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RESEARCH ARTICLE

SURGICAL TREATMENT RESULTS IN PRIMARY CHEST WALL TUMORS. A SINGLE INSTITUTION EXPERIENCE

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ABSTRACT

Background: Primary chest wall tumors constitute 1-2% of all malignancies, 5% of thorax tumors, and are histopathologicallymalignant in 80% of cases. Cases whichwere operated on due to primary chest wall tumor between March 2007 and October 2014 at our clinic were evaluated retrospectively in our study assingle institution experience.

Methods:A total of ten men and seven womencases witha mean age of 50.5 (range: 14-86) years were surgically treated. Tumors originated from the bony structures in nine (53%) cases, and from soft tissue structures in eight (47%) cases.Age, gender, symptoms, place and diameter of tumor, complications, recurrence, treatment methods, survival, duration of hospitalization, materials used for reconstruction, and survival outcomes were evaluated retrospectively.

Results: Rib resection was performed in eight cases, sternum resection was performed in one case, rib resection and partial sternum resection were performed in one case (accompanying pulmonary wedge resection in three cases), and soft tissue resection was performed in seven cases. Defects were reconstructed infive cases using various materials. The mean tumor diameter was 10.5±4.4 (4-20) cm. Histopathological diagnosis after resection was sarcoma in six (35%), mesenchymal tumor in six (35%), schwannoma in three (18%), desmoidtumor in one (6%), and chondroma in one (6%) case.Median survival was 40±35.2 (range: 3-96) months. No mortality was observed in the early phase, and one case developed wound infection.One other case developed seroma and pleural effusion during the follow-up.

Conclusions: Chest wall tumors typically present themselves with pain or swelling. Early diagnosis and wide resection with negative surgical margins are required for the best treatment.

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INTRODUCTION

Approximately 50-80% of chest wall tumors are malignant (1). Primary malignant tumors of the chest wall may arise from the bone, cartilage, or soft tissues. Primary chest walltumors (PCWTs) are rarely seen tumors that constitute 1-2% of all malignancies, and 5% of thorax tumors(2,3).The most commonly encountered chest wall tumors are reported as malignant fibrous histiocytoma and chondrosarcoma, whereas the most commonly encountered benign tumors are chondroma and desmoid tumor(4).Many types are resistant to chemotherapy and radiotherapy, which increases the significance of surgical resection.The current study evaluated PCWT cases that had surgical resection and retrospectively reviewed the resultsand various therapeutic strategies as single institution experience.

MATERIALS AND METHODS

A total of 17 cases (10 men, 7 women) with a mean age of 50.5 (range: 14-86) years, who were operated on due to primary malignant chest wall tumor at our clinic between 2007 and 2014 were included in the study. Informed consent was provided from all cases before the procedure. In the preoperative evaluation of cases, anamnesis, physical examination, Postero anteriorand lateral chest radiographies, computerized thorax tomography, thorax magnetic resonance imaging (MRI), and PET-CT were performed. Six cases (35%) were diagnosed preoperatively by excisional biopsy, and other cases were diagnosed during the procedure by frozen sectioning, and

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postoperative histopathological examinations. In all cases, resection was performed at a 4 cm margin of safety for the chest wall, and resection was performed in cases with suspected surgical margins by frozen pathology work-up.After the resection, reconstruction with autologous or synthetic materials was performed in five cases (33%) with anterior chest wall defects larger than 5 cm.Accompanying pulmonary wedge resection was performed in three of these cases. The most common symptoms were swelling in 11 cases (65%), pain in five cases (29%), pain and swelling in one case (6%). The tumor originated in the bony structures in nine cases (53%) (ribs+sternum), and from the soft tissues in eight cases (47%). Age, gender, symptoms, location and diameter of tumor, complication, recurrence, pre- and postoperative additional treatment methods, survival, hospitalization duration, and materials used during reconstruction were evaluated for all cases.

