The Philippine Journal of Orthopaedics

ORIGINAL ARTICLE

Characteristics, Treatment Patterns, and Clinical Outcomes of Patients Diagnosed with Fungating Soft Tissue Sarcomas*

Karla Teresa S. Araneta, MD, FPOA,[1] Tristan Dwight T. Sebastian, MD,[2] Edward HM Wang, MD, MSc (Epi), FPOA[2]

[1]*Department of Orthopaedics, Western Visayas Medical Center, Iloilo City, Philippines*
[2]*Department of Orthopaedics, University of the Philippines-Philippine General Hospital*

ABSTRACT

Objectives. A fungating soft tissue sarcoma of the extremities (F-ESTS) is a rare clinical presentation with limited literature. This study aims to describe the important clinical characteristics, treatment patterns, and outcomes of twenty patients diagnosed with F-ESTS and treated by a single surgeon at a sarcoma unit.

Methodology. We conducted a retrospective clinical study on twenty F-ESTS patients treated by a single surgeon at a sarcoma unit over 25 years (1993–2018).

Results. The local incidence of F-ESTS was 10.9%. The mean age of patients was 49.2 years old. The most common site of occurrence was the thigh (50%) with an average size of 11.8 cm. Most tumors were deep (65%) and high grade (85%). Liposarcomas were the most common histologic diagnosis (35%). Limb salvage was done in 60% of the patients with 50% requiring reconstructive procedures. Fifteen percent of patients developed complications, 25% had local recurrence, and 65% developed distant metastases. The mean survival for this cohort was 49.2 months. Sixty percent of patients died of disease.

Conclusion. The majority of F-ESTS patients were younger than 65 years old, had deep and high-grade tumors, predominantly liposarcomas, most commonly found in the thigh, and had a history of surgery or biopsy. In the last 10 years, limb salvage surgery has become the treatment of choice even for patients with fungating sarcomas. Most F-ESTS patients in our study were still able to undergo limb salvage surgery. Local recurrence was seen in five (25%) patients, while thirteen (65%) patients had distant metastases. Twelve (60%) patients had died of disease.

Keywords. soft tissue sarcoma, fungating; limb salvage, neoplasm recurrence, local, neoplasm metastasis, neoplasm seeding, neoplasm staging, neoplasm, residual, neoplasm invasiveness

INTRODUCTION

Soft tissue sarcomas (STS) are a rare and heterogeneous group of tumors of mesenchymal origin, occurring most commonly in the extremities (ESTS) followed by the trunk.[1,2] The heterogeneity of STS makes it difficult to clinically confirm the malignant potential of the mass. Locally, there is a 4.7/100,000 incidence of ESTS in adults with 3500 cases per year.[3] Treatment modalities for ESTS include surgical resection and adjuvant radio- or chemotherapy.[4] The prognosis of ESTS depends on several patient, tumor, and treatment variables such as age, metastasis at diagnosis, tumor size, tumor site, depth, tumor grade, and surgical margins.[2] Recently, the presence of fungation or malignant ulceration in an ESTS (F-ESTS) is a negative predictor for survival.[4,5]

Cutaneous involvement from a soft tissue sarcoma is rare and is often seen in patients with primary carcinomas like breast cancer and melanoma.[4] The tumor can erode through the dermis and communicate to the skin surface which is

eISSN 2012-3264 (Online)
Printed in the Philippines.

Received: February 15, 2024.
Accepted: May 10, 2024.
Published Online: May 23, 2024.
https://doi.org/10.69472/poai.2024.12

Corresponding author: Tristan Dwight T. Sebastian, MD
Resident, Department of Orthopaedics
University of the Philippines – Philippine General Hospital
E-mail: sebastiantristan811@gmail.com

* *Presented at 73rd Philippine Orthopaedic Association Convention Podium on June 16-18, 2022.*

called malignant ulceration or simply fungation, wherein the tumor grows like a fungus.[4,5] The clinical burden of F-ESTS has not been extensively discussed in the literature due to its rarity. Currently, only three studies have analyzed the impact of F-ESTS on patient outcomes; Potter et al., in the United States; Parry et al., in the United Kingdom, and Okajima et al., in Japan. However, Within Asia, despite the prevalence of more advanced disease owing to geopolitical and cultural factors, there are fewer outcome-based data as emphasized by Ngan et al., in their systematic review of Soft-tissue Sarcomas in the Asia-Pacific Region (STAR) in 2015.[6]

This study described the important clinical characteristics, treatment patterns, and outcomes of a local study of twenty patients diagnosed with F-ESTS and treated by a single surgeon at a sarcoma unit.

