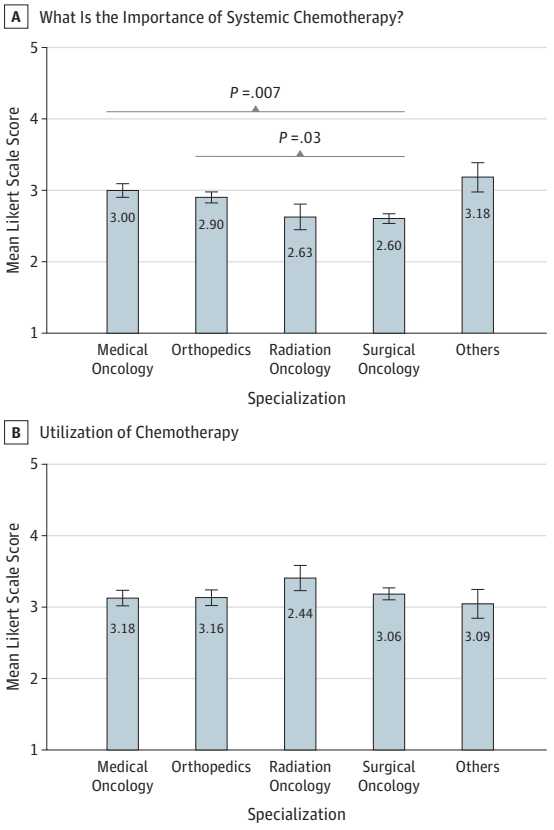
Variation in Responses by Specialty in Use of Chemotherapy

Overall, no significant differences in responses were seen in recommending systemic chemotherapy for patients younger than 50 years of age or for any tumor size. Medical oncologists were more likely to recommend systemic chemotherapy for high-grade tumors (mean [SEM] Likert scale score, 3.75 [0.15]), and orthopedic oncologists were more likely to recommend it for synovial sarcoma (mean [SEM] score, 3.73 [0.12]). Medical oncologists were also more likely to attribute an improvement in local control to systemic chemotherapy (mean [SEM] score, 2.91 [0.12]; $P = .08$) and to recommend it for margins positive for tumor (mean [SEM] score, 3.12 [0.12] $P = .03$).

Influence of Years in Practice and Percentage of Clinical Practice Devoted to Sarcoma Care on Use of Systemic Chemotherapy

Years in practice only influenced the opinion about local control with chemotherapy. Respondents with more than 15 years in practice felt that systemic chemotherapy had a greater effect on local control than those with less than 5 years in practice (mean [SEM] Likert scale score, 2.71 [0.06] vs 2.31 [0.10]; $P = .02$). Respondents who had greater than 75% of their clinical practice devoted to sarcoma care had differing responses on several of the factors compared with those who had less than 25% of their clinical practice devoted to sarcoma care. They placed more importance on systemic chemotherapy overall (mean [SEM] score, 3.05 [0.12] vs 2.65 [0.07]; $P = .014$) and on the survival benefit from therapy (mean [SEM] score, 3.32 [0.15] vs 3.00 [0.08]; $P = .02$). They were also more likely to recommend systemic chemotherapy for tumors larger than 10 cm

Figure 2. Questions About the Importance of Chemotherapy



Questions about the importance of chemotherapy in the treatment of soft tissue sarcoma (A; 320 respondents) and the utilization of chemotherapy in the treatment of soft tissue sarcoma (B; 315 respondents), stratified by physician specialty. Questions were scored on a 5-point Likert scale. For each question, mean values were calculated to generate a single response score (a range from 1 indicating not essential to 5 indicating essential). Error bars indicate SEM.

Table 4. Factors Influencing Recommendation for Chemotherapy by Respondents Stratified by Specialty

