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Ten-year Experience with Benign Rib Tumors

E.G. Andrianopoulos,[1]
G. Lautidis,[2]
P. Kormas,[2]
A. Karameris,[3]
I. Papachristos[2]

[1] Director of Thoracic Surgery Department, 401 Army General Hospital, Athens, Greece
[2] 401 Army General Hospital, Athens, Greece
[3] Director of Histopathology Laboratory, 401 Army General Hospital, Athens, Greece

Abstract *Purpose* To demonstrate the existing difficulties in distinguishing benign from malignant tumors of the ribs, and especially the problems that a clinical doctor encounters when dealing with a rib "hyperplasia". *Design* A retrospective review study adjusting the diagnoses according to current classification and histological standards. *Materials and methods* Forty-nine patients with benign rib tumor underwent surgery in a period of 10 years (1986—1996). Twenty one (42.8%) benign tumors originated from cartilage and bone, 7 (14.2%) were inflammatory, 5 (10.2%) originated from the bone marrow, and minor percentages (2—4%) had vascular, neurogenous, degenerative, traumatic or of miscellaneous origin. The mean age was 25.18 years. Related symptoms were pain (40.8%) and swelling (34.7%). One third of the patients were asymptomatic and the lesion was accidentally discovered in a routine chest radiograph. All patients were treated surgically with wide excision of the tumor and the diagnosis was established histologically. *Results* Resection was complete and curative in all cases without recurrence. *Conclusions* Since the likelihood of malignancy is high, all rib tumors should be considered malignant until proven otherwise. Therefore, prompt intervention is necessary and wide and radical initial excision of the involved rib is advocated.

Key words
Chest wall neoplasms,
thorax,
rib tumors,
resection,
bone,
cartilage,
thoracic surgery.

Introduction

Rib tumors are uncommon and comprise about 5—10% of all bony tumors.[1,2] Benign rib neoplasms are significantly less common than are malignant ones.[2—4] Early recognition and treatment of rib tumors require a broad knowledge of the pathologic features and natural history of these lesions. Bearing this in mind, the authors analyzed their cases and reviewed their experience.

Material and methods

The authors performed surgery on 49 Caucasians, who were admitted, investigated and treated at the Army General Hospital, Athens between 1986—1996. The study includes rib lesions clinically or radiologically identified. Calluses from known rib fractures were excluded. Benign rib tumors are seen on table 1. There were forty seven male (95.9%) and 2 female (one with hemangioma and one with Tietze's syndrome). The average age was 28.2 years (range 19—51). The right side was

Table 1. Histologic analysis of benign rib tumors.

Origin	Type of tumor	Pts No
Bone and cartilage	Hyperplasia	10
	Chondroma	5
	Osteochondroma	4
	Chondroblastoma	1
	Chondromyxoid fibroma	1
Inflammatory/ infectious	Necrotizing granulomatosis	3
	Osteomyelitis	2
	Tietze's syndrome	2
Marrow	Eosinophilic granuloma	4
	Reactive hyperplasia	1
	Lipoma	1
Vascular	Hemangioma	2
Neurogenous	Neurilemoma	2
Degenerative	Hyperparathyroidism	1
Traumatic	Callus formation	9
Miscellaneous	Myositis ossificans	1
Total		49

affected in 26 cases and the left side in 23. Twenty nine lesions were located in the upper six ribs and the remaining 20 in the lower ones. The tumor was in the anterior arch of the rib in 19 patients, in the lateral in 20 and in the paravertebral portion in 10. Twenty patients (40.8%) complained of pain and 17 (34.7%) had a palpable swelling. Twelve patients (24.4%) were completely asymptomatic and the lesion was accidentally discovered in routine chest radiograph. Computed tomography scan (CT-scan) was performed in all but 12 patients and was helpful in very few where fragmented periosteum was shown. Isotopic bone scan was performed in 25 patients and was positive (figure 1) in 19 of them. No biopsy was performed preoperatively and all patients had had the tumor resected widely including a rim of normal bone. All histopathological specimens were reviewed two months ago in order to readjust the diagnoses in the light of new information and classification.