RESULTS

Rib resection was performed in eight cases (47%) with primary malignant chest wall tumors. Sternum resection was performed in one (6%) case,and rib and partial sternum resection were performed in one (6%) case.Accompanying pulmonary wedge resection was performed in three of those cases.Soft tissue resection was performed in seven (41%) cases.Various reconstruction methods and grafts were used for defects (Table 1).Histopathological diagnoses after the resection were reported as sarcoma in six (35%) cases, mesenchymal tumors in six (35%) cases, schwannoma in three (18%) cases, desmoid tumor in one (6%) case, and chondroma in one (6%) case (histological subgroups were summarized in Table 1). The mean pathological tumor diameter was 10.5±4.4 (4-20) cm.The mean hospitalization duration was 12.1(range: 5-30)days. In a case operated on for liposarcoma wound infection developed postoperatively; therefore, they were treated by debridement and VAC (Vacuum Assisted Closure), and reconstructed by a free skin graft. In a case with a malignant mesenchymal tumor, seroma and pleural effusion developed on the graft in the postoperative first month. Effusion was drained via a pleural drainage catheter.

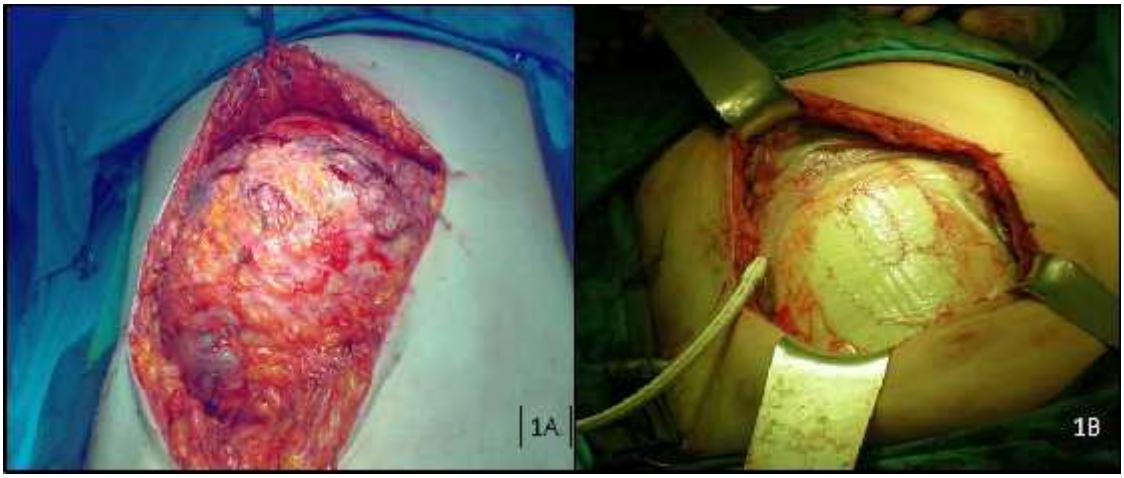

Figure 1A Preoperative image of malignant mesenchymal tumor at the chest wall. **1B:**Reconstruction with sandwich grafting using methyl methacrylate bone cement and dual mesh after tumor resection.

