Introduction

The registry of the Bone Tumour Reference Centre at the Institute of Pathology, Kantonsspital/University Clinics, Basle, contains 68 files of tumours or tumour-like lesions of the scapula gathered since 1971. The aim of this retrospective study is to give a review of this rather large series in an infrequently affected bone, to compare the results with similar reports and to seek answers to the following questions: Encountering a lesion in the scapula - what do we have to think of? What incidence of malignancy must we expect? How much can the patient’s age and site of involvement help to suggest a diagnosis? How often can we expect a typical radiologic appearance? For diagnosis, can we rely on the plain films or are crosssectional methods essential?

Materials and methods

A retrospective study of 68 histologically proven cases (68 patients - 43 male and 25 female, in the age of 1 - 80 years) was carried out. Each case was evaluated for lesion entity, activity and location, age and sex of the patient and, in 49 files with available radiographic documentation (mostly plain films), for radiologic appearance, with the aim to predict the histologic diagnosis or at least the correct dignity of the lesion. Statistically most frequent were cartilaginous tumours. More than 1/3 of all cases were osteochondromas, which demonstrated mostly a typical appearance. They were encountered predominantly in the first 3 decades in males and were located most often in the body of the scapula. 1/4 of all cases were chondrosarcomas, which were prevailing in the 4th - 7th decades, but were occasionally found at a younger age too. Chondrosarcomas were located mainly at the lateral scapular margin over the inferior angle and in the acromion and coxacond joint and their appearance ranged from typical to falsely benign. 1/3 of the cases represented a number of other benign and malignant histological entities.

Discussion

In terms of frequency, the series was dominated by cartilaginous tumours: 27 osteochondromas, 16 chondrosarcomas and 3 chondromas, which altogether presented 68 % of the cases. The rest of the cases (approximately one third) was evenly distributed among a variety of entities, demonstrated by Tab. 1. 11 benign and 8 malignant different diagnostic entities were encountered. 42 patients presented benign tumours or tumour-like lesions, 26 patients malignant tumours, the ratio of benign versus malignant thus being 1,9 : 1 respectively. Among the above mentioned most frequent tumours, this ratio is slightly more in favour of malignancy: 1,6 benign v. 1 malignant lesion. In other words in the entire series...
35% of the lesions and in the leading group 40% of the lesions were malignant. 

Tab. 1: Tumours and tumour-like lesions related to the scapula: (1) see literature - ref. (11).

| Tumours (lesions) | No. of cases | Tumours (lesions) | No. of cases |
|------------------|--------------|------------------|--------------|
| Osteochondroma    | 22           | Chondroblastoma   | 2            |
| Chondrosarcoma    | 16           | Desmoplastic fibroma | 1          |
| Enchondroma       | 3            | Metastasis        | 1            |
| Non-H lymphoma    | 3            | Osteoblastoma     | 1            |
| Chondroblastoma   | 2            | Traumatic diaphysis | 1          |
| Enchondroma       | 2            | Osteosarcoma      | 1            |
| Ewing sarcoma     | 2            | Simple bone cyst  | 1            |
| Chondrosarcoma    | 2            | Syn. involvement | 1            |
| Plasmocytoma      | 1            | Synovial sarcoma  | 1            |
| Round cell sarcoma| 1            | Myxositis osseous | 1            |

The age of the patients with more frequent lesions is revealed in Tab. 2. The age of the patients presenting rare lesions was in the typical range for each entity, except for 1 case of a simple bone cyst, diagnosed at the age of 4 years, 1 case of an Ewing sarcoma detected at the age of 2 years and 1 patient with a secondary osteosarcoma (following radiotherapy for hemangioendothelioma 4 years earlier) at the age of 59 years. Sex predominance (Tab. 2) was observed in osteochondromas (predominantly male patients). Non-Hodgkin’s lymphomas (in our series also affecting predominantly male patients), and enchondromas (affecting with lower significance predominantly female patients) were represented by small numbers of patients. Chondrosarcomas, on the other hand, displayed an almost equal sex ratio.