Significance

The presence of fungating or ulcerating lesions in soft tissue sarcoma has been associated with a high tumor grade and may increase the possibility of contaminated surgical margins or inadequate resection. The limited literature on this subgroup of patients has described abysmal survival rates for F-ESTS patients.[5]

From our own experience, these patients usually have been managed poorly or have had a delayed course of consult. By observing the clinical characteristics and treatment patterns in fungating sarcomas, surgeons can find room to improve the decision-making process for these patients to maximize survivorship and limit morbidity. Physicians can benefit by applying this knowledge to the urgent and rational management of such cases.

OBJECTIVES

General objective

This study aimed to describe the clinical characteristics, treatment patterns, and outcomes of F-ESTS patients treated by the senior investigator.

Specific objectives

1. Clinical characteristics of F-ESTS patients were described in terms of:
    a) Age
    b) Gender
    c) Tumor site (Upper, lower extremity)
    d) Tumor size
    e) Tumor depth (subcutaneous or subfascial)
    f) Tumor grade
    g) Tumor histology
    h) Metastases at presentation to sarcoma unit
    i) History of prior biopsy and/or treatment
2. The treatment of F-ESTS patients was described in terms of:
    a) Surgical treatment
        i) Limb salvage
        ii) Amputation
    b) Surgical margins
        i) Radical
        ii) Wide
    c) Margin status
        i) R0
        ii) R1
    d) Radiotherapy and Chemotherapy (Neo- and adjuvant)
    e) Reconstruction
3. The outcomes of F-ESTS patients were described in terms of:
    a) Survival
    b) Local Recurrence
    c) Metastases
    d) Complications
        i) Surgical Site Infection
        ii) Wound Dehiscence
        iii) Neurovascular complications

Scope and limitations of the study

This study described the important clinical characteristics, treatment patterns, and outcomes of twenty patients diagnosed with F-ESTS and treated by a single surgeon at a sarcoma unit. Because of the limited number of cases presented, this study could not make statistical associations or analyze the relationships of clinical and treatment factors with outcomes. Another limitation of this study is that the cases were only from a single orthopedic tumor surgeon and other F-ESTS patients treated by other tumor surgeons at the sarcoma unit were excluded.

METHODOLOGY

Study design

This was a retrospective clinical study on F-ESTS patients treated by the senior investigator at a sarcoma unit over 25 years (1993–2018).

Patient selection

Inclusion criteria

- Fungating extremity soft tissue sarcoma (F-ESTS) patients treated by the senior investigator
- Histologically confirmed STS by sarcoma unit pathologist
- F-ESTS patients with and without metastasis on presentation
- F-ESTS patients who received complete treatment at the sarcoma unit
- F-ESTS patients with at least a two-year follow-up in the absence of demise

Exclusion criteria

- Patients who did not undergo surgical management due to other co-morbidities
- Soft tissue sarcomas of the superficial trunk, neck

Materials and methods

The study was conducted at the Philippine General Hospital under the Department of Orthopaedics Tumor Service utilizing the data from the senior investigator's record of previously treated F-ESTS patients. The database was handled by the senior investigator and was accessed with his consent. From this database, the clinical characteristics, treatment variables, and outcomes were identified. The clinical characteristics included age, gender, tumor size, tumor depth (subcutaneous or subfascial), tumor site, tumor grade (low/high), tumor histology, biopsy before surgery, initial treatment done before sarcoma unit, and metastases at presentation. The treatment variables included were the type of surgery done (limb salvage/amputation), surgical margins (wide/radical), margin status (R0/R1), adjuvant therapy (radiotherapy/chemotherapy) given, and reconstruction done. The outcomes identified were the overall survival, local recurrence, metastases, complications (SSI, wound dehiscence, neurovascular injury), and the latest status of the patients. The follow-up data for two years or until demise were included to review the outcome.

