■ ONCOLOGY

Infiltration of the oedema tail with tumour cells in patients with a soft-tissue sarcoma – the predisposing factors and clinical relevance

IS THE OEDEMA TAIL CONTAMINATED TISSUE?

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Aims

Some histological subtypes of soft-tissue sarcoma have an oedema tail evident on T2 hyperintensity in MRI scans at the time of presentation. The clinical and prognostic relevance of the infiltration of the oedema tail with tumour cells is not clear. The aim of this study was to determine the rate of contamination of the oedema tail with tumour cells in a series of sarcomas, the variables that affect the presence of tumour cells in the oedema, and the oncological relevance of the infiltration.

Methods

A total of 67 patients who had a primary appendicular soft-tissue sarcoma with an oedema tail at the time of presentation were treated in our tertiary referral centre between June 2017 and January 2022; 21 were excluded and 46 were included in this prospective study. We recorded epidemiological, radiological, and histological variables and investigated their correlation with infiltration of the oedema by tumour cells. Preoperative MRI scans were used to determine the presence and length of the oedema tail as assessed by an expert radiologist. The oedema was defined as a high-intensity signal in the edges of the sarcoma on a T2 STIR sequence. The oedema tail and the margins of the resection were measured and evaluated by an expert pathologist based on preoperative MRI scans. The overall survival and local recurrence-free survival were determined at a median follow-up of 36.8 months (IQR 17.4 to 50.7). Four patients were lost to follow-up.

Results

A total of 12 of the 46 patients (26%) showed infiltration into the oedema by > 2 mm from the pseudocapsule. The mean distance between the pseudocapsule and the tumour cells in oedema was 20 mm (2 to 40). The size and superficial location were independent variables for infiltration by tumour. The presence of tumour cells in the oedema was significantly associated with the overall survival (hazard ratio (HR) 0.299 (95% CI 0.104 to 0.999); p = 0.042).

Conclusion

The mean length of the oedema tail was 20 mm (2 to 40) and was infiltrated with tumour cells in 12 patients (26%). The overall survival was significantly poorer in those with, compared with those without, tumour cells in the oedema. Future studies should focus on the risk factors for the infiltration of the oedema with tumour cells, the association between the presence of infiltration and radiotherapy and chemotherapy, and whether it affects the prognosis in these patients.

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Introduction

A sarcoma is a rare malignant mesenchymal tumour with an incidence of between 5.0 and 5.6 per 100,000 of the European population each year. Soft-tissue sarcomas account for 84% of these, and 15% are bone tumours.[1,2] The incidence of soft-tissue sarcomas in Europe is 4.7 per 100,000 of the population per year.[1–4] The heterogeneity of the

Table I. Inclusion and exclusion criteria.

Criteria
Inclusion
Patients with a soft-tissue sarcoma aged ≥ 14 years
Those with an appendicular sarcoma and an oedema tail
Surgery performed in one of the multidisciplinary centres involved in the study
Patient or the legal representative understood the procedure and the data management and consented to participate. Those aged between 14 to 18 years must have signed their consent with associated consent from their legal representative
Exclusion
Patients aged < 14 years
Those whose a previous biopsy or procedure performed in other centres
Those with a low-grade liposarcoma, or a sarcoma involving the head, neck, thorax, or abdomen
Those with a local recurrence
Patients who were unable or declined to consent

histology is such that immunohistochemical stains and molecular biological tests may be needed, and this may involve an expert pathologist in a specialist centre.[5] The outcome of treatment is improved by multidisciplinary team management.[6–8]

The main aim of musculoskeletal oncological surgery is to decrease the risk of local recurrence with a safe oncological margin. The optimal margin of resection has been widely studied, and several classification systems have been proposed. These include the Enneking classification with modification described by Trovick et al;[9] the R classification, according to microscopically detected pathological contact between tumour cells and an ink margin;[10] the R + 1 classification: the R + 1 de Union International Contre le Cancer (UICC) involving a distance of > 1 mm between tumour cells and the ink margin;[11] and the Canadian group classification which considers factors such as atypical lipomatous tumour or unplanned resection.[12] However, none of these classifications considers the differences between the histological types, the neoadjuvant treatments, or the quality of the surrounding tissue when determining the width of the margin of resection.

Musculoskeletal radiologists describe an oedema tail associated with the sarcoma. This is an area of high intensity in T2-weighted MRI sequences. The tail represents lax associated tissue, mainly at the fascial edges of the fast-growing tumour.[13] The appearances of the oedema tail change with neoadjuvant treatment.[14,15] These changes are more frequently seen in myxofibrosarcoma or pleomorphic sarcomas and are associated with increased levels of CRP and neutrophils in the blood.[16] The optimal margin of resection in these high-risk sarcomas with an oedema tail is not known. Although this area is usually included in radiation fields, it may not be completely resected in wide-resection oncological surgery.