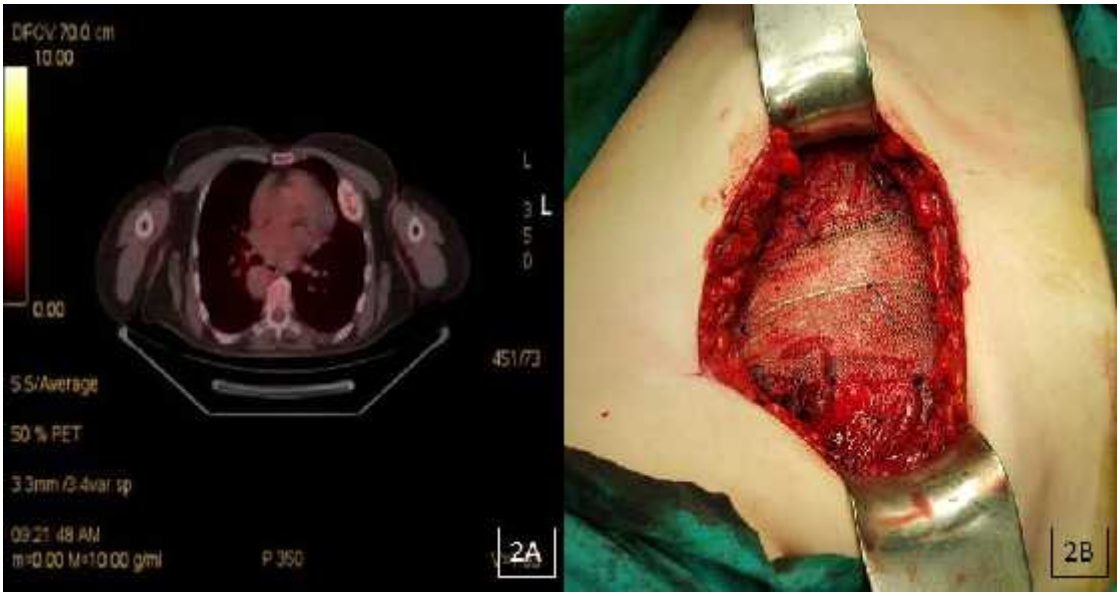

Figure 2A Positron emission tomography shows mass in rib**. 2B:** Preoperative picture indicates chest wall reconstruction with polypropilen mesh and intramedullary Kirshner wire.

The casedied due to respiratory failure and sepsis in the postoperative fourth month after chemotherapy. In a case operated on for chondrosarcoma, the casedied due to cardiac causes in the third month. The median survival in all cases was 40±35.2 (range: 3-96) months. During the follow-up, recurrence was detected in five (29%) cases. Surgical and neoadjuvant or adjuvant therapies and survival rates of all cases are summarized in Table 1. Although it was not statistically significant, it was observed that baseline symptoms appeared 18 (range: 1-60) months later in recurrent cases.

Table 1 Treatmentmodalitiesandsurvivalaccordingtohistopathologicaltumortypes

Name	Age	Gender	Histopathology	Prosthesis	Survival (month)	Neo CT	Neo RT	Adj CT	Adj RT	Recurrence
1	25	F	Desmoid type fibromatosis	-	96	-	-	-	-	4 times
2	78	M	Malignant mesenchymal tumor	-	50	-	-	+	+	-
3	75	M	Pleomorphic liposarcoma	-	84	+	+	+	+	2 times
4	14	M	Malignant mesenchymal tumor	-	40	+	-	-	-	-
5	36	F	Leiomyosarcoma	Prolene mesh	81	-	-	-	-	-
6	64	M	Malignant mesenchymal tumor	Prolene mesh + Methyl Methacrylate bone cement	5	-	-	+	+	-
7	45	M	Myxofibrosarcoma	-	68	-	-	-	+	-
8	55	M	Chondrosarcoma	Prolene mesh	3	-	-	-	-	-
9	24	F	Chondroma	-	36	-	-	-	+	-
10	37	F	Schwannoma	-	57	-	-	-	-	-
11	82	F	Schwannoma	-	83	-	-	-	-	-
12	51	M	Dermatofibrosarcoma protuberance	Split-thickness skin graft	94	-	-	-	-	3 times
13	28	F	Malignant mesenchymal tumor	-	16	-	-	-	-	-
14	73	M	Myxoidliposarcoma	-	17	-	-	+	-	4 times
15	49	M	Malignant mesenchymal tumor	Prolene mesh + methyl Methacrylate bone cement	4	-	-	+	+	-
16	37	F	Schwannoma	-	5	-	-	-	-	-
17	86	M	Malignant solitary fibrous tumor	-	5	-	-	-	-	1 time