Tab. 2: The age (No. of cases related to decades of life) and sex of patients in the most frequent entities.

| Age (decades) | Tumours | M | F |
|---------------|---------|---|---|
| Osteochondroma | 3 5 4 1 1 0 | 20 | 7 |
| - strongly proliferating | 1 1 1 1 | 3 |
| - mildly proliferating | 1 1 1 1 | 3 |
| - nonproliferating | 2 2 | 4 |
| Chondrosarcoma | 2 1 1 1 1 1 | 7 3 |
| Enchondroma | 2 1 1 1 1 1 | 2 2 |
| Non-Hodgkin’s lymphoma | 1 1 1 1 1 1 | 3 0 |

Osteochondromas were located mostly in the body of the scapula - 14 (of these 6 in spina scapulae), 2 were in the superior and 2 in the medial margin, 2 in the inferior and 1 in the superior angle (Fig 1a), with prominence dorsally as well as ventrally, twice in both directions. Chondrosarcomas, on the other hand, were encountered mostly in the lateral scapular margin - 6 (of these 5 near the inferior angle), 6 were in appendices (3 in the coracoid process and 3 in the acromion) and only 1 in the body (Fig 1b). 1 chondrosarcoma had destroyed the whole scapula. Enchondromas and non-Hodgkin’s lymphomas were distributed evenly. An aneurysmal bone cyst, Ewing sarcomas, osteomyelitis, a plasmocytoma, a round cell sarcoma, an osteoblastoma, an osteosarcoma, a simple bone cyst and a synovial sarcoma (extending from adjacent soft tissues) were distributed evenly in the upper half of scapula, the rest of the entities were in the lower half.

Out of the 16 radiologically documented osteochondromas, 12 were assessed as typical (Fig 2 and 3). 3 as benign lesions (mostly widening of a scapular structure by a very broad osteochondroma), 1 was considered equivocal in terms of possible malignization (Fig 4, malignization was not histologically proved). The 2 osteochondromas still proliferating at the age of 41 and 52 years both revealed a typical appearance.

Fig. 1: Localization of osteochondromas (a) and chondrosarcomas (b) in the scapula.

Fig. 2: A typical osteochondroma arising from the inferior angle of the scapula with prominence both ventrally and dorsally, demonstrating a lobulated shape with continuous cortical bone and a sharp margin.

Fig. 3: A typical osteochondroma arising from the inferior angle of the scapula with a typical prominence ventrally, demonstrating smooth continuous cortical and cancellous bone and a sharp margin.

Fig. 4: Osteochondroma located over the inferior angle of the scapula with a typical prominence ventrally, demonstrating smooth continuous cortical and cancellous bone, and a prominence dorsally of equivocal appearance due to superimposed massive unsharp calcifications. No histological evidence of malignization was found, the cartilage cap was thin, the calcifications were located in the osseous part of the prominence.

Fig. 5: A typical chondrosarcoma arising most probably from the coracoid process, demonstrating typical calcifications in rings and semicircles of sharp margins in a large soft tissue mass. The osteolytic component of the tumour is overlapped by the calcifications. A deviation and a light erosion of the inferior aspect of the lateral part of the clavicula are revealed. The age of the patient (6 years old) is uncommon.

Fig. 6: A chondrosarcoma with a malignant but atypical appearance, demonstrating inhomogenous osteolysis and broad destruction of the lateral cortical bone over the inferior angle and a soft tissue mass, which contains very scarce calcifications. The osteolysis is partly surrounded by an irregular sclerotic rim.
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![Fig. 1: Localization of osteochondromas (a) and chondrosarcomas (b) in the scapula.](image1)

![Fig. 2: A typical osteochondroma arising from the anterior surface of the scapula, demonstrating continuous cortical and cancellous bone and massive calcification.](image2)

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Out of the 13 radiologically documented chondrosarcomas, 5 were assessed as typical (Fig. 5), 5 as malignant, atypical for a cartilaginous tumour (Fig. 6), 1 was classified as equivocal (Fig. 7), the appearance of 2 chondrosarcomas was falsely judged as benign (Fig. 8).

Out of the 2 radiologically documented enchondromas, 1 was assessed as benign, the other as equivocal, none revealed typical calcifications, partly due to projection.

Fig. 7: A chondrosarcoma of an equivocal appearance in the coracoid process, demonstrating a very expansile character without destruction of the cortical bone and with a well defined irregular sclerotic rim. The tumour contains thick septations and very scarce calcifications. No soft tissue mass is revealed, the clavicula demonstrates an unaggressive erosion of its inferior aspect.