The main aims of this study were to evaluate the epidemiological and clinical characteristics of the oedema tail which is associated with sarcomas. The hypothesis was that contamination by tumour cells can spread beyond the conventional oncological margin into the lax tissues of the oedema tail, which may remain after neoadjuvant treatment. This was investigated by determining the incidence of tumour cells in the oedema tail and the distance between the tumour cells and the pseudocapsule of the sarcoma, identifying the factors related to the presence of tumour cells in the oedema, and examining the relationship between the presence of tumour cells in the tail and the overall survival and local recurrence-free survival.

Methods

This was a prospective study including patients with a soft-tissue sarcoma who were treated in two centres, following approval by the ethics committee of University Hospital La Paz, between July 2017 and January 2022. The inclusion and exclusion criteria are shown in Table I. A total of 105 patients with an appendicular soft-tissue sarcoma were treated during this time, of whom 64 fulfilled the inclusion criteria and gave informed consent. A total of 46 patients with an oedema tail at the time of presentation were included in the analysis. Although four were lost to follow-up, they were included in the histological and survival analysis.

Figure 1 shows the flow diagram of the inclusion of the patients into the study. The diagnosis of the 105 patients was determined at their first visit using a percutaneous needle biopsy undertaken by a specialist pathologist. A total of 38 sarcomas were excluded: 11 low-grade liposarcomas, three abdominal or chest wall sarcomas, ten local or systemic recurrences, and 14 patients who had already undergone an invasive procedure. Overall, 67 patients were proposed for the study at their second visit, when the protocol and the data management were explained and consent was obtained from 64 patients. Three refused or were unable to consent. The characteristics of the patients are summarized in Table II.

We offered neoadjuvant treatment to all patients unless there were contraindications, such as in those with a previously irradiated field or with Li Fraumeni syndrome,[17] or with a local complication requiring early surgery (e.g. those with a skin complication, haemorrhage, or with a tumour which protruded prominently), or the patient had a small, low-grade sarcoma which could be resected completely with a wide margin including the oedema tail without the need for a local skin flap.

All patients had complete removal of the oedema tail regardless of the neoadjuvant treatment. The following data were collected: age, sex, histology, localization (axial, upper or lower limb), and comorbidities, and radiological data including: the size of the tumour (cubic centimetres in anteroposterior × craniocaudal × mediolateral axes), length of the oedema as the longest dimension in both axes in centimetres on the pretreatment MRI

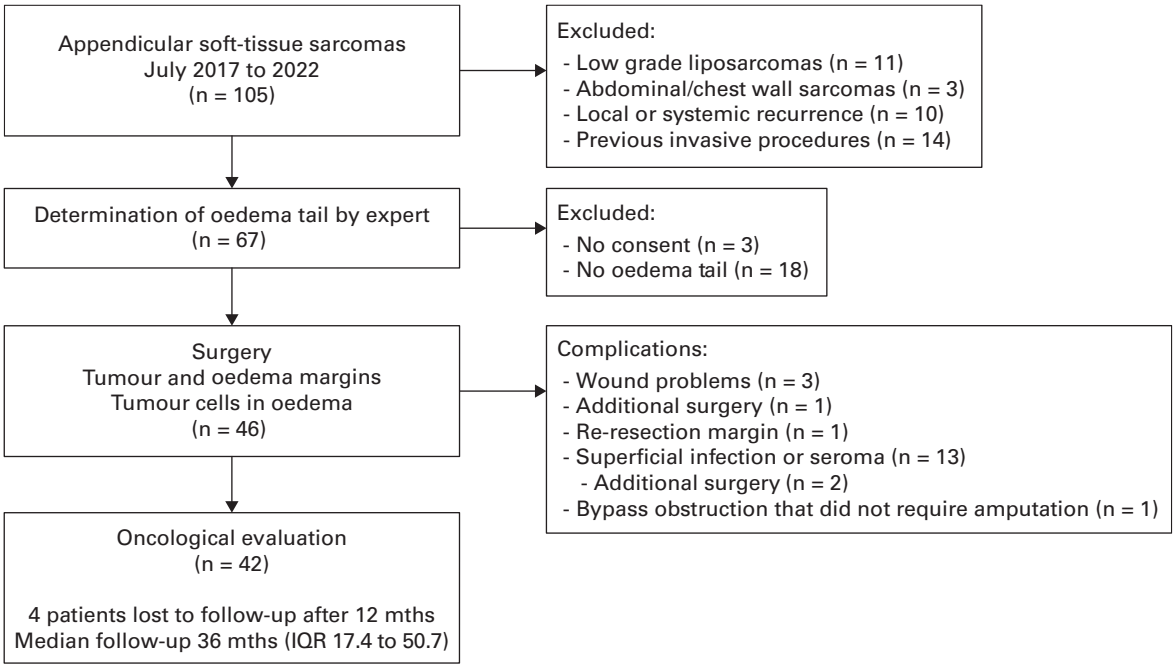

Fig. 1

The flow diagram of the visits required to complete the enrolment, the data collection, and the early complications of the surgery.