A data collection form (Microsoft Excel) contained the clinical characteristics, treatment, and outcomes. The patient's identity was not reflected in the collected data or the study. The data were not photocopied or duplicated and were stored and protected in a password-protected computer that only the researchers could access during the study. After the study, access was limited to the senior investigator. Sharing of the collected data was only allowed per the senior investigator's approval.

Data privacy for this study was maintained and no other personnel accessed the collected data. There were no reports to the Philippine General Hospital Data Privacy Officer.

Sample size

The sample size was not computed due to the rarity of the F-ESTS. All patients with F-ESTS treated by the senior investigator over the past 25 years were included. Of the 258 STS patients' records reviewed, this yielded 20 patients with F-ESTS whose data collected included the incidence, clinical factors, treatment, and outcome.

Statistical analysis

Descriptive statistics were used in this study to describe and summarize the data. The means for age, tumor size, and survivability in months were computed. The frequency of gender, tumor depth, tumor site, tumor grade, tumor histology, biopsy before surgery, initial surgery, surgical treatment, surgical margins, margin status, adjuvant therapy, reconstruction, overall survival, local recurrence, metastases, and complications were interpreted in percentage.

Ethical considerations

This study protocol was reviewed and approved by the University of the Philippines Manila Research Ethics Board (UPMREB) Panel. following the Data Privacy Law of 2012, Republic Act 10173, all patient information was kept anonymous and confidential. There was no external funding for this study; the primary investigator provided funding.

A waiver of informed consent was approved by the UPMREB panel in line with the National Ethical Guidelines for Health and Health-related Research of 2017 section 11.2; the study entailed no more than minimal risk and the medical records of the patients included in the study and their anonymity were maintained.

RESULTS

We reviewed 258 patients diagnosed with soft tissue sarcoma and treated by the senior investigator from 1993 to 2018. A total of 28 patients were identified to have F-ESTS. Three patients did not meet the two-year minimum follow-up and five patients were excluded due to missing data. Hence, 20 patients with F-ESTS were included for analysis in this study. Table 1 summarizes the clinical factors, treatment variables, and the outcomes of these patients.

F-ESTS patients had a mean age of 49.2 years old ranging from 17–80 years old. Most (55%) were female. The most common site for tumor occurrence was on the lower extremity, specifically the thigh, accounting for ten (50%) of the cases. On presentation, tumor size ranged from 5.5 to 20 cm with a mean of 11.8 cm. The majority of the tumors were deep, of which 85% were high grade (11 of the 13 deep tumors). Seven patients had superficial tumors, six of which were high-grade. Histologically, the most common diagnosis was a high-grade liposarcoma in six (35%) of the patients. This was followed by malignant peripheral nerve sheath tumors (MPNST) and rhabdomyosarcomas. Our study also had cases of synovial sarcoma, extra-skeletal osteosarcoma, high-grade undifferentiated pleomorphic sarcoma, low-grade spindle cell tumors, and low-grade angiosarcomas (Table 2).

Eleven patients (55%) had an unplanned excision and only two patients underwent diagnostic biopsies before consulting at the sarcoma unit. Two patients were diagnosed with metastasis on presentation (Table 2).

Limb salvage with wide margins was the treatment of choice in twelve (60%) patients while eight (40%) patients underwent amputation. An R0 margin was achieved in sixteen (80%) patients (Table 3). Out of the four (40%) cases with an R1 margin, three followed a limb salvage procedure and one had an amputation. Five patients (25%) received radiotherapy while four (20%) received chemotherapy. Two of the five

patients who had radiotherapy (RT) received it before surgery. Neoadjuvant chemotherapy was given in only one patient for a high-grade MPNST, in continuity with the chemotherapy given after an unplanned excision with a previous surgeon. A reconstructive procedure was required in 50% of the patients (skin graft in seven patients and flap coverage in three patients) (Table 3).