Twenty one male patients (42.8%) had tumor of cartilage and bone origin (table 1). Among them, 10 had benign hyperplasia and 5 had chondroma. Osteochondroma was present in 4 patients and 2 patients had single lesions consisting of chondroblastoma and chondromixoid fibroma. Of the remaining 28 patients, 6 (12.2%) had tumors of bone marrow origin and 7 (14.2%) of inflammatory. Vascular and neurogenous tumors were each encountered in 2 (4.1%) patients. Callus was found in 9 (18.3%) patients without trauma history and a tumor of degenerative origin was found

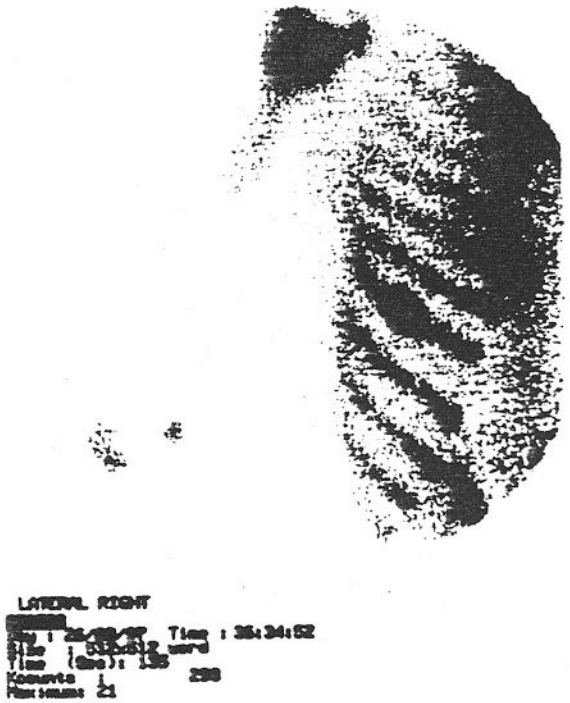

Figure 1. Isotope bone scan showing the uptake chondroma of right 7th rib.

in 1 case. Finally, one patient had a miscellaneous les expressed as myositis ossificans.

Benign hyperplasia was the most common lesion countered among tumors originating from bone a cartilage and involved a single rib in each of 10 tients. Five were of bony and 5 of cartilaginous orig The average age was 28 years. Six out of 10 lesions w left-sided and involved the upper six ribs. Five hyperp sias were located in the anterior portion of the rib laterally and 1 posteriorly. Two patients complained pain, 2 had swelling, 4 had both pain and swelling and had none. Seven patients with symptoms had no ra ological findings.

Chondroma was found in 5 patients ranging betwe 18—20 years. None of them had pain. Two had palpab swelling and three were asymptomatic. Four lesions volved the right upper 3 through 5 ribs (two anterio and 2 laterally) and 1 was located in the anterior porti of the left 7th rib. Radiologically, one patient present expansion of the rib, one had enlargement but 3 h normal radiograph.

Osteochondroma (figure 2) was encountered in 4 p tients aged 17, 20, 21 and 51 years. One complained pain and another presented painful swelling. Two we asymptomatic. All the tumors were left-sided (3 through 8th rib), 2 anteriorly and 2 posteriorly. Rib e largement was found in 3 cases, but in the patient wi painful swelling there were no radiological findings.

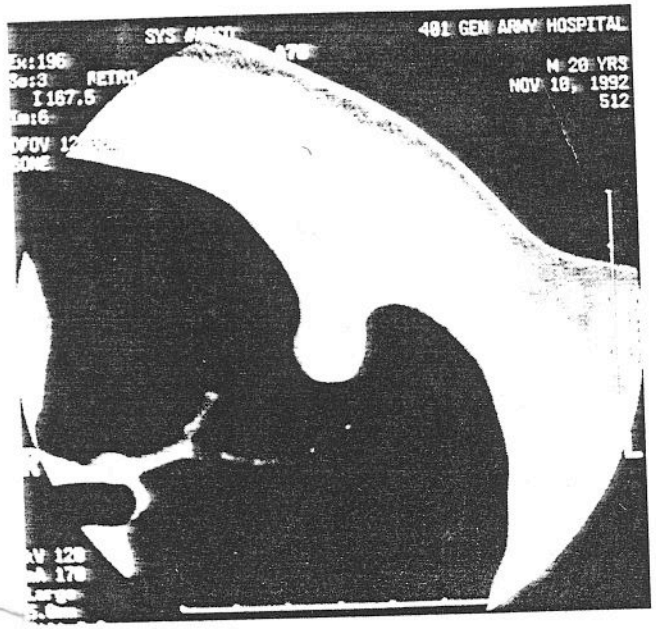

Figure 2. Chest CT scan of a 21-year-old patient showing osteochondroma of the 3rd left rib.

