

Evaluation of Outcome and Surgical Treatment Results of Primary Malignant Chest Wall Tumors

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Background: Primary chest wall tumors originate from different constructions of thoracic wall. This study was conducted with the aim of investigating the clinical outcomes and surgical results of primary malignant tumors of the chest wall

Materials and Methods: This study was conducted in a retrograde manner on patients with Primary malignant chest wall tumors treated in the course of 10 years at Masih Daneshvari Hospital. All the mentioned patients were extracted from the cancer registration unit of the hospital and 40 samples were collected. Patient information was extracted based on a pre-designed questionnaire and then analyzed using SPSS statistical software.

Results: Out of the 40 patients, 67.6% were men and the average age of the patients was 36.3 years. The complication after surgery were observed in 55% of cases, the most common complications were seroma and wound infection. The one and three overall survival (OS) of patients in the present study was 88% and 61%, respectively. The mean (\pm SE) survival time (OS) in the R0 to R2 margin increased from 87.6 ± 10.5 and 87.2 ± 20.6 to 15.2 ± 4.5 months, respectively (p-value=0.001). 55% of patients had relapse. The mean (\pm SE) duration of recurrence (PFS) in the R0 to R2 margin increased from 38.1 ± 8.9 and 31.4 ± 14.1 to 7.9 ± 5.0 months, respectively (p-value=0.02).

Conclusion: The one and three overall survival (OS) of studied patients was 88% and 61%, respectively, and half of the patients experienced disease recurrence. The status of the margin was one of the factors affecting the duration of disease-free survival (PFS) and the duration of overall survival (OS).

Keywords: Primary chest wall tumors, Soft Tissue Sarcoma, Chemotherapy, Radiation therapy

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Introduction

The chest wall can give rise to a variety of masses, including traumatic hematomas, benign tumors, malignant tumors, and primary soft tissue sarcomas. Primary chest wall tumors are relatively rare and constitute only a small fraction of human malignant tumors, with an incidence of less than 2% (1, 2), accounting for approximately 5% of all thoracic neoplasms (3). Primary chest wall tumors can be classified into bone or soft tissue tumors, in addition to being benign and malignant, based on their tissue of origin (4). Approximately 60% of chest wall tumors are malignant (3), and approximately 45% of them arise from soft tissue (5). The clinical presentation of primary chest wall sarcomas is diverse. Some sarcomas grow slowly, present as a painless, palpable mass, and are discovered incidentally. In contrast, highly aggressive sarcomas appear as rapidly growing tumors that may invade adjacent thoracic structures such as the lung, mediastinum, vertebrae, and diaphragm. As a result, invasive chest wall sarcomas often cause pain, dyspnea, and in some cases, systemic symptoms (6, 7). Primary soft tissue sarcomas are highly heterogeneous and consist of a variety of histological types. Therefore, treatment strategies and clinical outcomes will vary based on the origin of the mass. Therefore, accurate evaluation and diagnosis of such masses are very important. Adopting appropriate surgical strategies for the treatment of chest wall neoplasms can reduce the risk of recurrence and improve patient survival (8). Therefore, in order to accurately manage such masses, it is very important to determine the outcomes and procedures performed in previous patients and can lead to the adoption of appropriate surgical strategies for the treatment of chest wall neoplasms and reduce the risk of recurrence and increase patient survival. Therefore, the purpose of this study was to investigate the outcomes of surgical treatment of primary malignant chest wall tumors who were hospitalized and operated on at Masih Daneshvari Hospital over a 10-year period.

Materials and methods

This cross-sectional study was conducted with the ethics code IR.SBMU.MSP.REC.1400.805 on patients with primary chest wall tumors who were treated at Masih Daneshvari Hospital between 2009 and 2019, which included 40 patients. The inclusion criteria for the study were primary chest tumors and the exclusion criteria included incomplete patient records and inability to follow up. Initial information regarding baseline and surgical information was extracted from the patient records, and information regarding patient outcomes until 2014 was collected through records or

telephone calls with the patients. The obtained data were entered into the SPSS 21 statistical software. All quantitative variables were expressed as mean and standard deviation and qualitative variables as number (percentage). The normality of quantitative variables was examined by histogram plotting test. And the t-test was used to compare quantitative variables and the Fisher's exact test was used to compare qualitative variables. The life table method was used to determine survival and the Kaplan-Meier method and Log rank test were used to compare survival duration, and in all cases, a p-value<0.05 was considered as a significant level.