Neo CT: Neoadjuvantchemotherapy
Neo RT: Neoadjuvantradiotherapy
Adj CT: Adjuvantchemotherapy
Adj RT: Adjuvanradiotherapy

DISCUSSION

The most commonly encountered malignant tumors in the literature are malignant fibrous histiocytoma and chondrosarcoma; the benign tumors are reported as chondroma and desmoid tumor(4). Of primary malignant chest wall tumors, approximately 55% originate from cartilage and bone tissue, whereas 45% originated from soft tissues(3,5). Primary sternum involvement is lower than 1%, and it is nearly always malignant(6). In the current study group, 53% of tumors originated from bone tissues of the thorax wall, and 47% originated from the soft tissues of the thorax wall.Although PA radiography was commonly the first imaging method, computerized tomography was superior in showing cortical destruction and calcification, but magnetic resonance imaging was the preferred method in recent years. Positron emission tomography (PET) was recommended in showing metastasis and in ruling out other primary tumors (7).We started to use the PET method in our cases to screen distant metastases since 2009. The most prominent symptoms of chest wall tumors are pain and swelling. It is very rare that malignant tumors are asymptomatic. The presence of pain in PMCWT indicates a poor prognosis.Burt *et al*. (2) reported that the complaints of cases with primary malignant chest wall tumors were swelling in 50% of cases, pain and swelling in 33% of cases, and pain in 15% of cases. The complaints of our cases were swelling in 11 cases (65%), pain in five cases (29%), and pain and swelling in one case (6%).In general, the primary principle is to initially perform an excisional biopsy for diagnosis, and then to perform a wide excision leaving at least 4 cm of healthy tissue in all directions in chest wall tumors, whereas to perform a wide excision including one well rib above and below with negative surgical margins in rib tumors (1,3,7).If complete resection cannot be performed, then recurrence is observed within a very short period of time. Microscopically, negative surgical margins may be provided in 80% of primary sarcomas, and 64% of recurrent sarcomas.

When compared to primary sarcomas, chance of local control after surgery was lower in recurrent sarcomas (8). In our study, resection was performed, consistent with the literature, including 4 cm healthy margins, and including one healthy rib above and below in cases with bone tissue invasion. Reconstruction was performed in four cases with tumor diameter> 5 cm at the chest wall. Recurrence was detected in five cases (29%) in the five-year follow-up (Table 1). As recurrent cases had complaints longer than 18 months, it was believed that PMCWT showed late manifestations, and with early awareness and diagnosis, these cases might have had a longer period of time without recurrence if surgery with negative margins was performed. After wide chest wall resection, reconstruction is required to prevent flail chest, paradoxical breathing, pulmonary herniation, and to provide chest wall stability. There are two ways to close defects: prosthetic or autologous tissue (pedicled muscular or musculocutaneousflaps)with excellent circulation support (9,10).Reconstruction may not be required in small area resections that are approximately <10 cm in diameter or under the scapula in the posterior chest wall, and that are approximately <5 cm in diameter at the anterior chest wall. In addition to these exceptions, chest wall stabilizers should be used due to causes mentioned above.The recommended reconstruction methods are the closure of defects by synthetic materials (Polytetrafluoroethylene (PTFE) mesh, polypropylene mesh, polyester mesh, composite prosthesis- methyl