Chondroblastoma was found in a 23-year-old man experiencing uninvestigated mild pain of 8 years' duration. The tumor was located in the posterior left 3rd rib and in a chest radiograph an enlargement was seen.

Chondromyxoid fibroma was diagnosed in a 26-year-old man who had enlargement of the left 5th rib laterally without any symptoms. Past history included left chest wall injury due to falling 4 years ago, but consecutive chest radiographs taken routinely in the interim were normal.

Six male patients had tumors originating from marrow. Four had eosinophilic granuloma, 1 reactive hyperplasia and 1 had a lipoma.

Eosinophilic granuloma involved four patients aged 19, 20, 26 and 47 years. Three had left-sided tumor (5th, 7th and 9th rib laterally) and in one the tumor was located in the 5th right rib posteriorly. Two patients complained of pain and the tumor presented on radiographs as osteolytic lesion with fragmented periosteum on CT-scan. One patient presented with local swelling and negative radiograph. All four patients had positive isotope bone scan. Scrutinized investigation did not demonstrate other bony, soft tissue or visceral involvement.

Reactive hyperplasia was found in a 29-year-old man and the lesion was located in the 6th left rib laterally. His main complaint was pain and the radiograph presented an expansion of the rib. The patient had a history of left-sided injury with known old fractures of the 7th and 8th rib. The isotope bone scan was positive for these two ribs but there was no uptake in the 6th rib.

Lipoma was encountered in a 20-year-old man who had excision of a tumor of the 6th left rib laterally. He presented with local discomfort and expanding lesion on radiograph. Bone scan was positive and after resection histopathology revealed gross appearance of mature fat cells.

In 7 patients the hyperplasia was of inflammatory or infectious origin. Three had necrotizing granulomatosis, 2 had osteomyelitis and two presented with Tietze's syndrome.

Necrotizing granulomatosis. Tuberculosis was found in 2 of the 3 male patients aged 20 and 25 years. The former had a left-sided tumor of the 7th rib anteriorly with pain and swelling and positive isotope bone scan, and the latter was asymptomatic with a radiologically detected tumor located in the 9th right rib laterally, and negative bone scan. Both patients were put into anti-TBC treatment following the resection. The 3rd case concerned a 23-year-old man who had a lesion in the 5th right rib anteriorly. He was asymptomatic but was suffering from Crohn's disease and in his past history he was known to have abdominal and subxifoid abscesses.

Osteomyelitis. It was diagnosed in 2 male patients aged 23 and 33 years old respectively. In the first patient, the lesion was asymptomatic and located in the posterior portion of the 3rd right rib. Histology following the resection showed cavitating osteomyelitis. In the second, there was a discharging sinus below the manubrium and a lytic lesion in the 2nd left costal cartilage seen on a CT-scan (figure 3). Isotope bone scan was positive. Preoperative cultures were negative. After rib resection, cultures grew *Salmonella* group-D.

Tietze's syndrome. Two patients one male and one female, both aged 19, presented with painful recurrent

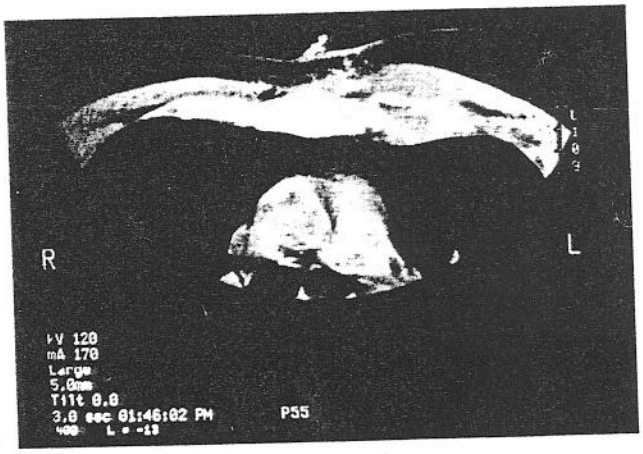

Figure 3. Chest CT scan of a 33-year-old man showing osteomyelitis of the left 2nd costal cartilage due to *Salmonella*.

swelling of the cartilage of the 3rd right rib. Plain chest radiograph showed slight rib enlargement but CT and isotope bone scan were negative. Since recurrences with persistent pain continued, resection was undertaken.