scans; Figure 2), the location of the oedema (cranial, caudal, medial or lateral, anterior or posterior), and the grade and stage of the tumour according to the American Joint Committee on Cancer (AJCC) classification (2017).[18] A specialist radiologist (DNBT) measured the length of the oedema, using MRI 1.5- or 3T systems. Spin-echo T1-weighted images (SE T1WI), fast spine-echo T2-weighted images (FSE T2WI), with or without fat suppression, and gadolinium-enhanced T1-weighted images with fat suppression (Gd-T1WI with FS), including the entire relevant compartment, were available in all patients. The oedema tail was measured as the high T2 hyperintensity in the end of the sarcomas. The oedema was measured in the proximal, distal, lateral-posterior, and medial-anterior axes. Diffusion and contrast-enhanced MRI scans were obtained in all patients to determine the existence of more cellular tissue, but all those with an oedema tail were included even if they did not have contrast enhancement. Muscle and peripheral oedema (not in the edge of the sarcoma) without enhancement, and those which were not present on the pretreatment MRI scans, were considered to be changes which were caused by radiation and are not included in the resection beyond the planned conventional R0 margin (Union for International Cancer Control (UICC) classification).[19,20]

A senior surgeon with > ten years' experience (IBR, MPP, or EJOC) performed the surgery with resection of the tumour and the oedema with R0 margins. Two senior musculoskeletal pathologists (JJPK, AB) determined the positioning of the resection and the location of the oedema according to the radiological findings and the margins. The pathological cuts followed the axis of the oedema tail. The ends of the tumour and the oedema were examined histologically using four micron cuts according to the longest axis of the oedema, and with a haematoxylin and eosin stain to identify tumour cells in the oedema and margins (Figure 3). The distance from the tumour cells in the oedema to the pseudocapsule (cm) was recorded. The tumour cells were stained with immunohistochemical and molecular techniques if they were required. We defined infiltration as the existence of atypical tumour cells and clusters of cells which showed the same characteristics as the primary tumour. We recorded any complications during surgery, even if they were not related to the procedure. The patients were reviewed three to four weeks after surgery. The patients received their pathology report, including the status of the margin and the presence of necrosis and tumour cells in the oedema. The use of adjuvant treatment (radio- and chemotherapy), pre- and postoperatively, was determined by a multidisciplinary team. The time between the radiotherapy and surgery was six to eight weeks, and the time between surgery and postoperative adjuvant treatment was two to four weeks. The patients were reviewed with MRI and CT scans of the thorax and abdomen every three months for two years to exclude local and systemic recurrences, every six months for five years, and then annually up to ten years. Local and systemic recurrences and additional treatments were recorded.

There were three wound problems, one of which required surgery. One patient required a second resection due to a positive margin. A total of 13 patients had a superficial infection or seroma, and two of these required further surgery. One patient had an obstructed bypass but did not require amputation.

The multidisciplinary team evaluated the patients before and after the biopsy, and after the surgery and adjuvant treatments. They also discussed any untoward incidents which occurred.

Table II. Epidemiological, clinical, and radiological characteristics of the patients with a sarcoma who were treated, without and with oedema in the edges.

Variable	Without oedema tail	With oedema tail	p-value
Sex, n (%)			0.261*
Male	10 (55.6)	34 (73.9)	
Female	8 (44.4)	12 (26.1)	
Side, n (%)			0.498*
Right	11 (61.1)	22 (47.8)	
Left	7 (38.9)	24 (52.2)	
Median age, yrs (IQR)	55.0 (26.3 to 74.8)	50.0 (41.3 to 70.5)	0.611†
Localization, n (%)			0.486*
Upper limb	2 (11.1)	6 (13.0)	
Lower limb	12 (66.7)	35 (76.1)	
Axial	4 (22.2)	5 (10.9)	
Median size, cm^3 (IQR)	84.0 (33.0 to 1,425.0)	624.0 (145.5 to 1,629.0)	0.023†
AJCC stage, n (%)			0.021‡
I	3 (17.6)	0 (0.0)	
II to III	12 (70.6)	38 (92.7)	
IV	2 (11.8)	3 (7.3)	
FNCLCC grade, n (%)			0.076*
Low (1)	6 (33.3)	5 (10.9)	
High (2 to 4)	12 (66.7)	41 (89.1)	
Margins, n (%)§			0.416‡
R0	13 (72.2)	38 (82.6)	
R1	4 (22.2)	7 (15.2)	
R2	1 (5.6)	1 (2.2)	
Neoadjuvant therapies, n (%)§			0.732‡
None	8 (44.4)	14 (30.4)	
CHT	4 (22.2)	10 (21.7)	
CHT + RT	1 (5.6)	5 (10.9)	
RT	5 (27.8)	17 (37.0)	
Relation to fascial plane, n (%)			0.206‡
Superficial	4 (22.2)	4 (8.7)	
Deep	14 (77.8)	42 (91.3)	
Local recurrence, n (%)			0.310‡
Yes	0 (0.0)	5 (10.9)	
No	18 (100.0)	42 (91.3)	
Metastasis, n (%)			> 0.999*
Yes	8 (44.4)	21 (45.7)	
No	10 (55.6)	25 (54.3)	

