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Epidemiology of musculoskeletal tumors in a national referral orthopedic department. A study of 3482 cases

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ABSTRACT

Aim of the study: Musculoskeletal tumors are relatively rare, and their geographic distribution varies greatly around the world. In this study, we present the incidence, age distribution and localization of musculoskeletal tumors diagnosed and/or treated at a tertiary referral orthopedic department, catering to an entire Southeastern European country.

Methods: This was a retrospective study of prospectively collected data, in which all patients diagnosed and/or treated for musculoskeletal tumors at our Department in the period of 30 years (1981–2010) were included.

Results: Data of a total of 3482 patients with musculoskeletal tumors were collected. Average age of patients was 33.5 years (range, 2 months–88 years), with even distribution according to sex. Malignant tumors were seen in 20.7% of patients, more often in men (56.9%). Most common malignant tumors were osteosarcoma (estimated incidence: 1.68/million/year), chondrosarcoma (0.79/million/year) and Ewing sarcoma (0.76/million/year). Benign tumors and tumor-like lesions were found in 79.3% of patients, with slight female predominance. Most common benign bone lesions were osteochondroma (5.81/million/year), simple bone cyst (2.13/million/year), and enchondroma (2.05/million/year).

Conclusion: This report represents a first of its kind in our region, and gives representative results to be compared to other middle and south European countries. Further nationwide studies are needed to improve strategies in bone tumor diagnosis and treatment.

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1. Introduction

Malignant neoplasms pose a serious public health problem in the modern world. Estimates from the GLOBOCAN project show that in the year 2008 there were approximately 12.7 million new cancer cases, and 7.6 million deaths related to cancer in the World [1]. The newest study of incidence and mortality projects a worldwide incidence of over 15.2 million new cases of cancer, as well as a death count of over 8.8 million for the year 2015 [2]. After a transition over the last decade, the greatest burden of non-communicable diseases, up to 80%, is now borne by low-income

and middle-income countries [3]. This is a cause for alarm mainly because many, if not most, of these countries lack affordable, universally available quality healthcare. The burden of cancer carries with it substantial economical issues for societies worldwide. Although it is not possible to determine the exact cost of the burden of non-communicable diseases, a good example comes from a model for the productivity costs of cancer mortality that projected the annual expenses for the United States of America (USA) at approximately \$115.8 billion in the year 2000, and \$147.6 billion for 2020 [4].

Musculoskeletal tumors are relatively rare, as they account for 0.2–0.5% of all malignancies in all ages [5,6]. They are most often seen in children and adolescents, and for example, comprise 3–5% of all tumors diagnosed in European children younger than 15 years, and 7–8% in adolescents from 15 to 19 years of age [7]. Geographic distribution of these tumors varies greatly around the world. Countries like India, China and Japan have a very low

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incidence of musculoskeletal tumors, while the highest incidence is reported in Western Europe and the USA, mainly osteosarcoma and Ewing sarcoma [8].

It is very important to raise global awareness of the growing burden of cancer, and to help improve knowledge of cancer epidemiology, various forms of presentations and populations at risk. Exact information on epidemiology of musculoskeletal tumors in Central, Southern and Eastern Europe are scarce. The aim of this study was to describe the incidence, age and sex distribution, location and histology of benign and malignant musculoskeletal tumors diagnosed and/or treated at a tertiary referral orthopedic department serving the whole country of Croatia.

2. Patients and methods

This was a retrospective analysis of prospectively collected data of medical records of all patients diagnosed and/or treated for any type of musculoskeletal tumor at our Department, in the period from 1981 to 2010. The Departmental central archive contains medical records of all patients treated at our facilities. In patients who had a biopsy, or had a tissue sample acquired, all histology findings are included in the records. In patients with confirmed diagnosis of a musculoskeletal tumor, whose data was used for this study, data on both patient and tumor (name, gender, age, tumor localization, tumor histology) were collected in a separate, tumor database that was kept and updated parallel with the main archive. All of the specimens acquired by biopsy or resection were analyzed at our Institution's Department of clinical pathology and cytology. The final histology diagnosis had been correlated with clinical presentation and imaging findings by two authors (M.B. and D.O.).

The tumors were classified according to the 2002 World Health Organization classification of tumors of soft tissue and bone, and stratified into main groups; cartilage-forming tumors, bone forming tumors, tumor-like lesions, connective tissue tumors and soft tissue tumors [5].

Descriptive statistics were carried out to calculate the frequency and percentages of the aforementioned variables. Age distribution was stratified into different groups at 5-year intervals. The statistical analysis was done using the Statistica 10 software for Windows operating system (StatSoft, Tulsa, OK, USA).

