

## Primary and Secondary Tumors of the Sternum

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### ABSTRACT

Sternal tumors are very rare and challenging. Secondary sternal tumors are more common than primary tumors. These tumors are usually refractory to chemotherapy and radiotherapy, and surgery is the best choice for their treatment. In this study, we reported the collected data of 15 patients with primary and secondary tumors of the sternum, histological type, as well as kind of resection and reconstruction. Out of 15 subjects, 13 and 2 cases had primary tumors and sternal metastases, respectively

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The chest wall tumors remain a clinical challenge even for experienced surgeons. Unfortunately, there is a significant rate of morbidity and mortality due to misdiagnosis, insufficient resection of tumors, and inappropriate reconstruction of thoracic wall defects. Sternal tumors are also rare and challenging.

Nearly all sternal tumors are secondary and typically caused by metastasis from malignant tumor of the lung, breast, kidney, and thyroid. Primary sternal tumors are rare and account for only 1% of primary bone neoplasms worldwide (1). The most common primary malignant bone tumor of the sternum is chondrosarcoma (33%) and then myeloma, plasmacytoma, lymphoma,

and occasional lesions, such as osteosarcoma, fibrosarcoma, and Ewing sarcoma (2, 3)

The results of studies conducted on chest wall tumors have shown that surgical approaches are probably the best treatment for primary tumors and some secondary tumors of the chest wall. In addition, it seems that surgery is a more successful and curative option for patients with chest wall tumors than other methods (4); however, surgeons should carefully consider that adequate wide margin resections and reconstruction of the anterior chest wall are essential (3).

The present study was conducted on a total of 198 patients who referred to Ghaem

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Hospital of Mashhad, Iran, due to chest wall tumors from 2000 to 2018 and Data analysis was performed on the demographic data of the patients, pathology of the sternum tumor, and involved region. Finally, 15 patients were chosen for the

investigation. Out of 15 patients, 13 and 2 subjects had primary tumors and sternal metastases, respectively. In this study 7 and 8 patients were male and female, respectively. (Table 1)

**Table 1:** Patient characteristics and kinds of tumor

Number of patients	Male/female	Age	Tumor	Surgery
1	M	30	Osteosarcom G1	Total excision sternum+Bone cement Reconstruction(sandwich) +pectoral muscle
2	M	59	Spindle cell sarcoma( high grade Pleomorphic sarcoma)	Total tumor excision+Reconstruction with mesh sandwich &omentum+wall repair
3	M	25	Undifferentiated carcinum	Tumor biopcy
4	M	16	Liposarcom G2 but IHC:Rhabdomyosarcom	Sternum&cartilage resection+ sandwich mesh reconstruction
5	F	60	Post radiation osteosarcom	Wide resection of sternum &cartilage+pericardiectomy+recostruction with sement&mesh( died after one week)
6	F	68	Chondrosarcom	Total excision chondrosarcom+sandwich mesh &omentum+chemotherapy
7	F	71	Osteosarcoma	Massive resection and reconstruction
8	F	32	Mass sternum &neck	Biopsy (non-hogkin lymphoma)(chemotherapy)
9	M	60	Sternal mass(1/3 superior)	Excisional biopsy(Osteosarcom)
10	F	55	Plasmacytoma	Core needle biopsy.reffered to oncologist.
11	F	13	Massive necrotic mass (Hogkine lymphoma)	Core needle biopsy(chemotherapy)
12	M	57	Osteosarcom	Sternum&manuberium&cartilage bilateral excision+reconstruction with mesh &sement(sandwich)
13	F	74	Thyroid metastasis	Total thyroidectomy +manuberium resection+reconstruction with dual mesch(without sement)+pectoral muscle
14	F	74	Chondrosarcom	Total sternectomy&bilateral cartilagectomy&head of clavicle +reconstruction with mesh(sandwich)
15	M	40	Metastasis to clavicle head &sternum&1 <sup>st</sup> rib mass	Resection of clavicle head &sternum&1 <sup>st</sup> rib.

The median age of the patients was 55 years. In addition, the youngest and oldest patients were 13 and 80 years old. Primary tumors included osteosarcoma, spindle cell sarcoma, undifferentiated sarcoma, liposarcoma, post-radiation sarcoma, chondrosarcoma, non-Hodgkin's lymphoma, plasmacytoma, Hodgkin's lymphoma, thyroid metastasis, and lung metastasis. One of these patients was reported in another study. He had primary osteosarcoma and underwent extensive surgery and then reconstitution with mesh sandwich separately (5).