Fig. 8a: A chondrosarcoma with a very expansile benign appearance in the coracoid process. The cortical bone seems to be thin but mostly continuous, only in two short parts of the cortex minimal destruction could be suspected (a).

Fig. 8b: The tumour contains thin septations and only in 1 projection (b), a few calcifications could be detected.

Fig. 9a: A non-Hodgkin’s lymphoma of the bone in the medial part of the scapula, demonstrating a very expansile character and thick septations. The plain film arouses no suspicion of cortical destruction.

Fig. 9b: The CT scan, on the other hand, shows the destruction of a considerable part of the dorsal cortex without a soft tissue mass.

Fig. 10: A plasmocytoma in the inferior region of the neck of the scapula, demonstrating an unsharp geographical osteolysis with a short but definite destruction of the cortical bone in the inferior aspect of the neck.

Fig. 11: A Ewing sarcoma demonstrating diffuse sclerotic infiltration of the glenoid, neck, coracoid process and superior and inferior margins of the scapula, extending without sharp margins into the body of the bone. No original cortex is revealed, the involved parts of the scapula are enlarged by periosteal appositions. An unsharp erosion of the medial aspect of the humeral metaphysis is present.

Fig. 12a: Chronic osteomyelitis of the scapula involving the acromion, the spina and extending into the body of the scapula. The lesion demonstrates diffuse inhomogeneous osteosclerosis engulfing a zone of irregular partly unsharp osteolysis and extensive periostosis (a,b).

Fig. 12b: The CT scan reveals obscured fat planes in the soft tissues dorsally.

One plasmocytoma (Fig. 10), the 2 Ewing sarcomas - both markedly sclerotic (Fig. 11), one round cell sarcoma and an osteosarcoma all had an unspecified malignant appearance.

The eosinophilic granuloma (Langerhans cell histiocytosis) and the simple bone cyst had a benign but very expansive appearance. The 2 cases of chronic osteomyelitis had in 1 case a typical appearance (Fig. 12), the other looked unspecic benign. The chondroblastoma, apart from its location in the neck extending to the infraspinat fossa, appeared typical. The desmoplastic fibroma appeared unaggressive, although its cortex was very thin and partly discontinuous. Myositis ossificans could not be distinguished from an osteochondroma due to superimposition of a neighbouring bony structure. An osteoblastoma demonstrated a very typical appearance (Fig. 13). The aneurysmal bone cyst, appeared in 1 case as a typical expansile thin walled lesion, in the other case as a highly malignant tumour with a completely dissolved acromion. Very confusing was the
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Out of the 3 non-Hodgkin’s lymphomas, 1 had the appearance of an equivocal lesion with sharp margins and almost continuous cortical bone on X-ray, which was later demonstrated by CT as discontinuous (Fig. 9). The other 2 lymphomas appeared malignant - 1 with permeative osteolysis and a pathological fracture, the other - though histologically classified as highly malignant - demonstrated a malignant but only mildly aggressive appearance.

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The location of osteochondromas and chondrosarcomas was strikingly different and corresponded with the findings of Erlemann and coll. (6). Osteochondromas were mostly located in the body, chondrosarcomas on the other hand mostly at the lateral scapular margin over the inferior angle and in the acromion and coracoid process. All the other groups were evenly distributed without respect to their dignity, with slight prevalence for the upper half of scapula.

The age of the patients at the time of clinical presentation was in osteochondroma mostly in the first 4 decades and in most cases correlated with the activity of the lesion (Tab. 2). Fulfilling thus the presumption, that an osteochondroma may grow only to the age of physical closure (18). The 2 exceptions were patients with proliferating osteochondromas at the age of 41 and 52 years. Both lesions revealed no suspicion of malignant transformation radiologically and histologically.

All 16 chondrosarcomas were differentiated (14: Grade 1, 2: Grade 2). 2 were secondary on previous osteochondroma and enchondroma, 2 were myxoid, 2 were anaplastic, 2 were myxoid and showed dead bone, 2 were mucoid, 2 were myxoid and had dead bone, 2 were anaplastic, 2 were myxoid and showed dead bone, 2 were anaplastic, 2 were myxoid and had dead bone. The age of the patients was variable, with a prevalence of occurrence after the age of 40 years. One case of a chondrosarcoma was encountered at the very low age of 6 years and 3 cases at the age of 19, 20 and 21 years (Tab. 2). There was no relation between the age and differentiation of the tumour. The slight prevalence of female patients (male:female 0.8: 1 resp.) is in contrast to the male predominance stated in literature (18), but may be attributable to the low number of cases.