Post-operatively, three (15%) patients developed complications. Two of these patients had both a surgical site infection and wound dehiscence and one had wound dehiscence alone. Five patients (25%) developed local recurrence. Thirteen patients (65%) had distant metastasis on their latest follow-up. Lymph node metastasis had occurred in three patients with the following histologies: embryonal rhabdomyosarcoma, extra-skeletal osteosarcoma, and dedifferentiated liposarcoma (Table 4).

Patients in this study had a mean survival of 49.2 months ranging from two months to 13.5 years. Twelve patients (60%) died of disease while one died of other causes. Only four (20%) patients were alive without evidence of disease on the latest follow-up (Table 4).

DISCUSSION

The presence of fungating STS has anecdotally denoted a poor prognosis; a 5-year survival rate of only 20.4% is expected for those patients presenting with a fungating STS. There is still a limited understanding of this aggressive tumor presentation. Potter et al., from the University of Miami Miller School of Medicine retrospectively reviewed 170 STS patients over fifteen years with twenty-four (14.1%) cases of fungating STS. Parry et al., from the Royal Orthopaedic Hospital, UK, retrospectively reviewed 2661 STS patients over eighteen years and found eighty-six (3.2%) cases of fungating STS. Okajima et al., from the Tokyo Metropolitan Cancer and Infectious Diseases Center Komagome Hospital/University of Tokyo Hospital/Saitama Medical Center Jichi Medical University retrospectively reviewed 26 patients with "Malignant fungating wounds (MFW)" over fourteen years and found that 19 (73%) patients initially presented with F-ESTS, and 7 (27%) developed fungation during the treatment course (Table 5).[7]

Of the 258 STS cases from the senior author's 25-year database, only 10.9% presented with a fungating mass. Although infrequent, this crude incidence was much higher than that described by Parry et al. in their retrospective series (3.2%). This may reflect delayed health-seeking behaviors in patients and/or a treatment gap in the management of these cases.

In our study, F-ESTS occurred in a younger age group compared to that in published literature (Table 5). Like the studies of Potter and Parry et al, our F-ESTS cases occurred mostly in women. The most commonly affected area was the thigh. Like the other studies, the tumor size was approximately 10 cm or larger. The most frequently encountered histology differed across the literature; locally, high-grade liposarcomas were most common. Fewer of our cases had metastasis on presentation. Potter et al. and Parry et al., aside from including only high-grade F-ESTS, also included patients who did not undergo surgery due to advanced disease. This could account for higher rates of metastasis on presentation in their study populations.

Before presenting to the sarcoma unit, 55% of patients had an unplanned excision of their tumor by another surgeon. The residual tumor, postoperative inflammation, and iatrogenic break in the skin most likely contributed to conditions favorable for fungation. Two patients who underwent a previous biopsy procedure were spared from an unplanned excision but still presented with a fungating lesion, most likely due to the same conditions mentioned.

All studies included M1 patients at presentation. We describe two M1 patients on presentation: one who underwent amputation and eventually died of disease and one who underwent limb salvage but was still alive with evidence of disease on a four-year follow-up.

Most patients in our study (60%) were treated with limb salvage surgery using wide margins. However, three of those cases reported R1 margins following surgery which may be due to inadequate resection or tumor contamination. The presence of a large, fungating, and sometimes leaking mass during limb-salvage surgery can present a difficult and unique challenge to the tumor surgeon when trying to avoid tumor contamination. Techniques include using iodine-impregnated adhesive drapes over gauze dressings to contain the fungated component. A review of these R1 cases shows that three patients were given post-operative RT without re-excision; only one underwent pre-operative RT. Two of these initially non-metastatic patients developed both local recurrences and distant metastasis within months of their surgery at the unit. Both patients died of disease before their one-year follow-up.

Published data of non-metastatic ESTS cases in the same sarcoma unit would show an aggregate amputation rate of 12.8%.[8] The amputation rate of our F-ESTS study (40%) was much higher, considering the overwhelmingly high-grade nature of this group. Tumor size did not seem to be a factor in amputation since the size of F-ESTS was no different than the average size of STS presenting at the sarcoma unit (~11 cm). Although our decision to amputate followed similar protocols to published studies, the amputation rate for our study of fungating cases was almost twice that of Parry et al. (23%).