methacrylate bone cement, etc....), titanium osteosynthesis materials, and autologous materials (bone grafts, muscular transpositions, etc....) (11).Various studies have reported that biological grafts were safe and they might be alternatives for synthetic grafts, especially incases of the pediatric age (12). However, we also believe that experience of the surgeon is important in addition to tissue depth containing the tumor, localization, and cosmetic results of tissue flaps during reconstruction, as mentioned previously by Tepliakov *et al*. (13).We used autologous or synthetic graft in five cases (29%), which were polypropylene mesh in two cases, polypropylene mesh and methyl methacrylate "sandwich" graft in onecase, dual mesh and methyl methacrylate "sandwich" graft in one caseand partial split-thickness skin graft in one case (Figure 1,2). Methylmethacrylate placed between the two layers of a mesh, or one or two rib grafts fixed to the mesh, can be used to gain additional stability in huge defects to avoid paradoxical breathing. Infection and seroma the most common complication that develops around the Methylmethacrylate mesh. Antibiotics must be started ifan infectionensues, which may need prosthesis removal. Seroma and effusion also developed in a case with malignant mesenchymal tumor who was reconstructed through methylmethacrylate. Po-Kuei Hsu *et al*.(14) reported that the median tumor diameter of primary malignant chest wall tumors was 9.17±5.36 cm, whereas it was 6.52±5.06 cm in benign tumors.The mean pathological tumor diameter was 10.5±4.4 (4-20) cm in the current study. The mean tumor diameter was 9.8 cm in recurrent cases, whereas it was 10.7 cm in non-recurrent cases. When pathological tumor diameter and time for application to the physician were considered, it was observed that recurrence was more common in cases that had a symptom initiation time longer than 18 months. However, this result was not statistically significant.Sabanathan*et al*.(2)reported the five-year survival rate of cases with primary malignant chest wall tumor as 68% in radical en-block resections.In the current series, the survival time ranged between 3 and 96 months, and the median survival time was calculated as 40 months. Demir*et al*.(15)performed a study on primitive neuroectodermal tumors of the chest wall, and reported a five-year survival rate of 77% in cases receiving neoadjuvant chemotherapy, whereas this value was 37% in cases who did not receive chemotherapy. Local recurrence and distant organ metastasis were lower in thecase group receiving neoadjuvantchemotherapy.In the same study, it was concluded that neoadjuvant treatment increased the survival rate. Neoadjuvant therapy may be considered in high-risk sarcomas: high-grade soft tissue sarcomas, high-risk bony sarcomas (Ewing sarcoma, osteosarcoma, dedifferentiated chondrosarcoma and mesenchymal sarcoma), and a some of desmoid tumors (16). One case with pleomorphicliposarcoma and malignant mesenchymalsarcoma received induction therapy in our study. Adjuvant chemotherapy is a standard treatment in soft tissue and bone tumors in children. Although the benefits of adjuvant therapy in soft tissue and bone tumors in adults differed between treatment receivers and non-receivers, no statistically significant difference was determined. In the current study, seven cases (41%) received adjuvant therapy (Table 1). However, the effects of adjuvant therapy on recurrence or survival were not statistically significant in our study. This may be caused by the small sample size of the study group to reach healthy data. Targeted treatments have been in the clinical trial stage. No distant organ metastasis orlocal recurrence wasdetermined among our cases during the follow-up period. Respiratory complications, such as respiratory insufficiency, pneumonia, chest wall instability, atelectasis, effusion, foreign body reaction, and cardiac rhythm disorders may be seen during operation, but these complications have been observed less frequently in anterior and lateral tissue defects in which rigid grafts have been used (17). Postoperative wound infection developed in one of the cases who were operated on for liposarcoma.Wound debridement was performed; and daily wet dressings, antibiotherapy according to the culture, and VAC treatment were performed. One month after the recovery of infection, free skin grafting and reconstruction were performed the using latissimusdorsimuscle. During the follow-up, seroma and pleural effusion developed on the graft in one case with a malignant mesenchymal tumor. Both of them were drained. The casedied due to respiratory insufficiency and sepsis in the postoperative fourth month after adjuvant chemotherapy.

CONCLUSION

Chest wall tumors are rarely encountered. Survival prognosis is generally unfavorable. For a successful treatment and cure, the goal should be wide resection with negative surgical margins in cases suitable for resection. Reconstruction of the defect after the resection should be decided according to size and place of a defect, and choice and experience of the surgeon. This study is a retrospective, nonrandomized small sized case population study and although it is not statistically significant, the appearance of initial symptoms after a mean duration of 18 months (range: 1-60 months) indicates the importance of early diagnosis in recurrent cases. However further long term studies including more cases and longer follow up times are needed.

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