Hemangioma was the main vascular hyperplasia, found in 2 patients, 1 man and 1 woman aged 35 and 38, respectively. Both tumors were left-sided, one in the 5th rib anteriorly and the other in the 2nd rib laterally. The man presented swelling and negative chest radiograph and the woman complained of pain and rib enlargement was found radiologically. In both, isotope bone scan was negative.

Neurilemoma was identified in 2 male patients, 25 and 41 years old. Both tumors involved the right posterior portion of the 7th and 8th rib respectively. One patient had swelling confirmed by CT-scan and the other was asymptomatic but the rib enlargement was found on a routine chest radiograph.

Hyperparathyroidism was the degenerative cause of a lytic lesion seen in a plain chest radiograph of a 20-year-old man who was complaining of mild chest pain. The tumor was located in the 10th left rib laterally. Bone scan showed isotope uptake.

Nine male patients aged 20—51 years (mean 25.7 years), had trauma caused rib hyperplasias (7 right-sided, from 3rd through 8th rib and 2 left-sided, 3rd and 6th rib). All but one anterior were located laterally. Two patients complained of pain and one presented with swelling. The asymptomatic patients had had the tumor identified accidentally on routine chest radiograph. In 4, the isotope bone scan was positive. Resection of the hyperplastic rib portion showed histological findings consistent with callus appearance of a presumed rib fracture, spontaneous or not. It is of significance to state that none of the 9 patients of this group experienced a past chest injury or could recall a period of having previously chest pain either spontaneously or appearing and/or changing with deep breathing, coughing or sneezing, so as to suspect and justify a rib fracture.

Myositis ossificans was diagnosed in the last patient with benign lesions. It concerned a 20-year-old man whose lesion was located in the 9th left rib anteriorly. He presented a persistent painless swelling which had appeared some time after a chest wall injury.

Discussion

All rib hyperplasias should be considered malignant until proven otherwise. The mode of the presentation such as pain and/or swelling, provides no safe guide to the benign or malignant nature of a rib lesion,[5,6] since 61% of benign and 48% of malignant tumors may present with pain.[3,6] In our series 40.8% and 34.7% of benign lesions presented with pain and swelling respectively. Symptomless patients are reported to be as high as 31%.[3] Others,[4] raise the number of rib tumors detected at routine chest radiograph in about 60% of the cases. The quality of the pain depends on the location and growth of the neoplasm. It can be either of pleuritic nature, if the tumor grows within the pleural space, or neuritic, if it has invaded the intercostal nerves.[1]

Roentgenography is a useful diagnostic procedure but does not always result in visualization of an existing rib tumor. Computed tomography scanning is helpful and sometimes demonstrates fragmented periosteum which is suspicious of malignancy. Irregular or complete destruction of portions of ribs, sometimes with calcific mottling, may be a reliable sign of malignancy.[2]

There is a difficulty of preoperative diagnosis of rib lesions. Needle biopsies have no place in the diagnosis of these lesions and should be discouraged, not only because there is fear of implanting tumor tissue along the needle track, but also because they cannot provide enough material for full diagnosis.[5,7] Therefore, the identity of the tumor will be obtained only after excisional biopsy or wide and radical initial excision of the involved rib. All evaluations are planned and various parameters are taken into consideration. The major neurovascular bundles adjacent to the tumor should be evaluated carefully. This is particularly important for those tumors in proximity to the 1st rib, axilla or paravertebral area. CT scan is necessary for all patients, and mediastinal, bone and lung windows are of great help. Isotope bone scan should also be performed, because all of the histologic types of primary malignant rib neoplasms can metastasize to bones.

Cartilaginous tumors, are the most commonly (50%) encountered benign rib lesions,[3—5] and the most frequent benign representatives of this group are chondroma and osteochondroma. The majority of patients are below the age of 21 and there is a predominance of males. *Chondroma* is more often situated near the costochondral junction.[5,8,9] Chon-

dromas are often mentioned as tumors likely to become malignant (11%) after years of benign growth.[10] This incidence is relatively lower (1—2%) for osteochondroma[11] and may raise in familial syndromes of multiple osteochondromas.[12] Other cartilaginous benign neoplasm is *chondroblastoma*. It is relatively rare, comprising less than 1% of 2,900 bone tumors reviewed at the Mayo Clinic.[13] Of 24 chondroblastomas collected[14] by Dahlin (1967), one was in a rib. It is found more commonly in the male (2:1 ratio) and the majority of chondroblastomas affect patients of the second decade of life. The authors' patient was 23 years old but had a history of 8-year duration pain. *Chondromixoid fibroma* is an also uncommon rib tumor, constituting 2% (20/956) of benign whole-body bony tumors seen at the Mayo Clinic.[13] It occurs in both sexes equally (with a slight male predilection), predominantly in persons between the ages 10 and 30.