Variable	Specialty, Mean (SEM) Likert Scale Score					*P* Value[a]
	Overall Mean	Medical Oncology	Orthopedic Oncology	Radiation Oncology	Surgical Oncology	
Tumor 5-10 cm in size (n = 312)	2.85 (0.05)	3.25 (0.13)	3.10 (0.11)	2.67 (0.23)	2.55 (0.07)	.11
Tumor >10 cm in size (n = 311)	3.24 (0.06)	3.62 (0.14)	3.54 (0.11)	2.89 (0.26)	2.99 (0.08)	.10
Age <50 y (n = 311)	3.04 (0.06)	3.25 (0.14)	3.52 (0.11)	2.59 (0.19)	2.80 (0.07)	.13
High-grade tumor (n = 312)	3.54 (0.06)	3.75 (0.15)	3.74 (0.11)	3.19 (0.27)	3.39 (0.08)	.04
Pleomorphic sarcoma or MFH (n = 314)	3.29 (0.06)	3.30 (0.14)	3.51 (0.11)	3.07 (0.26)	3.17 (0.08)	.02
Synovial sarcoma (n = 312)	3.67 (0.12)	3.73 (0.12)	4.01 (0.09)	3.30 (0.23)	3.55 (0.08)	.049
Margins positive for tumor (n = 314)	2.84 (0.06)	3.12 (0.12)	2.84 (0.19)	2.41 (0.20)	2.81 (0.08)	.03
Improvement in local control (n = 313)	2.54 (0.06)	2.91 (0.12)	2.61 (0.12)	2.37 (0.21)	2.32 (0.08)	.09
Survival benefit (n = 313)	3.17 (0.06)	3.27 (0.13)	3.56 (0.10)	2.77 (0.23)	2.99 (0.08)	.08

Abbreviation: MFH, malignant fibrous histiocytoma.

[a] Indicating significant results of analysis of covariance. Between-group differences are further discussed in the text.

(mean [SEM] score, 3.58 [0.18] vs 3.03 [0.08]; $P = .009$) and for patients younger than 50 years of age (mean [SEM] score, 3.29 [0.16] vs 2.86 [0.08]; $P = .004$).

Comment

Although data are available from randomized controlled trials to guide treatment decisions in the multidisciplinary management of STS of the extremities, there is a lack of consensus regarding relative indications for the use of adjuvant radiation therapy and systemic chemotherapy. By studying specialty-specific responses to scenarios on the use of radiation therapy and systemic chemotherapy in the treatment of localized STS, we show that physician specialty is an important factor contributing to variability in treatment recommendations.

The importance of radiation therapy in the management of STS of the extremities was rated highest by radiation oncologists, who were also more likely to assert that radiation therapy is underutilized in the multimodality treatment of patients with STS. Similarly, among all the responding physicians, medical oncologists assigned the greatest importance to systemic chemotherapy, even though, overall, most respondents felt that current utilization was appropriate.

Considerable interspecialty variation was observed with regard to indications for treatment, which suggests that, even among experts, there is a diversity of opinions regarding the multidisciplinary management of STS of the extremities. In general, clinicians' recommendations tend to be biased in favor of their specialty-specific modality. Although this may seem intuitive, it has not been well studied in the medical literature, in general, or in the sarcoma literature, in particular. Given the preponderance of treatment guidelines and tumor board recommendations that are based on expert opinion rather than level I evidence for a rare disease process such as STS of the extremities, it would seem to be important to deconstruct the process by which clinicians at the individual and group level arrive at treatment recommendations.

Current National Comprehensive Cancer Network guidelines recommend consideration of adjuvant radiation therapy for patients with high-grade STS, with large tumors, or with final margins close to or positive for tumors.[11] Our respondents demonstrated the highest agreement across all specialties in cases of STS of the extremities with margins positive for tumor, with a high-grade tumor, with a tumor size of greater than 10 cm, or with a tumor close to a neurovascular bundle. Although respondents rated improvement in local control as a significant benefit of radiation therapy, improvement in overall survival was not. These responses are consistent with the published literature regarding the oncologic benefits of adjuvant radiation therapy.[12]

However, subtle but important differences emerged when we analyzed the responses by physician specialty. Radiation oncologists were more likely to offer radiation therapy to patients younger than 50 years of age and for tumors 5 to 10 cm in maximal size. Furthermore, they were more inclined to disagree with the statements that radiation therapy is not indicated for radiation-associated STS of the extremities and that radiation therapy is not indicated for low-grade STS of the extremities. These are controversial areas in which specific evidence-based data and guidelines are not available and for which clinicians may have substantially different views of the risk-benefit ratio of treatment.[13,14]

Overall, respondents viewed chemotherapy as less important than radiation therapy in the multidisciplinary management of STS of the extremities. This appropriately reflects the conflicting nature of data from randomized trials examining the benefits of adjuvant chemotherapy in STS of the extremities. Interestingly, both radiation and surgical oncologists placed less emphasis on a survival benefit with chemotherapy than did medical oncologists and orthopedic oncologists. Medical oncologists felt that chemotherapy played a greater role in local control than did surgical oncologists. These opinions are supported by outcomes data. In the previously quoted meta-analysis of systemic therapy in STS,[6] the hazard ratio with adjuvant chemotherapy for local recurrence was 0.73 (95% CI, 0.56-0.95), which corresponds to a 4% reduction in absolute risk. For synovial sarcoma, orthopedic oncologists felt most strongly about recommending chemotherapy, which may be explained by practice patterns (ie, orthopedic oncologists treat a higher proportion of younger patients with bone sarcoma and STS for whom chemotherapy is more routinely administered).