Results

Of the 40 patients studied, 27 (67.6%) were males and 13 (32.5%) were females. The mean age of the subjects was 19.5 ± 36.3 years that ranged from 2 to 87 years. The mean age of the men and women studied was 39.1 ± 20.9 and 30.4 ± 15.5 years, respectively, which was not significantly different (p-value=0.194). The characteristics of the tumors in the patients studied are shown in **Table 1**, with the most common site of involvement seen in the ribs (92.5%), 1 (2.5%) case involving the sternum, and 1 (2.5%) case involving the scapula. In 25 (62.5%) cases involving soft tissue, and in 15 (37.5%) cases involving bone. Postoperative side effects in the studied patients showed that 18 (45%) of the patients had no obvious side effects. In terms of frequency of complications, hematoma, lung collapse, pleural effusion, wound infection + seroma, wound infection + bleeding, edema + nerve damage, hemorrhage + pulmonary embolism, and edema + chylothorax + nerve damage were each reported in one (2.5) patient, and hemorrhage, pneumothorax, and edema + hematoma were each reported in 2 (5%) patients and seroma in 5 (12.5%) patients. To reconstruct the chest of the studied patients after surgery, mesh was used in 15 (37.5%) patients, titanium mesh in 1 (2.5%) patient, soft tissue in 23 (57.5%) patients, and a combination of both methods was used in 1 (2.5%) patient. In total, 9 (52.9%) of 17 patients using mesh (mesh alone or in combination with soft tissue repair) developed one of the complications listed in the table below, compared to 13 (56.5%) of 23 patients using soft tissue reconstruction, which was not statistically significant (p-value=1.00). Preoperative and postoperative pathology reports in the subjects are shown in **Table 1**. The most common pathology before (30%) and after (20%) was PNET. In 18 cases, the pathology before and after surgery was the same. Pathological margins were R0 in 29 cases (74.4%), R1 in 6 (15.4%) cases, and R2 in 4 (10.3%) cases (one case with an unclear margin). Tumor size was less than 10

cm in 17 (54.8%) cases and 14 (45.2%) cases (9 cases with an unclear size). The most common symptom of the disease in the studied individuals was pain with a mass, which was observed in 18 (45%) patients. Mass alone was observed in 12 (30%) cases, pain alone in 4 cases (10%), chronic ulcer and fever + pain each in 1 case (2.5%), and pain + weight loss and mass + chronic ulcer each in 2 (5%) cases.

The results of the follow-up after surgery of the patients (**Table 2**) showed that 55% of the patients had recurrence and metastases occurred in 13 (32.50%)

patients. Reoperation was performed in 11 (27.5%) patients. In total, 15 (37.5%) patients died of various causes (**Table 2**). The overall survival (OS) of the first and third patients studied was 88% and 61%, respectively.

As shown in Table 3, 75% of patients with preoperative PNET pathology relapsed, while this rate was 46.4% in other pathologies, which was not statistically significant. The mortality rate was also higher in patients with preoperative PNET pathology,

Table 1. Frequency distribution of types of pathology reports before and after surgery in the studied subjects.

