Chest Wall Tumors

A review of clinical experiences with 30 cases.*

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Tumors of the chest wall, although not uncommonly encountered, have received relatively little attention in the literature. In view of this, we are prompted to present a review of our clinical experiences with 30 such tumors particularly to emphasize their insidious nature and the consequent necessity for early and adequate surgical extirpation. The clinical features of benign and malignant chest wall tumors will be reviewed and the principles of their surgical management discussed. The sequence of inadequate primary excision of an ostensibly benign tumor followed by repeated local recurrences and ultimately by widespread metastases is tragically documented in several of our cases. Also, two cases are included in which a metastatic chest wall tumor provided the sole clue to the location and nature of a silent primary neoplasm.

In 1933, Hedblom1 reviewed the world literature and collected 291 cases of tumors of the osseous structures of the chest wall to which he added 22 cases of his own. Thereafter, Sommer and Major,2 in 1942, summarized an additional 66 cases recorded in the world literature from 1933 to 1940 and added 15 cases from the thoracic surgical service of the University of Michigan. No further review of the subject appeared until Blades and Paul3 summarized their experiences with 53 chest wall tumors in 1950. From 1950 to the present, there have been isolated case reports of chest wall tumors, generally dealing with the complexities and techniques of repair of large chest wall defects following surgical excision. To our knowledge, however, there have been no further reviews of clinical experiences with chest wall tumors as a group.

In view of the inconsistency of the clinical behavior of certain of these lesions with their pathological appearance, we feel that it is appropriate to employ a clinical classification, as suggested by Blades and Paul, of (1) benign; (2) malignant; and (3) metastatic chest wall tumors. All of the tumors included in this report were encountered in a practice restricted to thoracic surgery so that the many varieties of neoplasms of the skin and subcutaneous tissues which are not clinically fixed to the deeper structures of the chest wall are automatically excluded. In addition, we have excluded all metastatic tumors of the chest wall except those which were solitary and originated from a silent primary neoplasm. Accordingly, these metastatic lesions clinically appeared to be primary chest wall neoplasms.

**Benign Tumors — 17 cases**

Upon referring to Table 1 it is noted that the largest category of benign chest wall tumors is comprised of the neurogenic group. In our experience, these tumors were frequently asymptomatic and discovered on

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routine survey chest x-ray films. The symptomatic neurogenic tumors were productive of pain, either constant and dull, as in the neurofibromas and ganglioneuromas, or intermittent, sharp and lancinating, as in the one case of intercostal neuroma which we encountered. In contradistinction to many other types of chest wall neoplasms which presented as palpable tumefactions, none of the neurogenic tumors were palpable on clinical examination and all of them exhibited varying degrees of intrapleural protrusion upon x-ray film examination. Characteristically, they produced a smooth discrete radiodensity which was convex centrally and based upon the chest wall peripherally (Figure 1).

The neurofibromas and ganglioneuromas were generally located posteriorly and, at operation, were related to the intercostal nerves or sympathetic chain. Occasionally, it is difficult to differentiate these tumors from a peripheral pulmonary lesion without induction of a diagnostic pneumothorax.

Chondroma was the second commonest benign tumor encountered in our series (Table 1). These lesions presented clinically as gradually enlarging, palpable tumefactions associated, in one case, with mild local discomfort. They were all located anteriorly in the costal cartilages and could not be visualized radiologically. One of these cases was classified clinically as a post-traumatic chondroma in that there were two large chondromatous masses, one in each costal arch, which the patient ascribed to a steering-wheel type of chest injury four months previously. Pathologically, there was evidence of some recent inflammatory reaction in association with the chondromas.

Although each of these four patients remain well to date, it is with considerable trepidation that we report these lesions as "benign chondromas." As noted by Mallory, although chondromas of the rib cage may appear benign histologically, they frequently exhibit a predispo-
tion to local implantation with the ultimate development of frank malignancy and widespread metastases. Three of the five cases of chondrosarcoma in our series followed this pattern.