*Chi-squared test.
†Mann-Whitney U test.
‡Fisher's exact test.
§Percentages in this column refer to the percentage of patients overall.
AJCC, American Joint Committee on Cancer; CHT, chemotherapy; FNCLCC, Fédération Nationale des Centres de Lutte Contre le Cancer; RT, radiotherapy.

The median follow-up was 36 months (IQR 17.4 to 50.7) and four patients were lost to follow-up at the 18- and 21-month follow-up visits.

Statistical analysis. Statistical analysis of qualitative data are reported as absolute frequency and percentage. Quantitative data are reported as mean (SD) or median (IQR). The normality of the variables was evaluated with the Kolmogorov-Smirnov proof. The comparative analysis between sarcomas with and without oedema tail was performed by chi-squared test, Fisher's exact test, and Mann-Whitney U test. The survival analysis was performed with Kaplan-Meier curves, and differences were analyzed using the Cox proportional hazard regression model. All the tests were bilateral, and significance was set at $p < 0.05$. The data were analyzed using SAS v. 9.3 (SAS Institute, USA).

Results

A total of 46 sarcomas in 46 patients (72%) had an oedema tail at the time of diagnosis. Of these, 21 were myxofibrosarcoma (MFS) and undifferentiated pleomorphic sarcoma (UPS) (45.6%). Table II shows the epidemiological characteristics of the sarcomas with an oedema tail compared with those without, at presentation. There was a higher rate of high-stage sarcomas and a size of > 10 cm in those with an oedema tail. Superficial sarcomas had a lower rate of an oedema tail (4/18) than the

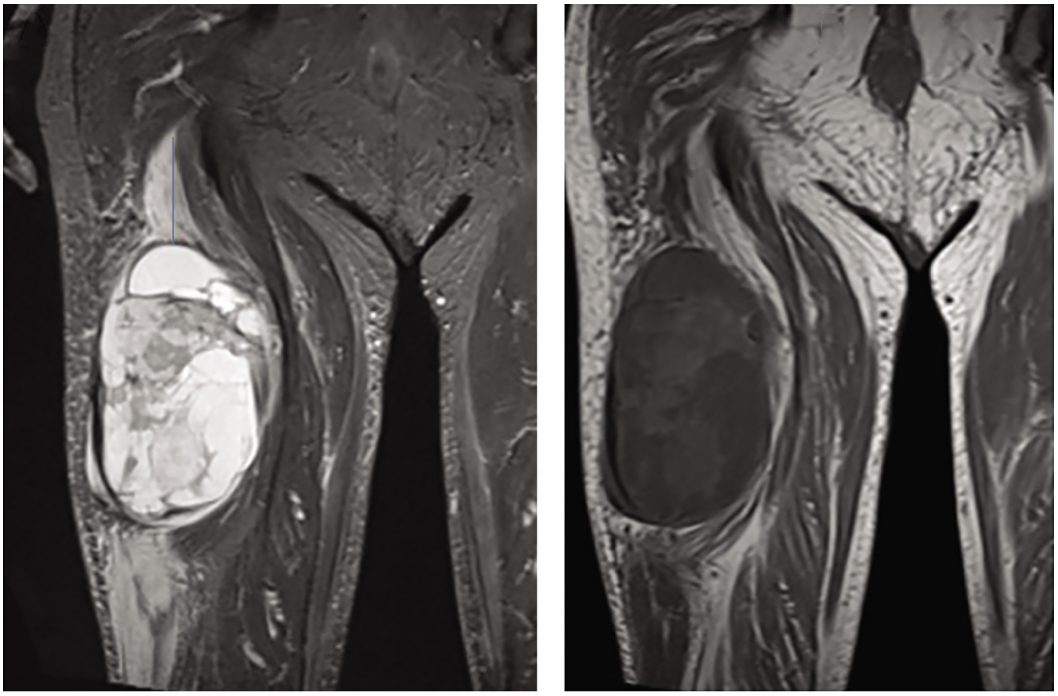

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Fig. 2

The figure shows a pretreatment MRI in a) T1 and b) T2 of a 63-year-old female with a pleomorphic sarcoma in the anterior compartment of the thigh who had neoadjuvant radiotherapy. The blue line is the measurement of oedema at the cranial edge of the tumour.