The presence of local recurrence, distant metastases, and poor survival make surgeons question if limb salvage surgery (LSS) can be pursued or if all F-ESTS cases should be amputated. The outcome of LSS in our study demonstrated three (25%) cases of local recurrence, seven (58%) cases of distant metastasis, and seven (58%) cases died of disease. The amputated group demonstrated two (25%) cases of local recurrence, six (75%) cases of distant metastasis, and five (63%) cases died of disease. The oncologic outcomes of the two surgical groups (LSS vs

Table 1. Clinicopathologic demographics of F-ESTS patients

Case	Age at Diagnosis (Years)	Sex	Tumor site	Tumor size	Tumor depth	Tumor grade	Tumor histology	Biopsy prior to surgery	Surgery prior to unit	Neoadjuvant Therapy		Metastases at presentation	Surgical treatment	Surgical margins	Margin status	Adjuvant RT	Adjuvant Chemo	Recon-struction	Compli-cation	Recur-rence	Metastases	Survival (months)	Latest status
1	46	M	Knee	14	SF	high	Rhabdomyosarcoma pleomorphic	No	no surgery	none		No	limb salvage	wide	R1	Yes	No	Yes	None	Yes	Yes	8	DOD8
2	48	F	Elbow	11	SF	high	Liposarcoma myxoid	No	unplanned excision	none		No	amputation	wide	R0	No	No	No	None	No	No	150	ANED150
3	33	M	Knee	11	SF	high	Liposarcoma NOS	No	unplanned excision	none		No	amputation	radical	R0	No	No	No	SSI, Wound dehiscence	Yes	Yes	3	DOD3
4	37	M	Leg	14	SF	low	MPNST	No	unplanned excision	none		No	amputation	radical	R1	No	No	No	None	No	Yes	162	AWED162
5	73	M	Thigh	16	SF	high	Liposarcoma NOS	No	unplanned excision	RT		No	limb salvage	wide	R0	Yes	No	No	None	No	Yes	12	DOD12
6	56	F	Leg	8.2	SF	low	Angiosarcoma of soft tissue	No	unplanned excision	none		No	amputation	wide	R0	No	Yes	No	None	Yes	Yes	52	DOD52
7	17	M	Foot	20	SF	high	Rhabdomyosarcoma embryonal	No	no surgery	none		Yes	amputation	radical	R0	No	No	No	None	No	Yes	2	DOD2
8	58	F	Thigh	20	SF	high	Liposarcoma pleomorphic	No	no surgery	none		No	amputation	radical	R0	No	No	No	None	No	Yes	53	DOD53
9	64	F	Foot	6	SF	high	Synovial sarcoma NOS	No	unplanned excision	none		No	amputation	radical	R0	No	No	No	None	No	No	105	ANED105
10	33	F	Thigh	n/a	SF	high	MPNST	No	unplanned excision	Chemo		No	limb salvage	wide	R0	Yes	Yes	No	None	Yes	No	16	DOD16
11	62	F	Thigh	11.5	SC	high	Liposarcoma myxoid	Yes	no surgery	none		No	limb salvage	wide	R0	No	No	Yes	None	No	Yes	30	DOD30
12	66	F	Thigh	7.5	SC	high	MPNST	Yes	no surgery	none		No	limb salvage	wide	R0	No	No	Yes	None	No	No	65	DOC65
13	32	F	Thigh	5.5	SC	high	Rhabdomyosarcoma alveolar	No	unplanned excision	none		No	limb salvage	wide	R0	No	No	Yes	None	No	Yes	14	DOD14
14	53	M	Gluteal	n/a	SC	high	Extraskeletal osteosarcoma	No	unplanned excision	none		Yes	limb salvage	wide	R0	No	Yes	Yes	None	No	Yes	47	AWED47
15	64	F	Thigh	18	SF	high	UPS	No	unplanned excision	none		No	limb salvage	wide	R1	Yes	No	Yes	None	Yes	Yes	7	DOD7
16	60	F	Thigh	11	SC	high	Liposarcoma dedifferentiated	unknown	planned wide	none		No	limb salvage	wide	R0	No	No	Yes	Wound dehiscence	No	Yes	48	DOD48
17	37	M	Thigh	12	SC	high	High grade sarcoma	No	no surgery	none		No	limb salvage	wide	R0	No	Yes	Yes	None	No	No	108	AWED108
18	25	M	Thigh	n/a	SF	high	Synovial sarcoma NOS	No	no surgery	none		No	amputation	wide	R0	No	No	No	SSI, Wound dehiscence	No	Yes	6	DOD6
19	40	M	Pelvic	7	SC	low	low grade spindle cell tumor	No	no surgery	none		No	limb salvage	wide	R0	No	No	Yes	None	No	No	53	ANED53
20	80	F	Forearm	7.5	SF	high	MPNST	No	unplanned excision	RT		No	limb salvage	wide	R1	Yes	No	Yes	None	No	No	44	ANED44