Time	Type of diagnosis	Number (%)	
Before the Surgery	Non	8 (20.0)	
	PNET	12 (30.0)	
	Malignant Melanoma	1 (2.5)	
	Sarcoma	4 (10.0)	
	Pleomorphic sarcoma	1 (2.5)	
	Ewing sarcoma	2 (5.0)	
	Spindle cell sarcoma	4 (10.0)	
	Malignant fibrous histiocytoma	1 (2.5)	
	Solitary fibrous tumor	1 (2.5)	
	Bone cyst tumor	1 (2.5)	
	Chondrosarcoma	5 (12.5)	
	After the Surgery	Pathological response	4 (10.0)
		PNET	8 (20.0)
Angiosarcoma		1 (2.5)	
LCH		1 (2.5)	
Chondrosarcoma		10 (25.0)	
Spindle cell sarcoma		5 (12.5)	
Malignant Melanoma		1 (2.5)	
Pleomorphic sarcoma		4 (10.0)	
Epithelioid sarcoma		1 (2.5)	
Osteosarcoma		2 (5.0)	
Ewing sarcoma		1 (2.5)	
Giant cell tumor		1 (2.5)	
liposarcoma		1 (2.5)	

Table 2. Frequency of outcomes of patients studied after surgery.

Index	Number (%)	
Recurrence	(22.0)	
Metastasis	13(32.5)	
Reoperation	1 (27.5)	
Death	15 (37.5)	
	Pulmonary metastasis	5 (33.3)
	Pulmonary + liver metastasis	2 (13.3)
	Peritoneal metastasis	1 (6.7)
	Brain metastasis	1 (6.7)
	Local recurrence	4 (26.6)
	COVID-19	1 (6.7)
	Pulmonary + brain metastasis	1 (6.7)

overall survival (OS) duration in PNET pathology but it was not statistically significant. The margin status in 9 patients with PNET pathology who relapsed was R0 in 8 patients and R2 in 1 patient. The mean (\pm SE) duration of relapse (PFS) in PNET pathology versus other pathology types was 45.2 ± 12.0 and 20.6 ± 5.9 months, respectively (p-value=0.078). The mean (\pm SE).versus other pathology types was 79.3 ± 16.7 and 81.2 ± 10.3 months, respectively (p-value=0.667)

The recurrence rate in the R0 to R2 margin increased from 48.3% to 75% for the metastasis index,

from 31% to 50%, and for the mortality index, from 34.5% to 75%, with no significant differences observed in any of the cases (**Table 3**). The mean (\pm SE) time to recurrence (PFS) in the R0 to R2 margin increased from 38.1 ± 8.9 and 31.4 ± 14.1 to 7.9 ± 5.0 months, respectively, which was statistically significant (P=0.02) (**Figure 1**). The mean (\pm SE) time to survival (OS) in the R0 to R2 margin increased from 87.6 ± 10.5 and 87.2 ± 20.6 to 15.2 ± 4.5 months, respectively, which was statistically significant (p-value=0.001) (**Figure 2**).

Table 3. Frequency distribution of outcome of the patients studied according to the variables studied.

Variable		Live / Deceased		Metastasis		Recurrence	
		Number (%)		Number (%)		Number (%)	
		Deceased	Live	Yes	No	Yes	No
PNET	Type of pathology	5 (41.7)	7 (58.3)	4 (33.3)	8 (66.7)	9 (75.0)	2 (25.0)
Other types	before surgery	10 (35.7)	18 (64.3)	9 (32.1)	19 (67.9)	13 (46.4)	15 (53.6)
P-value		0.736		1.000		0.165	
R0	Pathological margin	10 (34.5)	19 (65.5)	9 (31)	20(69.0)	14 (48.3)	15 (51.7)
R1		2 (33.3)	4 (66.7)	2 (33,3)	4 (66.7)	4 (66.7)	2 (33.3)
R2		3 (75.0)	1 (25.0)	2 (50.0)	2 (50.0)	3 (75)	1 (25.0)
P-value		0.226		0.617		0.342	
<10	Tumor size	4 (23.5)	13 (76.5)	4 (23.5)	13 (76.5)	9 (52.9)	8 (47.1)
=>10		5 (25.7)	9 (64.3)	6 (42.9)	8 (57.1)	8 (57.1)	6 (42.9)
P-value		0.693		0.441		1.000	
The existence of the answer	Pathological response	1 (25.0)	3 (75.0)	-	4 (100.0)	2 (50.0)	2 (50.0)
Lack of response		14 (38.9)	22 (61.1)	13 (36.1)	23 (63.9)	20 (55.6)	16 (44.4)
P-value		1.000		0.284		1.000	