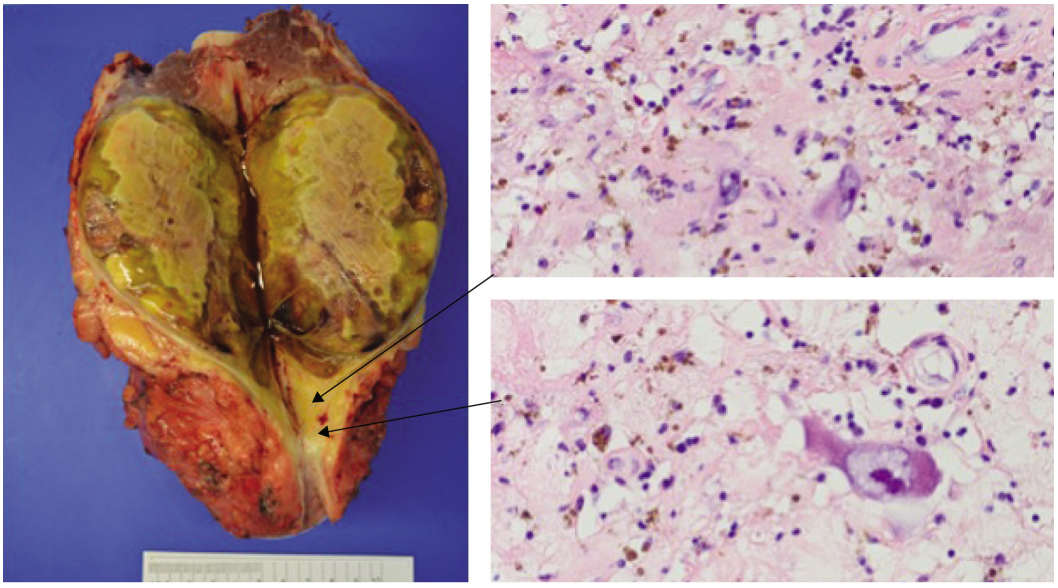

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Fig. 3

a) Photograph of a macroscopic view of the same patient as in Figure 2 with a pleomorphic sarcoma resected after preoperative radiotherapy to the anterior thigh. The oedema can be seen in the proximal (7 mm) and distal edges (20 mm). b) A haematoxylin and eosin stain (×400) showing tumour cells in the distal oedema.

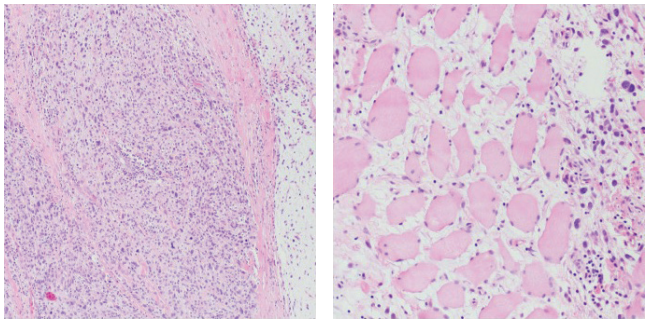

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Fig. 4

a) A haematoxylin and eosin stain (×100) of a myxofibrosarcoma showing the pseudocapsule between the tumour cells and the oedema. b) The same tumour (×200) showing clusters of tumour cells in the oedema.

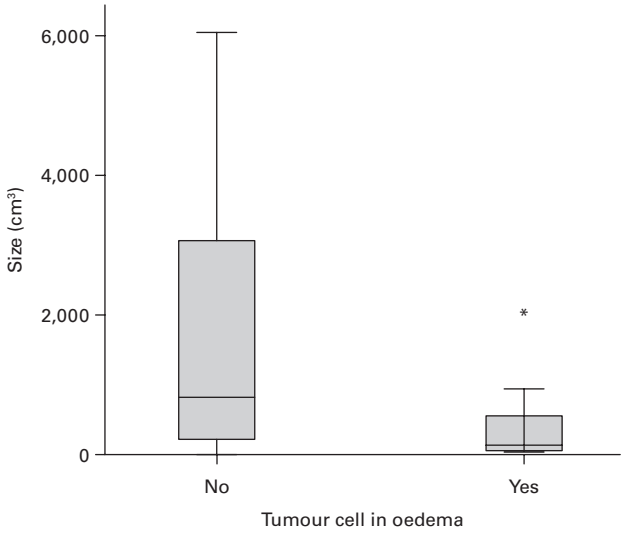

Fig. 5

Box plot graph showing the higher risk of tumour cells in the smaller tumours (p = 0.007, Mann-Whitney U test).