For clinical scenarios in which adjuvant treatment is clearly indicated, such as radiation therapy for large or high-grade STS and chemotherapy for younger patients with favorable subtypes, any lack of agreement by specialists is concerning. Either the current data are felt to be inadequate to inform clinical decision making or there is unfamiliarity with data outside one's scope of practice. An argument could also be made for better quality studies. Furthermore, if the first point of contact for a patient is a specialist who places less importance on adjuvant therapy, then the treatment algorithm may not progress beyond surgical resection. Our data also point to the importance of a multidisciplinary STS tumor board. Even though individual physicians may have differing opinions about treatment, in aggregate, the best course for the patient will be charted by discussion and consideration of all treatment options. Finally, experience as measured by the percentage of clinical practice devoted to sarcoma care may also influence responses. In particular, physicians who had greater than 75% of their clinical practice devoted to sarcoma care placed more importance on systemic chemotherapy and a potential survival benefit with treatment. They were also more likely to recommend systemic chemotherapy for patients younger than 50 years of age and for tumors larger than 10 cm.

Certain limitations of our study must be acknowledged. Some are related to the survey methods that we used to collect our data. The use of a survey instrument has the inherent limitation of respondent bias because only physicians who were interested or inclined to respond took the time to do so. Although electronic dissemination results in easy and rapid delivery, many e-mail addresses were not valid or had filters, which meant that the survey never arrived to the intended recipient. By opting to only include physicians who were active members of selected oncology societies with a self-declared interest in sarcoma care, we also potentially introduced a selection bias. It is likely that there are additional physicians who treat a substantial number of patients with STS in their clinical practice who were not solicited to participate or who did not participate in this survey. Finally, although statistically significant differences were seen in the mean response rates for many of the questions, whether these translate into meaningful clinical differences is not demonstrated by our data.

To conclude, physician specialty appears to influence recommendations for adjuvant radiation therapy and chemotherapy in STS of the extremities. This bias likely arises from divergent interpretations of published literature and perhaps from a lack of familiarity with data outside of one's clinical scope of practice. Multidisciplinary clinics and tumor boards may be an effective tool for discussion among different specialties to reach consensus decisions and to minimize variation due to specialty bias. However, the effect of specialty bias on multimodality treatment recommendations of expert panels and tumor boards warrants further study.

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Invited Commentary

Overcoming Specialty Bias

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Using a national survey of sarcoma experts with an exceptionally high response rate, Wasif and colleagues[1] present an interesting study designed to evaluate whether physician specialty influences adjuvant treatment recommendations in the multidisciplinary management of soft tissue sarcoma and the perceived benefit of these modalities. They reveal a specialty bias in treatment recommendations for soft tissue sarcoma of the extremities that provides unique insights into understanding the existing variation in treatment approaches for this relatively rare disease.

This study[1] raises some important issues regarding the current treatment of soft tissue sarcoma and the factors influencing recommendations for adjuvant therapy. Not surprisingly, Wasif and colleagues[1] identified physician specialty–associated variation in adjuvant treatment recommendations for many clinical scenarios involving soft tissue sarcoma of the extremities. These findings suggest that the quality of available evidence may be insufficient to standardize clinical decision making and, importantly, that physician specialty may play a prominent role in treatment decisions. This may be based on training paradigms (ie, better knowledge of the literature in one's own domain), or it may also be self-serving (eg, physician reimbursement may prompt utilization of their services). Nonetheless, the coordinating physician's specialty may have the greatest effect on the treatment plan and use of adjuvant therapies by controlling subsequent referrals.

Related article page 632

Given its rarity and histologic heterogeneity, soft tissue sarcoma presents several unique challenges in patient management. To address this challenges, the National Comprehensive Cancer Network has compiled comprehensive patient treatment guidelines that are universally available and updated annually by a multidisciplinary specialist panel from each member institution.[2] Although the majority of evidence on which the guidelines are based is level 2A (based on lower level evidence) for the vast majority of recommended interventions, there is consensus among the multispecialty panels. Additional histology-specific studies on the role and sequence of adjuvant treatment may guide treatment for specific histologic subtypes. In the end, we concur with Wasif and colleagues[1] and with the National Comprehensive Cancer Network sarcoma panel: All sarcoma patients should be managed by a multidisciplinary team with expertise in sarcoma to mitigate individual physician and physician specialty treatment bias.

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