As in the cases of fibrous dysplasia reported by Blades and Paul, each of our three cases of fibrous dysplasia of rib gave a clear cut history of antecedent trauma to the area of involvement. In one of these cases, the lesion was discovered on a survey film whereas the other two patients reported for x-ray film examination because of the onset of localized chest discomfort. In each case, x-ray films revealed a localized osteolytic process within a rib (Figure 2). At operation, a well-circumscribed fusiform tumor mass involving the rib was uniformly found. Resection of these lesions resulted in permanent cure.

Only lipomas arising beneath the fascia propria of the chest wall musculature and thereby fixed to the deep structures of the chest wall were included in this series. For this reason, only two lipomas are reported; one arose deep to the left scapula and presented in the left posterior cervical triangle, and the second arose from the seventh left intercostal space anterolaterally and presented as a semi-fixed local tumor mass. In each case the development of a palpable tumor mass was the presenting complaint and in one there was also some associated local discomfort. In each case, excision necessitated a meticulous dissection of a lobulated tumor mass arising from the deep structures of the chest wall. These lesions, in contradistinction to the many superficial lipomas, should be excised only with the patient under general anesthesia in a major operating room where one is equipped to proceed with thoracotomy.

The remaining benign tumor of the chest wall which we encountered involved the sternoclavicular joint. A 57 year old white woman, had noted progressive swelling and tenderness of the right upper anterior chest region for a period of one year. The lesion clinically appeared to be a firm, non-tender circumscribed tumor mass involving the sternoc.

FIGURE 2: Fibrous dysplasia of rib appearing as central osteolytic process surrounded by a ring of increased radiodensity.
clavicular joint. She had no other joint symptom. X-ray films were negative. At surgical exploration, a discrete tumor mass limited to the joint capsule was encountered and it was elected to proceed with a resection of the sternoclavicular joint. Postoperatively, she has been entirely relieved of her symptoms and has no deformity resultant from the excision. Pathologically, the tumor mass was reported to represent chronic papillary synovitis of the sternoclavicular joint.

**Malignant Chest Wall Tumors — 13 cases**

In this series of chest wall tumors, 13 of the 30 cases (43 per cent) were malignant. Two of the 13 malignant tumors were metastatic while the remaining 11 were primary. This compares with an incidence of malignancy of 47 per cent reported by Blades and Paul but, as they have pointed out, is an inaccurate reflection of the total incidence of malignancy among chest wall tumors since the preponderantly benign lesions of the skin and subcutaneous tissues not clinically fixed to the chest wall have been excluded. Nevertheless, we believe that the figure, 43 per cent, serves to reflect accurately on the high incidence of malignancy among the deep-seated chest wall tumors and should dispel any complacency in dealing with these neoplasms.

The pathologically benign-appearing chondroma is, perhaps, the most insidious of all chest wall tumors. It must be resected adequately at the outset because of its propensity to implantation and local recurrence. Three of the five cases of chondrosarcoma in our series appeared initially as small, painless, tumors which were subjected to multiple biopsy procedures or inadequate local excisions over extended periods of time before their intrinsic malignant nature was recognized. In one case, the tumor mass was stable and asymptomatic for at least 10 years, when...
a gradual increase in size was noted. In retrospect, the primary surgical excision in this case and in two other cases, all done elsewhere, was inadequate but was tempered by the deceptive pathological diagnosis of benign chondroma. Recurrences occurred in all three cases despite the subsequent employment of extensive surgical resections. Two of the patients died as a result of both locally recurrent and metastatic chondrosarcoma and the third, although still alive six years after the primary operation, is in poor condition due to extensive implantation metastases both locally and throughout the entire ipsilateral pleural space (Figure 3A and B). Only in two of our five cases was an adequate primary en bloc resection performed. One of them, a 71 year old man, died on the third postoperative day of gastric dilatation and aspiration of vomitus. The other is living and well one year following surgery.