deep sarcomas. A total of 42 patients (65%) had preoperative treatment and 36 (56%) had preoperative radiotherapy; eight (33%) without and 32 (70%) with an oedema tail had neoadjuvant treatment. The margins were wide (R0) in 57 patients (90%), marginal (R1) in four (one who had a further resection), and two had a contaminated R2 margin. There were five local recurrences (8%), one with marginal resection R1 and the other with a wide margin R0. Although it was not the aim of the to compare the local and systemic recurrence of the sarcomas with and without an oedema tail, there was no significant difference in the rate of metastasis or local recurrence between those with and without an oedema tail.

The oedema in the 46 patients was seen proximally in 43, and also on the distal edge in 40. The mean length of the proximal and distal oedema was 21 mm (4 to 79) and 24 mm (6 to 73), respectively. The median length of the anterior or medial oedema in 19 patients was 12 mm (IQR 7 to 24) and the median length of the posterior or lateral oedema in 21 patients was 16 mm (IQR 10 to 25). A total of 32 patients with an oedema tail had neoadjuvant treatment and 14 did not; of those 14, 12 had adjuvant treatment, while two had neither neoadjuvant nor adjuvant treatment. One with Li Fraumeni syndrome did not have radiotherapy due of the risk of further radiation-induced changes, while the other had a postoperative infection contraindicating the use of chemo- or radiotherapy. One patient had infiltration into the oedema tail. There were no local recurrences in these cases.

There were tumour cells in the oedema of 12 sarcomas (26%). The median distance between the oedema and the pseudocapsule was 7 mm (IQR 4.25 to 24.0). The cells were individual in most patients and in clusters in two (Figure 4). Three of these patients had a local recurrence (25%); two of these had neoadjuvant treatment and one had postoperative radiotherapy.

There was a significantly higher rate of infiltration of tumour cells into the oedema of smaller sarcomas (p = 0.007, Kolmogorov-Smirnov proof) (Figure 5), and significantly more tumour cells (p = 0.047, chi-squared test) in the oedema of superficial sarcomas (3/4) compared with deep sarcomas (8/42). There was no significant correlation between the tumour cells in the oedema and the grade of tumour or the use of neoadjuvant treatments. Nevertheless, tumour cells were present in 30% and 40% of the sarcomas of patients who only had preoperative radiotherapy or chemotherapy, respectively, and in 12% of those who had both forms of neoadjuvant treatment. The histology was not significantly associated with the presence of tumour cells in the oedema: two (18%) of the UPSs, four (44%) of the MFSs, and three (25%) of the liposarcomas presented with tumour cells in the oedema (p > 0.05).

The presence of tumour cells in the oedema was significantly related to the overall survival (hazard ratio 0.299 (95% CI 0.104 to 0.999); p = 0.042). Patients with a sarcoma without tumour cells in the oedema had a risk of mortality which was 70.1% lower than in those with tumour cells in the oedema (1-HR = 1-Exp(B)) (Figure 6).

There were five local recurrences: two in patients without, and three in patients with, tumour cells in the oedema. Two of the 31 patients (6.5%) without tumour cells, and three of the 12 (25%) with tumour cells in the oedema, had a local recurrence. The risk of local recurrence, however, was not significantly related to the presence of tumour cells in the oedema.

Discussion

Soft-tissue sarcomas may have a high T2 signal at the ends of the tumour at the time of presentation, corresponding to a reactive zone known as the oedema tail. This is thought to be due to local changes in the fascial plane caused by the presence of the sarcoma. An oedema tail can also be found in some benign fibrous conditions,[21] such as nodular fasciitis, fibromatosis, dermatofibrosarcoma protuberans, and fibroblastic myxoid inflammatory tumours. However, the presence of an oedema tail in sarcomas may indicate a poor prognosis reflecting its fast growth, although the real pathophysiology and prevalence