One patient suffered from osteosarcoma and was advised for the radiotherapy of right breast cancer. One week after massive resection of the sternum and ribs, as well as pericardial lesions, the patient died due to a heart attack. Moreover, eight patients who had sarcomas underwent surgery and reconstruction. One subject with plasmacytoma and two cases of lymphoma referred to an oncologist for radiotherapy and chemotherapy. Thyroid metastasis to the sternum and lung metastasis to the clavicle and sternum were reported for two patients with metastases, respectively (Figure 1). One patient with undifferentiated carcinoma had a massive invasion with no possible resection.

Sternal primary tumors only account for about 0.9% of all primary bone tumors (3), and nearly all of them are malignant (6). The most common primary malignant tumor of the sternum is chondrosarcoma, and less common tumors are osteosarcoma, myeloma, and malignant lymphomas (3, 6). Primary benign sternal tumors are rare. There have been descriptions regarding giant-cell tumor (2, 3, 7, 8), chondroma (3), osteoblastoma (9), and hemangioma (10), (11). A majority of anterior chest wall malignancies arise from ribs, sternum, sternoclavicular joint or chondrocostal junction, and surrounding soft tissues. Surgery is still the best treatment for sternal primary tumors.

Radical en bloc excision is performed when clinical findings and radiological features are suggestive of malignancies. In the first surgery, resection should be performed wide

enough with the aim of preventing local recurrence. Chondrosarcomas are not responsive to radiotherapy and chemotherapy, and radical en bloc excision provides longer survival time (12).

Fine-needle aspiration does not have a clear role in the diagnosis of primary chest wall tumors. It is controversial because the derived specimen is not usually enough and sometimes can cause misdiagnosis. It is also believed that small chest wall tumors should undergo excision biopsy and large tumors should undergo incision biopsy. Computed tomography scan provides more data, such as tumor location, tumor morphology, and probable invasions. To provide more data about vascularity of tumor, intravenous contrast should be injected (7).

About 2% of all chest wall tumors are lymphomas. In these cases, the disease usually extends to mediastinum (8). As mentioned, isolated primary chest wall lymphoma is rare. The biopsy has an important role in diagnosis. In the case series report of 4 patients, Witte et al. performed chemoradiotherapy as the mainstay of treating these tumors. (6). In unusual cases, it is suggested to perform surgical resection and then adjuvant chemotherapy.

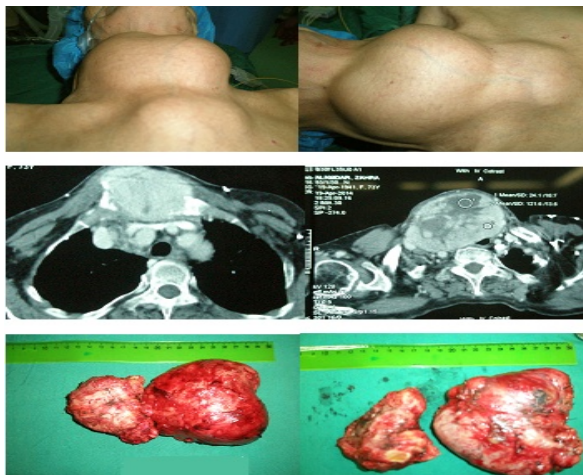
At the time of diagnosis, 3-4% of patients with the follicular thyroid carcinoma and about 1% of subjects with the papillary carcinoma had distant metastasis (Figure 2) (13). Follicular variants of metastasis to the bone and lung are more common due to hematogenous spreading, and papillary variants are less common. Clinical presentation and pathological features of insular tumors of the thyroid are similar to the papillary carcinoma. Lymphatic spreading, extra-thyroidal invasion, metastasis to the lung and bone, and visceral involvement are the similar features of them (10).

In the case of solitary bone metastasis, surgery is the first-line therapeutic modality. Up to now, surgery remains the only curative option and can provide longer survival with improved quality of life (9). Radical resection is recommended only in primary and solitary secondary malignant sternal tumors can only be undergone radical resection if there is no metastasis.

To prevent pulmonary complications, such as flail chest and paradoxical breathing, the sternum should be reconstructed adequately after tumor resection. It also causes the protection of underlying structures (10) and results in better functioning and better cosmetic outcomes. Surgeons can choose several methods for reconstruction depending on their preferences. To generate a stable construction commonly a methyl methacrylate and polypropylene mesh as a sandwich mesh is employed (14).



**Figure 1:** 15 year's old man with sternal liposarcoma, sternum resection and reconstitution with sandwich mesh



**Figure2:** Metastase of thyroid cancer to sternum, and resection of manubrium and sternum, reconstitution with mesh (without cement)

#### Conflict of interest:

The authors declare that they have no competing interest.

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