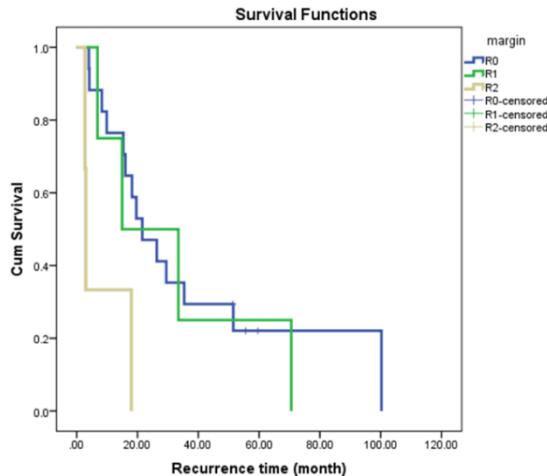


Fig. 1. Recurrence time status according to pathological margin in the studied individuals.

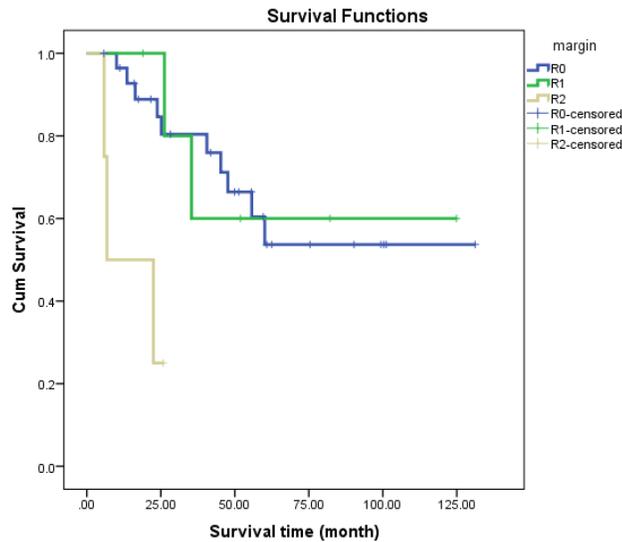


Fig. 2. Survival time status according to pathological margin in the studied individuals.

In tumor sizes less than and greater than 10 cm, the recurrence rate was 52.9 and 57.1%, the metastasis rate was 23.5 and 42.9%, and the death rate was 23.5 and 35.7%, respectively, with no significant difference observed in any of the cases (**Table 3**). the mean (\pm SE) PFS for tumor sizes less than and greater than 10 cm was 40.8 ± 11.6 and 16.9 ± 6.0 months, respectively (p -value=0.129). the mean (\pm SE) OS for tumor sizes less than and greater than 10 cm was 103.6 ± 12 and 59.3 ± 11.4 months, respectively (p -value=0.177).

According to the presence or absence of pathological response, the recurrence rate was 50 and 55.6%, the metastasis rate was zero and 36.1%, and the death rate was 25 and 38.9%, respectively, with no significant difference in any of the cases (**Table 3**). the mean (\pm SE) PFS for the presence or absence of pathological response was 40.0 ± 7.9 and 26.0 ± 6.2 months, respectively (p -value=0.137). the mean (\pm SE) overall survival (OS) duration in the presence or absence of pathological response was 56.9 ± 4.7 and 79.7 ± 9.9 months, respectively (p -value=0.434).