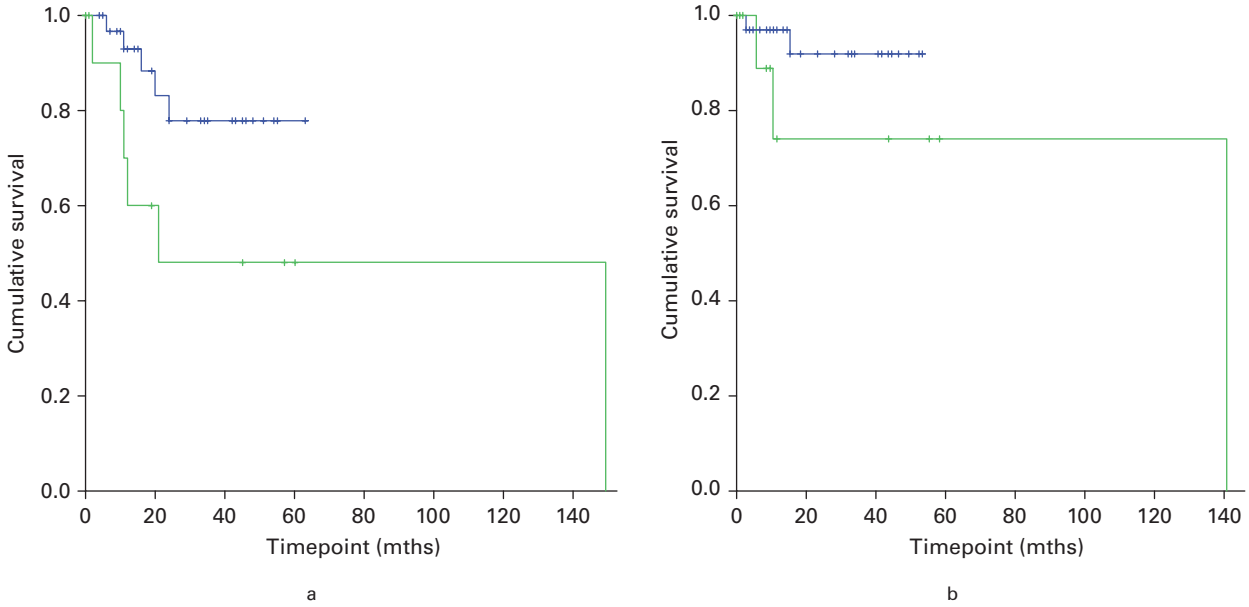

Fig. 6

a) Kaplan-Meier curve showing the overall survival in patients with and without tumour cells in the oedema (p = 0.042). b) Kaplan- Meier curve of the local recurrence free survival showing a trend to higher local recurrence. Hazard ratio 0.299 (95% CI 0.104 to 0.999); p = 0.042.

is not known, and we did not find a significantly higher rate of local or systemic events in patients with an oedema tail.

The study had limitations, including the heterogeneity of the sarcomas, which prevented the inclusion of histology as a variable for determining the risk of infiltration by tumour cells into the oedema. The sample size was also small, which precluded strong statistical significance of the presence of tumour cells in the oedema, and the risk of local recurrence and the effect of neoadjuvant treatments. The fact that the oedema was completely resected in all patients may represent a bias towards diminishing the importance of the infiltration of the oedema by tumour cells in the assessment of local recurrence-free survival. We are aware that the aggressive nature of the histological findings could be a confounding factor, which is difficult to evaluate.

An oedema tail appears frequently in fast-growing perifascial sarcomas, such as an UPS and MFS. Kikuta et al[16] studied 50 patients with an oedema tail, defined using contrast enhancement: 32 (64%) were UPSs and MFSs. Yoo et al[22] studied 178 soft-tissue sarcomas and classified them based on the oedema tail as absent, thin, or tail-like thick enhancement (> 2 mm). They found a significantly higher rate of superficial tumours, oedema enhancement, and fascial thickening 18 (53%) in UPSs and MFSs. We also found a significantly higher rate of an oedema tail in UPSs and MFSs of 25/30 patients (83%). Although we did not find a higher rate of oedema in superficial tumours, all the superficial UPSs and MFSs had an oedema tail. This may be related to the smaller number of superficial tumours in our study, and the fact that recurrences were not included. Many authors have reported a tail sign, describing it as an oedema tail with contrast enhancement. Yoo et al[22] studied oedema in 20 patients with a tail sign, and four of them had clusters of tumour cells less than 1 cm from the pseudocapsule.

White et al,[23] 20 years ago, described a mean length of oedema of 2.5 cm (0 to 7.1) in 15 patients with a soft-tissue sarcoma, who had preoperative radiotherapy. This was significantly larger in the craniocaudal axis (p = 0.006) and 12 oedema tails enhanced with contrast. There were tumour cells in the oedema in nine patients (60%); in ten of these, the cells were < 1 cm from the pseudocapsule and in four, the tumour cells were up to 4 cm from the edge of the tumour. In this study, we detected tumour cells in a smaller percentage of patients (12/47), but the distance (1 to 40 mm) was similar; we found infiltration in eight of < 1 cm, and in six of between 1 and 4 cm.