In contrast to the benign chondromas, which frequently appear during adolescence and early adulthood, the chondrosarcomas generally appear during middle or late adulthood. The sex incidence is essentially evenly divided. All of the chondrosarcomas in our series were located in the anterior chest wall.

The remaining six cases of primary malignant tumors of the chest wall in our series are representative of six different types of tumors, including five varieties of sarcoma and a localized plasma cell myeloma. (Table 2) We encountered one case of osteogenic sarcoma of rib occurring in a 61 year old white man. These tumors are less frequently found in the ribs and sternum than are the chondrosarcomas. Only 1 to 3 per cent of osteogenic sarcomas occur in the osseous structures of the chest wall. The primary symptomatology in our patient was that of pleuritic chest pain and associated cough dating back some 10 months. X-ray films revealed a mass arising in the right fifth rib and protruding intrapleurally. At operation, the tumor mass, although bulging intrapleurally, did not invade the parietal pleura. The involved rib and adjacent intercostal muscles and pleura were resected en bloc. Upon exploration of the mediastinum at this time we were chagrined to find a firm node overlying the superior vena cava. This node was excised and was reported to contain metastatic osteogenic sarcoma. The patient was re-admitted two months later because of acute femoral arterial thrombosis ultimately necessitating amputation of the right leg. He expired shortly thereafter and post mortem examination was conducted which revealed extensive metastatic sarcoma in the left (contralateral) pulmonary hilum, the liver, adrenals, and abdominal peri-aortic lymph nodes. Although osteogenic sarcomas classically engender hematogenous metastases, this particular tumor had spread both hematogenously and lymphogenously.

There was one Ewing's sarcoma in our series. This lesion, which occurred in a 30 year old white woman, manifested itself originally as a tumor mass arising in the left clavicle. It was biopsied and treated intensively with x-ray. Three years later a cystic lesion was noted in the left third rib. Excisional biopsy of the involved segment of rib was performed and was reported to show only fibrous dysplasia. When last seen, nine years following treatment, she was entirely well. As reported previously, biopsy and radiotherapy rather than radical excision is the treatment of choice for Ewing's sarcoma.
Three other sarcomatous lesions were encountered: a malignant mesenchymoma, a recurrent neurogenic sarcoma and a hemangioendothelial sarcoma. The malignant mesenchymoma presented as an inflammatory tumor mass in the chest of a 56 year old man and was erroneously thought to represent an abscess or hematoma requiring incision and drainage. This procedure had already been carried out when we first saw him (Figure 4). An en bloc resection of the chest wall to circumscribe the entire tumor mass was then effected, necessitating resection of the 9th, 10th, and 11th ribs together with a portion of the diaphragm and the upper abdominal musculature. His convalescence was marred by the development of mechanical small bowel obstruction which, at laparotomy, was found to be due to a sarcomatous peritoneal implant. Resection and anastomosis was carried out. He expired a few months later of metastatic sarcoma.

The recurrent neurogenic sarcoma appeared about two years following local excision elsewhere of a small painless nodule in the anterior chest wall of a 52 year old man. A radical resection of the chest wall to include the entire area of recurrence was carried out without difficulty. He is entirely well four years postoperatively.

The hemangioendothelial sarcoma presented as a painful tumor mass in a 57 year old woman. X-ray film study revealed an osteolytic process in the right 10th rib associated with a surrounding tumor mass. En bloc excision was carried out but an extensive local recurrence developed which was refractory to irradiation and she expired a few months later.

The plasma cell myeloma of rib was discovered on a routine survey chest film. It appeared as a triangular area of density in the right anterior thorax. (Figure 5.) This 47 year old white man was subjected to a wide resection of the tumor mass including a segment of adjacent uninvolved rib on either side of the tumor. Seven years postoperatively he continued to be entirely well.