3. Results

In the reviewed 30-year period, we identified 3482 patients who underwent surgery due to a diagnosis of tumor or tumor-like lesions of the musculoskeletal system at our Department. The average age of patients with musculoskeletal tumors was 33.5 years (range, 2 months–88 years). An even distribution according to sex, with 1745 (50.1%) men and 1737 (49.9%) women, was noted.

Out of the total 3482 patients with musculoskeletal tumors diagnosed and/or treated at our Department, 79.3% of tumors were benign and 20.7% ($n = 721$) malignant. Out of malignant tumors, the most common were osteosarcoma (29.7%), chondrosarcoma (14.0%) and Ewing sarcoma (13.5%). Malignant tumors were more often seen in men (56.9%) than women (43.1%). A very slight female predominance was seen in the total number of benign tumors, affecting 51.9% of women and 48.1% of men in the study.

The most commonly seen tumor groups were cartilage-forming tumors ($n = 1193$, 34.3%), tumor-like lesions ($n = 470$, 13.5%), and bone forming tumors ($n = 468$, 13.4%) (Table 1). In regard to diagnosis, osteochondroma was the most commonly seen tumor with 21.3% incidence, followed by chondroma (7.5%), simple bone cyst (7.8%), soft-tissue lipoma (7.3%), osteosarcoma (6.1%), osteoid

Table 1

Distribution of musculoskeletal tumors diagnosed and/or treated in our Department in the period of 1981–2010. The tumors are classified according to the 2002 World Health Organization classification of tumors. The data is given in total number of diagnosed tumors of a certain histological type (second column), and as a percentage of all tumors in this study (third column).

	Total number	% of all tumors
A. Bone tumors		
I. Cartilage tumors		
1. Osteochondroma	741	21.3
2. Chondroma	262	7.5
3. Chondroblastoma	32	0.9
4. Chondromyxoid fibroma	12	0.3
5. Synovial chondromatosis	45	1.3
6. Chondrosarcoma	101	2.9
II. Osteogenic tumors		
1. Osteoma	30	0.9
2. Osteoid-osteoma	191	5.5
3. Osteoblastoma	33	0.9
4. Osteosarcoma	214	6.1
III. Fibrogenic tumors		
1. Desmoplastic fibroma	10	0.3
2. Fibrosarcoma	4	0.1
IV. Fibrohistiocytic tumors		
1. Non-ossifying fibroma	56	1.6
2. Malignant fibrous histiocytoma	14	0.4
V. Ewing sarcoma/PNET		
VI. Hematopoietic tumors		
1. Plasma cell myeloma	19	0.5
2. Malignant lymphoma	4	0.1
VII. Giant cell tumor of bone		
VIII. Vascular tumors		
1. Hemangioma	12	0.3
2. Angiosarcoma	3	0.1
XI. Smooth muscle tumors		
1. Leiomyoma	36	1.0
2. Leiomyosarcoma	14	0.4
X. Lipogenic tumors		
1. Lipoma	41	1.2
2. Liposarcoma	4	0.1
XI. Neural tumors		
1. Neurilemmoma	4	0.1
Miscellaneous tumors		
1. Adamantinoma	2	0.1
2. Metastatic malignancy	149	4.3
Miscellaneous/tumor-like lesions		
1. Aneurysmal bone cyst	75	2.2
2. Simple cyst	272	7.8
3. Fibrous dysplasia	31	0.9
4. Langerhans cell histiocytosis	23	0.7
5. Non-classified miscellaneous lesions	69	2.0
B. Soft tissue tumors		
I. Adipocytic tumors		
1. Lipoma	253	7.3
2. Liposarcoma	25	0.7
II. Fibroblastic/myofibroblastic tumors		
1. Fibroma	28	0.8
2. Myositis ossificans	16	0.5
3. Hemangiopericytoma	3	0.1
4. Fibrosarcoma	22	0.6
III. Fibrohistiocytic tumors		
1. Giant cell tumor of tendon sheath	12	0.3
2. Diffuse-type giant cell tumor	60	1.7
3. Undifferentiated pleomorphic sarcoma	27	0.8
IV. Smooth muscle tumors		
1. Leiomyosarcoma	4	0.1
V. Pericytic (perivascular) tumors		
1. Glomus tumor	5	0.1
VI. Vascular tumors		
1. Hemangiomas	68	2.0
2. Lymphangioma	2	0.1
3. Kaposi sarcoma	1	0.0
4. Angiosarcoma	2	0.1
VII. Chondro-osseous tumors		
1. Extraskelatal osteosarcoma	3	0.1
Tumors of uncertain differentiation		
1. Synovial sarcoma	26	0.7

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