Other authors have studied the factors which influence the cellular infiltration in the oedema, focusing on the associated neoadjuvant treatment. O'Donnell et al,[24] ten years ago, retrospectively compared the composition of the pseudocapsule in 48 patients who did not receive neoadjuvant treatment and 28 who received routine chemotherapy. They described thicker, more complete pseudocapsules and fewer peritumour cells in the neoadjuvant group. We found fewer tumour cells in the oedema of patients who received both preoperative radio- and chemotherapy, although these findings were not statistically significant. A total of 37 patients with an oedema tail received neoadjuvant treatment, seven of whom (19%) had infiltration of tumour cells into the oedema. Three of nine patients whose tumour had an oedema tail, but who did not receive neoadjuvant treatment, had infiltration of tumour cells into the oedema. Therefore, even if the neoadjuvant treatment does not sterilize the field, we can see a trend towards a lower infiltration of tumour cells with preoperative treatment.

O'Donnell et al[24] also studied the relationship between the increased enhancement in the oedema after preoperative treat ment and the persistence of > 10% of viable cells (OR = 4.09, p = 0.030) and the increased risk of recurrence (OR = 4.95, p = 0.017) in a multivariate analysis. Our findings similarly suggest that radiotherapy alone is not enough treatment for the oedema in some patients. Other authors have historically reported changes in the histological composition and perme ability of the pseudocapsule in patients with both forms of neoadjuvant treatment.[24,25]

White et al[23] also did not find a significant increase in tumour cells in the oedema in relation to the size of the tumour, the length of the oedema, or the location (superficial or deep to fascia) of the tumour. Our results were closer to those of Yoo et al,[22] which suggested a higher rate of contamination of the oedema in smaller, superficial tumours. The difference compared with the findings of White et al[23] could be explained by the smaller sample size and the fact that all patients had radiotherapy irrespective of the size of the tumour. In our study, 8/19 (42%) smaller sarcomas and 6/27 (22%) larger sarcomas with oedema did not have neoadjuvant treatment, so neoadju vant treatment was less frequently used for smaller sarcomas. However, for smaller sarcomas with infiltration of the oedema, 5/9 had neoadjuvant treatment and four did not. Two patients with infiltrated oedema in a larger sarcoma had neoadjuvant treatment, and one did not.

Nakamura et al[15] described three radiological patterns in high-grade sarcomas: pushing growing, local infiltration, and diffuse infiltration. They found significantly worse overall and local recurrence-free survival in patients with diffuse infiltra tive patterns, elevated levels of CRP in the blood, and larger sizes of tumour. These factors had a statistically significant and independent relationship in multivariate analysis. The authors found a non-significant trend towards longer local recurrence-free survival for patients with pushing patterns compared with local infiltrative growth patterns. We found that patients with an oedema tail had a significantly worse overall survival and a trend towards a worse local recurrence-free survival in those whose oedema included tumour cells compared with those whose oedema did not.

Many authors have studied MFS and the correlation between an enhanced oedema tail and the prognosis, finding that the two-year local recurrence-free survival was signifi cantly worse in those with a MFS and an oedema tail (two-year local recurrence-free survival: 75.1% vs 92.8%, p = 0.019).[22] However, the presence of an oedema tail was not significantly associated with a decrease in survival for histologies other than MFS (two-year local recurrence-free survival: 91.7% vs 95.1%, p = 0.142). Kikuta et al[26] also reported a shorter local recurrence-free survival in MFS with enhanced oedema (30% to 82%) and a five-year disease-free survival of 80% to 65%.[26] In our series, a significantly decreased survival was associated with an oedema tail and infiltration with tumour cells ($p < 0.05$). This could reflect a more infiltrative pattern with increased cellular migration, as described by Nakamura et al.[15] Fascial oedema at the edge of the tumour on MRI and the infiltrative pattern are associated with a significantly worse prognosis in MFS and UPS.[13,16,26–30]

In conclusion, an oedema tail associated with a malignant soft-tissue tumour is probably related to its aggressive nature. This infiltrative pattern of growth can lead to the spread of tumour cells into the oedema. Tumour cells were present in 12/46 (26%) of the oedema tails included in our series. The rate of infiltration of the oedema with tumour cells was significantly higher in smaller tumours, and was significantly associated with a worse prognosis. Preoperative radio- and chemotherapy may decrease the infiltration with tumour cells, but they do not ster ilize the field. Thus, it is our opinion that the area of the oedema should be included in the initial local resection, particularly in patients with an UPS or MFS. Studies with larger sample sizes are required to identify the prognosis associated with the infiltration of tumour cells into the oedema and the role of preoperative treatment.

Take home message

- Oedema tail is associated with aggressive infiltrative tumours; 26% of them had tumour cells that would remain if we resected the tumour with a wide R0 margin, even with preoperative radiation.
- The smaller tumours have a higher risk of infiltration of oedema tail, and the tumour infiltration in oedema tail is associated with a poorer survival.
- Further studies are necessary, but the oedema resection may be considered in selected cases.

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