Discussion

The present study was conducted to investigate the clinical outcomes and surgical results of primary malignant chest wall tumors treated at Masih Daneshvari hospital over a 10-year period. The results of the present study showed that the overall survival (OS) of patients 1 and 3 in the present study was 88% and 61%, respectively. in a study conducted by king et al. on 90 patients with primary malignant chest wall tumors, the 1-year survival rate was 89% (9). Also, the 3-year survival rate in the study by Bagheri et al. in

Mashhad, which was conducted on 40 patients with primary malignant chest wall tumors, was 65% (10), which is similar to the present study. several factors play a role in the survival of patients with chest tumors, and the results of the present study also showed that the median survival (OS) in patients with r0 margins was significantly longer than in patients with R1 and R2 margins. In a study conducted by Collaud et al. on 33 patients with thoracic sarcoma, the R0 margin was a factor affecting patient survival (11). However, the type of PNET pathology (versus other types of pathology), the presence of pathological response, and tumor size did not have a significant relationship with patient survival, which is probably due to the small number of samples in the present study. In a study conducted by Kocaman et al. on 77 patients with primary and secondary malignant tumors of the chest wall, tumor grade was a factor affecting patient survival (12). Or in the study by Bagheri et al. in Mashhad, the type of pathology was a factor affecting patient survival (10).

The results of the follow-up after surgery of the patients studied show that about half of the patients (55%) experienced recurrence. This rate was reported to be 60% in the study by Bagheri et al. in Mashhad (10), which was similar to the present study. In a study conducted by shah et al. on the results of treatment of 115 patients with primary malignant thoracic tumors, the local recurrence rate was reported to be 50% (13), while this rate was reported to be 52% in the study by king et al. (9). Comparison of the present study and other studies shows that a high percentage of patients with malignant thoracic wall tumors experience recurrence after surgery, which may be related to

various factors such as tumor characteristics, treatment method, individual genetic characteristics, and residual tumor cells. Further and more detailed studies in related fields are needed to investigate the cause of recurrence more precisely. In the present study, the median time to recurrence (PFS) was longer in PNET pathology compared to other pathology types, but it was not statistically significant, which is probably due to the small number of samples in the present study. However, margin status was an effective factor and a significant variable in the time to recurrence, and people with R0 margins relapsed after a longer time compared to people with R1 and R2 margins. In the study by Collaud et al., tumor grade and wide resection were effective factors in the absence of recurrence (11). In the present study, although smaller tumor size (compared to larger tumor size) and the presence of pathological response (compared to the presence of pathological non-response) were associated with a longer time to recurrence, no significant difference was observed in either of these two cases, which is probably due to the small number of samples in the present study.

The results of the present study showed that the mean age of the subjects was 36.3 years and most of the patients (67.6%) were males. In a study conducted by Tabatabaei et al. in Isfahan, the mean age of patients with malignant thoracic tumors was 44.7 years and 56.5% of the patients were males (14). However, this malignancy occurs at any age and affects a wide age range from children to the elderly.

The most frequent adverse events in the present study were seroma and wound infection, and overall postoperative adverse events were observed in half of the patients (55%). The reconstruction method with mesh or soft tissue had no significant effect on the occurrence of postoperative complications, and about half of the patients experienced postoperative complications in both methods. Surgical site complications are mainly related to the wound, prosthesis, or soft tissue flap. In a review study conducted by Lampridis et al., which reviewed 15 large studies (the initial inclusion criteria for studies were a sample size of at least 50 cases) on the management of complications after chest wall resection and reconstruction, the rate of postoperative complications was reported in different studies from 4% to 49% (15). Comparison of the results of the present study and other studies shows that postoperative complications occurring in a significant percentage of people, which can vary in different studies due to differences in the type of patients and the conditions of the patients. In any case, it includes a significant percentage. Close postoperative monitoring, increased vigilance for severe complications, and a multidisciplinary approach to controlling complications are essential. By

emphasizing the prevention and prompt treatment of complications, complications can be controlled in patients undergoing chest wall resection and reconstruction.

This retrospective study had several limitations. Due to the rarity of primary malignant chest wall tumors, the study population was small and the patients were heterogeneous, and the study covered a long period of time. Therefore, the reliability of the statistical analyses presented in this study may not be high, and the surgical resection and reconstruction strategies were not homogeneous during the study period. Therefore, to overcome the inherent limitations of primary malignant chest wall tumor studies, an organized multicenter registry system should be established in the country.