M = male, F = female, SF = subfascial, SC = Subcutaneous, MPNST = Malignant peripheral nerve sheath tumor, UPS = Undifferentiated Pleomorphic Sarcoma, NOS = Not otherwise specified, RT = Radiotherapy, Chemo = Chemotherapy, R0 = clear margins, R1 = tumor detected microscopically, SSI = Surgical Site Infection, DOD = Dead on disease, DOC = Dead on other cause, AWED = Alive with evidence of disease, ANED = Alive with no evidence of disease

Table 2. Clinical characteristics of patients with F-ESTS

Variables	N	Frequency (%)	Mean
Age	Mean = 49.2 (Range 17-80)		
Gender			
Male	9	45	
Female	11	55	
Tumor site			
Elbow	1	5	
Forearm	1	5	
Pelvis	1	5	
Buttock	1	5	
Thigh	10	50	
Knee	2	10	
Leg	2	10	
Foot	2	10	
Tumor size (cm)			
05-Oct	6	35.2	11.8
Nov-15	7	41.1	
16-20	4	23.5	
Tumor depth			
Subcutaneous	7	35	
Subfascial	13	65	
Tumor grade			
Low	3	15	
High	17	85	

Variables	N	Frequency (%)	Mean
Tumor histology			
Liposarcoma	7	35	
Rhabdomyosarcoma	3	15	
MPNST	4	20	
Angiosarcoma	1	5	
Synovial Sarcoma	2	10	
Extraskeletal OSA	1	5	
UPS	1	5	
LGSCT	1	5	
Biopsy prior to surgery			
Yes	2	11	
No	17	89	
Surgery prior to sarcoma unit			
Planned	1	5	
Unplanned	11	55	
None	8	40	
Metastases at presentation			
Yes	2	10	
No	18	90	

MPNST = Malignant Peripheral Nerve Sheath Tumor, LGSCT = Low Grade Spindle Cell Tumor, UPS = Undifferentiated Pleomorphic Sarcoma

Table 3. Treatment variables for F-ESTS patients

Variables	N	%
Surgery done		
Limb salvage	12	60
Amputation	8	40
Surgical margin		
Wide	15	75
Radical	5	25
Margin status		
R0	16	80
R1	4	20
Radiotherapy		
Neo-adjuvant	3	15
Adjuvant	5	25
Neo or adjuvant	5	25
None	15	75
Chemotherapy		
Neo-adjuvant	1	5
Adjuvant	4	20
Neo or adjuvant	4	20
None	16	80
Reconstruction		
Yes	10	50
No	10	50

R0 = clear margins, R1 = tumor detected microscopically

Table 4. Outcome of treated F-ESTS patients

Variables	N	%
Complications		
Yes	3	15
SSI	2	10
Wound dehiscence	3	15
Neurovascular	0	0
No	16	80
Local recurrence		
Yes	5	25
No	15	75
Distant metastases		
Yes	13	65
No	7	35
Survival (months)	Mean = 49.2 months (Range: 2 to 162 months)	
Status		
ANED	4	20
AWED	3	15
DOD	12	60
DOC	1	5