Non-cartilaginous benign lesions include tumors originating from bone, marrow, fibrous or neurogenous tissue, or even vascular elements. *Osteoma*, which is extremely rare in ribs, is a protruding tumor mass composed of abnormally dense but otherwise normal bone formed in the periosteum. These tumors have been reported from age 10—79, with most cases seen in the forth and fifth decades. Men are affected twice as often as women.[15] *Osteoid osteoma* is another rare benign rib tumor which in approximately 60—75% of the cases, occurs in patients in the first two decades of life. The main characteristic of osteoid osteoma is pain, although painless osteoid osteoma has been reported.[16] The pain begins mildly, increases progressively in severity especially during the night, and is relieved by salicylates. *Osteoblastoma* is an uncommon tumor similar to osteoid osteoma and there is a debate as to the relationship between them. Some authors separate those only on the basis of size (larger than 1 cm), site of involvement, and degree of reacting bony sclerosis. The majority of patients with this tumor are over 10 and under 35 years of age, and there is no sex predilection.

Among the tumors arising within the marrow cavity are lipoma and eosinophilic granuloma. *Lipomas* of bone are uncommon. Dahlin (1967)[17] reported 1 per 1000 tumors of bone. Rib involvement is extremely rare. The major problem of lipoma lies in its radiographic differential diagnosis. It has been incorrectly diagnosed as giant cell tumor, solitary bone cyst or osteoblastoma. Because the cortex of the bone is sometimes destroyed, it has been confused with a malignant neoplasm. The present lipoma case was diagnosed only after rib resection and careful microscopic study. *Eosinophilic granuloma* is a non-neoplastic solitary lytic lesion arising from the reticuloendothelial system, and the rib is one of the more frequent locations. McGarvan and Spady (1960)[18] in 28 reported bone eosinophilic granulomas, found 3 involving the ribs. The authors found 4 new cases. The pathogenesis of this tumor is unknown, but this lesion is commonly classified as a member of the reticuloendothelial proliferative disorders, known as histiocytosis-X, that include Letterer-Siwe and Hand-Schuller-Christian diseases. Eosinophilic granuloma occurs from infancy to the 6th decade with a peak incidence between the ages of 5—10 years. The majority of cases appear before the age of 30 and there is a slight male preponderance.[1] The predominant symptom of eosinophilic granuloma is pain of short duration. It is not necessary for these patients to have peripheral eosinophilic counts.

Fibrous tissue within the rib, may induce the development of benign lesions such as *xanthoma, fibromyxoma, ossifying or non-ossifying fibroma, fibrous dysplasia*, and *desmoplastic* fibroma. All these lesions are very rare conditions, affect mostly young ages, with the exception of fibromyxoma that occurs in older persons, and are recognizable only on histopathologic grounds. Equally rare tumors of ribs are those of neurogenous origin, with main representative the *neurilemoma*. It arises from the nerve sheath and appears within the bony substance. It has to be distinguished from neurofibroma in which encapsulation does not exist. Neurilemoma occurs in the 4th decade of life, shows no sex predilection and presents with pain and/or swelling over the affected rib. Vascular tumors also occur in ribs and hemangioma is the main representative. It affects both sexes equally and although may be found in patients of all ages, it is most commonly diagnosed in the middle decades of life. Radiographically, it can be mistaken for

myeloma, metastatic carcinoma or Paget's disease, but the "soapbubble" or "honeycomb" appearance on the radiogram is of diagnostic help.

Treatment of rib hyperplasias

It is generally advocated that all primary rib neoplasms should be treated by complete en bloc excision.[1,3,5] As it is impossible in most instances to determine with certainty, whether the tumor is benign or malignant by radiograms alone, the policy should be to resect all tumors radically because of the likelihood of malignancy. If there is infiltration of the soft tissues, pleura, lung parenchyma or diaphragm, one should not hesitate to excise the involved portions. The size of the tumor should not be contraindication for radical removal. The main and major therapeutic error in handling rib tumors, is failure to perform a radical excision.

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Corresponding address:

E.G. Andrianopoulos, 92 Pindou str., GR-156 69 Papagou, Greece