Conclusion

The results of the present study showed that the overall survival (OS) of patients one and three in the present study was 88% and 61%, respectively, and half of the patients experienced disease recurrence. Margin status was an effective factor in disease-free survival (PFS) and overall survival (OS), and other factors such as pathology type, tumor size, and the presence of pathological response did not have a significant effect on PFS or OS.

Declaration

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Conflict of interest

The authors reported no conflicts of interest.

References

1. Faber LP, editor Chest wall tumors: introduction. *Seminars in Thoracic and Cardiovascular Surgery*; 1999.
2. Athanassiadi K, Kalavrouziotis G, Rondogianni D, Loutsidis A, Hatzimichalis A, Bellenis I. Primary chest wall tumors: early and long-term results of surgical treatment. *European Journal of cardio-thoracic surgery*. 2001;19(5):589-93.
3. Hsu P-K, Lee H-C, Hsieh C-C, Wu Y-C, Wang L-S, Huang B-S, et al. Management of primary chest wall tumors: 14 years' clinical experience. *Journal of the Chinese Medical association*. 2006;69(8):377-82.
4. Shah AA, D'Amico TA. Primary chest wall tumors. *Journal of the American College of surgeons*. 2010;210(3):360-6.

5. Chou AJ, Merola PR, Wexler LH, Gorlick RG, Vyas YM, Healey JH, et al. Treatment of osteosarcoma at first recurrence after contemporary therapy: the Memorial Sloan-Kettering Cancer Center experience. *Cancer: Interdisciplinary International Journal of the American Cancer Society*. 2005;104(10):2214-21.
6. Cipriano A, Burfeind W. Management of primary soft tissue tumors of the chest wall. *Thoracic Surgery Clinics*. 2017;27(2):139-47.
7. Thomas DA, Massagué J. TGF- β directly targets cytotoxic T cell functions during tumor evasion of immune surveillance. *Cancer cell*. 2005;8(5):369-80.
8. Nystrom LM, Reimer NB, Reith JD, Dang L, Zlotecki RA, Scarborough MT, Gibbs Jr CP. Multidisciplinary management of soft tissue sarcoma. *The Scientific World Journal*. 2013;2013(1):852462.
9. King RM, Pairolero PC, Trastek VF, Piehler JM, Payne WS, Bernatz PE. Primary chest wall tumors: factors affecting survival. *The Annals of thoracic surgery*. 1986;41(6):597-601.
10. Bagheri R, Haghi SZ, Kalantari MR, Sharifian Attar A, Salehi M, Tabari A, Soudaneh M. Primary malignant chest wall tumors: analysis of 40 patients. *Journal of cardiothoracic surgery*. 2014;9:1-6.
11. Collaud S, Stork T, Dirksen U, Pöttgen C, Hegedüs B, Schildhaus H-U, et al. Surgical treatment for primary chest wall sarcoma: A single-institution study. *Journal of Surgical Research*. 2021;260:149-54.
12. Kocaman G, Kahya Y, Balcı BMK, Yenigün BM, Özkan M, Özakıncı H, et al. Oncological results in primary and secondary malignant chest wall tumors. *Turkish Journal of Thoracic and Cardiovascular Surgery*. 2024;32(1):55.
13. Shah AC, Komperda KW, Mavanur AA, Thorpe SW, Weiss KR, Goodman MA. Overall survival and tumor recurrence after surgical resection for primary malignant chest wall tumors: a single-center, single-surgeon experience. *Journal of Orthopaedic Surgery*. 2019;27(2):2309499019838296.
14. Tabatabai sa, Hashemi sm, Ahmadi Nejad m, Toolabi a, Afshar Pour s. Study of frequency of operated chest wall tumors In Al Zahra hospital from 2007 to 2009,Isfahan,Iran. *scientific magazine yafte*. 2011;13(2):69-73.
15. Lampridis S, Minervini F, Scarci M. Management of complications after chest wall resection and reconstruction: a narrative review. *Journal of Thoracic Disease*. 2024;16(1):737.