SSI = Surgical Site Infection, DOD = Dead on disease, DOC = Dead on other cause, AWED = Alive with evidence of disease, ANED = Alive with no evidence of disease

Table 5. Comparison of characteristics and outcomes of F-ESTS patients in the literature

Mean	Mean age (years)	Mean tumor size (cm)	Most common location	Most common histology	Deep tumors (%)	High grade tumors (%)	M1 on presentation (%)	Crude LR (%)	Crude DM (%)	Died of disease (%)
Our study	49.2	11.8	Thigh	High grade liposarcoma	65	85	10	25	65	60
Potter et al	64.9	9.9	Thigh/ groin	UPS / MFH	46	100	33	13	44	54
Parry et al	68.8	11.4	n/a	Angiosarcoma	48	86.8	20	20	n/a	75
Okajima et al.	73	≥10 cm	Extremity	UPS / MFH	54	100	31	11	44	61

M1 = Distant metastases, LR = Local recurrence, DM = Distant metastases

amputation) were similar in terms of local recurrence and distant metastasis. The oncologic principle of doing limb salvage surgery for STS whenever marginally possible still applies regardless of whether a fungating lesion is present. We note that most surgeries done before 2010 were amputations (78% were amputations). Treatment previously leaned more towards amputation due to fear of tumor leakage and contamination. In the last decade, there was a reversal toward limb salvage surgeries even for deep high-grade F-ESTS cases (92% were LSS). Okajima et al., similarly call for the consideration of limb-salvage surgery to improve quality of life.

Following treatment protocol, all patients with deep and high-grade tumors, for which limb salvage surgery was planned, were given RT pre- or post-operatively. The use of chemotherapy, on the other hand, was much less routine in our study. Parry et al. do not analyze the effect of chemotherapy except to mention that this was rarely given (i.e., for soft tissue Ewing's, rhabdomyosarcomas, or advanced disease). In contrast, Potter et al. mostly followed a chemotherapy treatment protocol for patients with a large, high-grade sarcoma, effectively giving 61% of their patients a neoadjuvant doxorubicin-based drug regimen. They elaborated that in patients with >90% tumor necrosis after the neoadjuvant treatment, adjuvant chemotherapy was continued post-operatively while those with <90% tumor necrosis had modified adjuvant chemotherapy or were alternatively given radiotherapy. Although their regression analysis showed no benefit of chemotherapy for disease-specific survival, Potter et al. had better survival rates and local control compared to Parry et al. despite a population with inherently poorer prognosis. Potter et al., also emphasize that an aggressive multidisciplinary approach can improve survivorship for this group of patients. This does give us pause to consider that their treatment protocols may account for the difference.

Almost half of the patients in this study underwent surgical reconstruction using skin grafting, and flap coverage. Two cases of SSI and one case of wound dehiscence were recorded. Only one patient with SSI underwent re-operation (debridement). This patient previously presented with a fungating mass that was already infected. Despite multi-modal treatment consisting of adjuvant chemo and RT, the patient eventually developed malignant degeneration of his other lesions and died of disease within two years of his STS diagnosis.

The 148 ESTS patients included in Wang et al.'s study of unplanned excisions without metastasis on presentation were fairly distributed between low- (40%) and high-grade (60%) lesions.[8] In this study of F-ESTS patients, the majority (85%) were high-grade lesions. Comparing the outcomes of this study with Wang et al., there was a slightly higher local recurrence (25% vs 23%), almost double the rate of distant metastasis (65% vs 36%), and nearly half the survival rate (35% vs 63%).[8] The patients in this study had half the survival rate of the aggregate STS population treated at the sarcoma unit (64%). These crude differences may be attributed not only to fungation but also to the concentration of high-grade tumors in our study and the inclusion of M1 cases on presentation.

Our study had proportionally more patients who developed local recurrence and distant metastasis but had fewer patients lost to disease compared to Parry et al., likely explained by the inclusion of several inoperable F-ESTS patients in the latter study.