FIGURE 4: Malignant mesenchymoma which presented as an inflammatory mass and had already been subjected to an ill-advised “incision and drainage.”
Metastatic Tumors — Two cases

The first of these patients, a 55 year old man, developed a painless nodule in the right anterior chest wall. Chest x-ray films revealed an osteolytic process in the right third rib with apparent expansion of the cortex in this area. Both lung fields were clear. An excisional biopsy was performed and frozen section revealed squamous cell carcinoma of pulmonary origin. He was lost to follow-up for a period of almost eight months, at which time repeat chest x-ray films revealed a large hilar mass on the left (contralateral) side suggestive of bronchogenic carcinoma. This lesion was deemed categorically inoperable and he died shortly thereafter. In our entire experience with bronchogenic carcinoma, this was the only example of a metastatic chest wall lesion appearing before the primary pulmonary lesion could be detected. Without question, the chest wall lesion in this case represented an early hematogenous metastasis, excision of which promptly established both the diagnosis and prognosis, and obviated exploratory thoracotomy.

The second patient was a 55 year old white man who had noted the development of progressively severe left chest pain over a period of two months. Clinical examination revealed a non-tender fusiform mass within the posterolateral portion of the left fifth rib. Chest films demonstrated an osteolytic lesion. At operation, a fusiform tumor mass was noted to replace the posterolateral portion of the left fifth rib. Biopsy and frozen section examination indicated that the tumor was a metastatic carcinoma. Accordingly, a simple segmental resection of the tumor-bearing portion of the rib was performed. Microscopic study of the permanent sections established a diagnosis of metastatic Hurthle cell carcinoma. Subsequently, a total thyroidectomy was done and a microscopic Hurthle cell "adenoma" was found in one section of the gland. He was then given a therapeutic dose of radioactive iodine followed by total body screening but no concentrated area of uptake was observed. He is cur-

FIGURE 5: Plasma cell myeloma involving right third rib anteriorly.
FIGURE 6A: Chondrosarcoma of the sternum which had been biopsed several times over a period of years with a diagnosis of "benign chondroma" being returned on each occasion.

FIGURE 6B: Postoperative status following total excision of body of sternum, costal cartilages and underlying pericardium with repair by shifting flaps and split-thickness skin grafting.
rently entirely well eight months following surgery. In this case, biopsy and frozen section study indicated that the tumor was a metastatic carcinoma. A radical resection of the chest wall was thereby obviated. Whether or not this patient has been permanently cured of his carcinoma, it is certain that early excision of the chest wall metastasis, in combination with the other therapeutic measures, has afforded him excellent palliation and will prolong the period of his useful existence.

Results

The results of our experience with malignant chest wall tumors can be summarized by stating that of the 11 patients with primary malignancies, six have died, five of recurrent or metastatic disease, and one of a postoperative complication (Table 3). Of the five survivors, one has extensive recurrent malignancy. Accordingly, there are four (36 per cent) in the primary malignancy group who are living and well following surgery. These include a chondrosarcoma case which has only been followed for slightly more than one year after surgery; the Ewing's sarcoma, nine years following surgery and irradiation; the neurogenic sarcoma, four years following radical re-operation; and the plasma cell myeloma, seven years following radical excision.

Surgical Considerations

All primary chest wall tumors should be subjected to early and adequate excision. This almost invariably should involve a thoracotomy approach, entering the pleural space two or more interspaces above or below the tumor in order to evaluate the nature and extent of pleural involvement. If one is reasonably secure in the belief that the tumor is benign, a thorough local excision is accomplished and the specimen is sent for frozen section microscopic study. A radical re-excision of the

<table>
<thead>
<tr>
<th>TABLE 1 — BENIGN CHEST WALL TUMORS — 17 cases (57 per cent)</th>
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</thead>
<tbody>
<tr>
<td>Neurogenic Tumors</td>
</tr>
<tr>
<td>Chondroma</td>
</tr>
<tr>
<td>Chronic Papillary Synovitis, sternoclavicular joint</td>
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FIGURE 7