In concordance with literature (20,10,8) and almost identical with the data presented by Erlemann and colleagues (6), who presented 63 % of cases with correct diagnosis while other authors mention the lack of typical features in tumours located in the scapula (2,7,15,21).

In our series the typical appearance was encountered mainly in the group of osteochondromas (12 out of 16). On the other hand in the group of chondrosarcomas a reliable predictive diagnosis was possible only in 5 out of 13 lesions. 5 had a malignant appearance without typical calcifications. I was equivocal (a chondrosarcoma secondary on an enchondroma) and 2 displayed even in retrospect benign features. The false negative and equivocal results were mostly caused by a number of unaggressive appearing chondrosarcomas, often demonstrating a pattern of expansile geographic osteolysis with more or less sharp margins and even a sclerotic ring of various thickness, sometimes containing septations. The breakthrough of the cortical bone and typical calcifications were partly not present at all and partly were superimposed over other structures, so that it was or could have been only the CT, that could reveal them. No relation with age, localization or grading was found comparing the aggressive and nonaggressive appearing chondrosarcomas. The 1 available of the 2 periosteal chondrosarcomas had a very atypical appearance resembling a malignant tumour originating from the centre of the bone. The other (documented by an MRI study) had a non-specific appearance of a soft tissue tumour.
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In concordance with literature (20,10,8) and almost identical with the data presented by Erlemann and colleagues (6) was the age of the patients. Benign tumours and lesions were encountered equally in the first 6 decades, with slight prevalence for the upper half of scapula.

Discussion

Tumours and tumour-like lesions are rarely located in the scapula. Resnick (18), summarizing several papers, indicates the frequency of scapular location of 0 - 8 % of all skeletal sites. According to other authors, the scapula is the site of occurrence of 1 - 3 % of all primary bone tumours. Most of the reports (12,16,14,21,5,23,13,9) therefore review smaller series of scapular lesions, the largest being, to our knowledge, the report of Erlemann and colleagues from the year 1988 (6), who presented 38 cases. This may also be one of the reasons why scapular lesions tend to be a diagnostic problem.

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At operation on May 4th, 1995 90 % of the upper lobe
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Summary:
The present indications for surgery are mainly large or increasing bullae that result in compression of apparently good lung tissue, and the complications of bullous diseases such as pneumothorax. The results of local resection of localized giant bullae are dramatic. The resection of small bullae generally has little effect on lung function. Lobectomy should not be done until bullae have been removed locally and the remaining lung has been tested by positive ventilation. The indications for the resection of large bullae in the presence of diffuse emphysema require very careful individual study. Pulmonary function tests are mandatory but computed tomography is the single most useful method of assessing the extent of the bullous disease and the remaining lung disease. If the underlying lung is diffusely cystic then any surgical treatment is palliative only.

Key words: Bullous emphysema, Surgical treatment

The surgical treatment for bullous disease in emphysema has been redefined over the past decades. The indications for surgical intervention, the types of surgical procedures and the objectivity of the results have been questioned repeatedly. Although there is no single way to recognize with certainty the type of emphysema producing bullae of the lung, the term of bullous emphysema is firmly established in clinical nomenclature. The key to good results in the surgical treatment is proper selection of patients. Bullectomy for giant bullae is the method of choice.

Case report
A 44-year old man was admitted to the department of Cardiosurgery in May 1995 with increasing shortness of breath. The patient’s symptoms dated back to six years ago when he had noticed the gradual onset of dyspnea on exertion. His symptoms gradually worsened to the extent that he was dyspneic at rest. The patient, non-smoker and, worked for 25 years as a mechanic in a dust-free environment.

The chest roentgenogram (Fig. 1) revealed bilateral bullous emphysema with hyperlucency of the upper left lung field caused by giant bulla and compression of lower left lobe. At operation on May 4th, 1995 90 % of the upper lobe of the left lung and the lingula were found to be involved with bullae. There were also the two small bullae along the upper margin of the superior segment of the lower lobe.

Fig. 1: Chest roentgenogram with hyperlucency of the upper left lung field caused by giant bulla and compression of lower left lobe.