CONCLUSION

Common clinical characteristics in our F-ESTS study were age <65 years, deep and high-grade tumors, typically liposarcomas, a predilection for the thigh, and a previous history of surgery or biopsy. Our study involved a younger age group of F-ESTS cases, with a larger proportion of deep tumors compared to the literature.

At the end of our study, five (25%) patients developed local recurrence, 13 (65%) patients had distant metastases, and 12 (60%) died of disease with a mean time to death of 21 months from diagnosis. Those who survived had a mean follow-up time of 7.6 years (range: 44 months to 13.5 years). This poor outcome was consistent with prognostic studies in the literature. However, with multi-modal treatment at a sarcoma unit, a long disease-free survival remains entirely possible. While chemotherapy use was rare and inconsistent given a lack of published evidence, there is room to improve our local control rates with a lower tolerance for radiotherapy (i.e., giving RT for all high-grade lesions regardless of depth).

Most F-ESTS patients were still able to undergo limb salvage surgery, receiving RT if they had both deep and high-grade tumors. We found that in the last 10 years, limb salvage surgery had become the treatment of choice for the patients in this

study, without grossly compromising local control or survival outcomes. This upends the notion that fungating tumors require amputation and may allay fears of contamination from "tumor leakage."

Given the inherent limitations of our study design, more collaborative and comprehensive prospective studies can be done involving other institutions and orthopedic oncologic surgeons (i.e. multi-center research) to gather more robust data on F-ESTS. The same issue can be addressed by tapping into existing registry data from cancer societies or consortiums.

STATEMENT OF AUTHORSHIP

All authors certified fulfillment of ICMJE authorship criteria.

AUTHORS DISCLOSURE

The authors declared no conflict of interest.

FUNDING SOURCE

None.

REFERENCES

1. Mahmoud AMA, Mahmoud M, Charaf A, Moneer MM. The profile of extremity and trunk soft tissue sarcoma in a tertiary referral center. J Egypt Natl Canc Inst. 2017;29(2):89-94. PMID: 28462849 DOI: 10.1016/j.jnci.2017.03.001
2. Vodanovich DA, M Choong PF. Soft-tissue sarcomas. Indian J Orthop. 2018;52(1):35–44. PMID: 29416168 PMCID: PMC5791230 DOI: 10.4103/ortho.IJOrtho_220_17
3. Wang E, Arbatin J, Dela Rosa T, Punzalan P, De Dios AV. Prognostic factors in non-metastatic extremity soft tissue sarcoma. Musculoskeletal Tumor Unit, UP-PGH. PowerPoint slideshow. Accessed October 30, 2023. Unpublished.
4. Potter BK, Adams SC, Qadir R, Pitcher JD, Temple HT. Fungating soft-tissue sarcomas. Treatment implications and prognostic importance of malignant ulceration. J Bone Joint Surg Am. 2009;91(3):567–74. PMID: 19255216 DOI: 10.2106/JBJS.H.00071
5. Parry M, Evans S, Sugath S, Wafa H, Jeys L, Grimer R. Fungation in soft tissue sarcomas is associated with poor survival. Int Orthop. 2017;41(12):2613–8. PMID: 28971269 DOI: 10.1007/s00264-017-3628-6
6. Ngan R, Wang E, Porter D, et al. Soft-tissue sarcomas in the Asia-Pacific region: a systematic review. Asian Pac J Cancer Prev. 2013;14(11):6821–32. PMID: 24377612 DOI: 10.7314/apjcp.2013.14.11.6821
7. Okajima K, Kobayashi H, Okuma T, et al. Prognosis and surgical outcome of soft tissue sarcoma with malignant fungating wounds. Jpn J Clin Oncol. 2020;51(1):78–84. PMID: 33037437 DOI: 10.1093/jjco/hyaa176
8. Wang EHM, Araneta KTS, Gaston CLL, et al. Unplanned excision of soft tissue sarcomas of the extremities in a low-to-middle-income country. Ann Surg Oncol. 2023;30(6):3681–9. PMID: 36800129 PMCID: PMC9936942 DOI: 10.1245/s10434-023-13188-x