TECHNIQUE OF RECONSTITUTING PERIOSTEAL BED
(APPLICABLE TO SINGLE OR MULTIPLE SEGMENTAL RIB EXCISIONS)

ELEVATION OF ANTERIOR HINGED PERIOSTEAL FLAPS

SUTURE OF HINGED FLAPS TO FORM PERIOSTEAL BED
TABLE 2 — MALIGNANT CHEST WALL TUMORS—13 cases (43 per cent)

1. Primary Malignancies
   - Chondrosarcoma 5
   - Osteogenic Sarcoma 1
   - Ewing’s Sarcoma 1
   - Malignant Mesenchymoma 1
   - Neurogenic Sarcoma 1
   - Hemangioendothelial Sarcoma 1
   - Plasma Cell Myeloma 1
   Total 11

2. Solitary Metastatic Malignancies (Silent Primary)
   - From Lung (Squamous Cell Carcinoma) 1
   - From Thyroid (Hurthle Cell Carcinoma) 2

The entire wound can be carried out if warranted by the frozen section report. In the case of metastatic tumors, the primary local excision should suffice. If the tumor clinically appears to be malignant, particularly if it represents a recurrence of a previously excised tumor, a primary radical resection should be performed, resecting at least one uninvolved rib and intercostal bundle above and below the tumor mass, together with a wide portion of any adjacent involved tissue such as upper abdominal or chest wall musculature, diaphragm, lung, pericardium, etc.

The chief problem arises in dealing with the potentially malignant neurogenic tumors and especially the chondromas, which may appear benign clinically and upon microscopic study. Presently, it is our policy to content ourselves primarily with an adequate total excisional biopsy and to follow these patients closely for several years postoperatively. As previously noted, the malignant chondromas particularly tend to implant and recur locally repeatedly before giving rise to distant metastases. At the first indication of local recurrence, a radical resection should be carried out.

Numerous technics have been devised to repair the chest wall defects which attend excision of these tumors. Recently, attention was centered upon the employment of prostheses of various types. Our own experience coincides with that of Blades and Paul in that we have been able to effect repair of even the most extensive defects by shifting muscles flaps, employing releasing incisions in the skin and utilizing skin grafting procedures. One case of chondrosarcoma involving the sternum had been biopsied several times over a period of years and on each occasion a diagnosis of chondroma was returned. At the time we saw the patient, a

TABLE 3 — RESULTS OF TREATMENT (Primary Malignancies)

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Dead</th>
<th>Living with Recurrence</th>
<th>Living and Well</th>
</tr>
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<tbody>
<tr>
<td>Chondrosarcoma (5)</td>
<td>3</td>
<td>1</td>
<td>1 (1 yr.)</td>
</tr>
<tr>
<td>Osteogenic Sarcoma (1)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewing’s Sarcoma (1)</td>
<td></td>
<td>1</td>
<td>1 (8 yrs.)</td>
</tr>
<tr>
<td>Malignant Mesenchymoma (1)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurogenic Sarcoma (1)</td>
<td></td>
<td>1</td>
<td>1 (4 yrs.)</td>
</tr>
<tr>
<td>Hemangioendothelial Sarcoma (1)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plasma Cell Myeloma (1)</td>
<td></td>
<td>1</td>
<td>1 (7 yrs.)</td>
</tr>
<tr>
<td>Total Cases (11)</td>
<td>6</td>
<td>1</td>
<td>4 (38%)</td>
</tr>
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large ulcerating tumor mass bulged from the body of the sternum (Figure 6A.) and necessitated an extensive resection of the entire sternal body including the adjacent costal cartilages and underlying pericardium. Even this huge post-resectional defect could be satisfactorily closed by the use of plastic surgical technics. (Figure 6B.) Figure 7 demonstrates diagrammatically a technic which we employ to reconstruct the periosteal bed following segmental resection of one or more ribs. This technic has been applied by one of us (D. C. D.) for more than 10 years and has effectively eliminated the persistence of soft areas postoperatively in the chest wall.

SUMMARY

Our clinical experience with a group of 30 chest wall tumors, of which 13 (43 per cent) were malignant, has been presented. The neurogenic tumors were found to be the commonest of the benign neoplasms whereas the chondrosarcomas were the most frequently encountered of the malignant neoplasms. Two metastatic tumors were documented, each masquerading as a primary chest wall tumor.

The surgical approach to tumors of the chest wall was discussed, emphasizing the importance of early and adequate primary excision by thoracotomy approach, and radical re-excision when indicated by study of the excised specimen. It is our opinion that early radical excision will result in a much higher salvage rate, especially for the chondrosarcomas. One can assume that almost half of the deep-seated chest wall tumors will prove to be malignant. Repair of the chest wall defect resulting from radical excisional procedures was found to be most easily effected by means of plastic technics. The use of prosthetic materials was unnecessary in our experience.

RESUMEN

Nuestra experiencia clínica con un grupo de 30 tumores de la pared del tórax de las que 13 (43 por ciento) fueron malignos, es el objeto de este trabajo.

Los tumores neurológicos son los más comunes de las neoplasias benignas en tanto que los condrosarcomas fueron los más frecuentes de los malignos.

Los tumores metastásicos fueron comprobados, en cada caso aparecieron como si fueran primitivos.

Se diserta sobre el tratamiento quirúrgico de estos tumores recalcando la importancia de la extirpación temprana y adecuada por la toracotomía así como por la reexcisión cuando estaba indicada por el estudio del especímen resecado. Somos de opinión que la extirpación radical produce mayor proporción de curaciones, especialmente para los condrosarcomas.

Puede uno suponer que como la mitad de los tumores de la pared del tórax profundamente situados son malignos. La reparación de la pared defectuosa por la resección de estos tumores fue más fácil de efectuarse por las técnicas plásticas. En nuestra experiencia no se necesitó el uso de materiales protésicos.

RESUMÉ

L'auteur rapporte l'expérience clinique qu'il a pu tirer de l'étude de 30 tumeurs de la paroi thoracique, parmi lesquelles 13 (43%) étaient malignes. Les tumeurs d'origine nerveuse se trouvèrent être les plus communes des néoplasies bénignes, tandis que les chondrosarcomes furent les plus fréquents des néoplasies malignes. Des recherches furent faites sur deux tumeurs métastatiques, qui se présentaient chacune sous les traits d'une tumeur primitive de la paroi thoracique.

L'indication chirurgicale pour les tumeurs de la paroi thoracique est discutée, en mettant l'accent sur l'importance d'une première exérèse convenable par thoracotomie d'abord, puis par intervention radicale si elle est indiquée après étude de l'échantillon prélevé. L'opinion de l'auteur est qu'une exérèse radicale précoce doit donner un pourcentage plus élevé de sauvetages surtout pour les chondrosarcomes. On peut admettre que presque la moitié des tumeurs de la paroi thoracique profondément situées feront la preuve de leur malignité. L'auteur pense que la réparation de l'altérations thoraciques après exérèse radicale est plus facilement effectuée grâce aux techniques plastiques. L'utilisation de matériaux de prothèse ne fut pas nécessaire dans son expérience.

ZUSAMMENFASSUNG

Darstellung unserer klinischen Erfahrungen an einer Gruppe von 30 Brustwandtumoren, von denen 13 (43%) bösartig waren. Es zeigte sich, daß die neurogenen Tumoren unter den gutartigen am häufigsten vorkamen, während die Chondrosarcome die häufigsten bösartigen Formen darstellten. Wiedergabe von 2 Fällen mit metastatischen Tumoren, von denen jeder sich als primäre Brustwandgeschwulst maskiert hatte.

REFERENCES