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Spine Tumor Epidemiology in Patients who Underwent Orthopaedic Surgery

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Abstract

Purpose of the study — to evaluate the frequency of spine tumors in patients who underwent orthopaedic treatment in a specialized hospital. ***Materials and Methods.*** All patients treated in the Vreden Russian Research Institute of Traumatology and Orthopedics (RNIITO) with spine tumor diagnosis were examined from 2000 till 2017. The data was obtained from medical histories. Patients' distribution per gender, age, histological type and tumor location was evaluated. ***Results.*** 2023 patients were included into the study, where 1298 (64.3%) were female. Patients with secondary metastases prevailed (59% overall), including breast cancer (43.6%), renal carcinoma (18%) and lung cancer (10.7%). Among benign tumors (overall 18.7%) symptomatic hemangiomas prevailed (93.8%). Primary malignant tumors (total 10.2%) were represented mainly by multiple myeloma (54.2%) and plasmacytoma (14.6%). Intermediate tumors with local aggressive growth were observed rarely (overall 3.9%). ***Conclusion.*** Spine is affected mainly by secondary tumors, where metastases of breast, renal and lung cancer are observed most often. Benign symptomatic hemangiomas demonstrate a high prevalence. Primary malignant tumors are presented mainly by multiple myeloma. Other primary malignant tumors and tumors with local aggressive growth are observed rather rarely.

Keywords: primary spine tumors, metastatic spine tumors, epidemiology.

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Introduction

Oncological diseases are the key issues of the current healthcare. 617 177 new cases of malignant tumors were reported in Russia in 2017. Growth of this criteria as compared to 2016 amounted to 3.0%. 3.6 million patients are under observation with oncology specialists by end of 2017 [1].

Bone tumors rank third after liver and lungs for frequency of malign cancer spread [2, 3]. Research demonstrates that bone metastases including spine are observed almost in 70% of patients with the most widespread malignant tumors (breast, lung and prostate cancer) [4]. In 10% of patients metastatic spine lesion is clinically demonstrated by spinal cord compression and vertebral column instability [5, 6]. Primary tumors of the bone skeleton are a rare pathology among malignant new growth [7, 8]. There is no information on such tumors prevalence in the Russian official statistics [1]. Besides, national literature contains scarce epidemiological publications on spine tumors frequency [9].

Purpose of the study — to evaluate the frequency of spine tumors in patients who underwent surgical orthopaedic treatment in a specialized hospital.

Materials and Methods

The authors collected and generalized the data on 2023 patients who underwent specialized surgical orthopaedic treatment in Vreden Russian Research Institute of Traumatology and Orthopedics from 2000 till 2017 in respect of spine tumors. There were 725 (35.8%) men and 1298 (64.2%) women (Table 1). Patients underwent several types of surgical treatment.

1. Radical reconstructive surgeries including total resection of the tumor with affected vertebra, replacement of vertebral body defect by an interbody implant and instrumental reconstruction of the spine.

2. Palliative decompression and stabilizing procedures like intrafocal tumor resection and removal of elements compressing the neural structures followed by instrumental stabilization of vertebral column, isolated stabilizing procedures to maintain spine support ability. Such minimally invasive interventions were performed like vertebroplasty and radiofrequency ablation of pathology centers aiming at relief of pain syndrome and maintaining spine support.

Spine tumors were divided into three groups: 1) primary, 2) metastatic (secondary), 3) new growth of unspecified etiology. Within the groups tumors were divided in accordance with histological type. In accordance with the third version of International classification of diseases or oncology (ICD-O-3)* benign, intermediate (with local aggressive growth) and malignant were separately identified among primary tumors. Metastatic tumors were divided by location of primary focus. In the group of new growth with unspecified etiology the histological verification was performed in postoperative period.

Medical histories of patients provided information on gender and age, tumor localization and histological type, presence of neural compression and treatment of the main oncology disease performed prior to spine surgery.

* International Classification of Diseases for Oncology. ICD-O-3 Online. 2018. Available from: http://codes.iarc.fr/.

Table 1

Overall features of patients with spine tumors

Tumors	Number of patients	Share of the total number. %	Share of patients in subgroup * (%)	Women (%)	Men (%)
		Primary tumors			
Total	683	32.8	-	62	37
Malignant	212	10.2	-	56.1	43.9
Multiple myeloma	115	5.5	54.2	54.8	45.2
Plasmacytoma	31	1.5	14.6	64.5	35.5
Chordoma	29	1.4	13.7	58.6	41.4
Chondrosarcoma	6	0.3	2.8	16.7	83.3
Osteosarcoma	11	0.5	5.2	45.5	54.5
Liposarcoma	9	0.4	4.2	77.8	22.2
Other	11	0.5	5.2	54.5	45.5
Intermediate	81	3.9	-	55.6	44.4
Giant cell tumor	59	2.8	72.8	54.2	45.8
Osteoblastoma	11	0.5	13.6	72.7	27.3
Aneurismal bone cyst	6	0.3	7.4	33.3	66.7
Other	5	0.2	6.2	60	40
Beneign	390	18.7	-	68.2	31.8
Hemangioma	366	17.6	93.8	67.8	32.2
Chondroma	15	0.7	3.8	93.3	6.7
Other	9	0.4	2.3	44.4	55.6
		Metastatic			
Total	1229	59	-	65.9	34.1
Breast	536	25.7	43.6	100	0
Kidney	221	10.6	18	22.6	77.4
Lung	132	6.3	10.7	28.8	71.2
Large intestine	81	3.9	6.6	53.1	46.9
Prostate	56	2.7	4.6	0	100
Skin	35	1.7	2.8	54.3	45.7
Uterine cervix	34	1.6	2.8	100	0
Uterus	33	1.6	2.7	100	0
Stomach	22	1.1	1.8	68.2	31.8
Thyroid	17	0.8	1.4	41.2	58.8
Bladder	15	0.7	1.2	40	60
Liver	14	0.7	1.1	57.1	42.9
Lymphogranulomatosis	12	0.6	1	75	25
Salivary gland	6	0.3	0.5	33.3	66.7
Other	15	0.7	1.2	73.3	26.7
Neo-plasms of unspecified etiology	111	5.3	-	52.3	47.7
Total	2023	-	-	64.2	35.8

* Subgroups: primary malignant, primary intermediate, primary benign and metastatic tumors.

Statistical analysis

Statistical processing was made using software R version 3.5.1. Table and chart data aggregation was used for descriptive statistics. Monte Carlo random criteria was used for assessment of qualitative signs. $p<0.01$ value was considered statistically significant.

Results

In the 18-year period (from 2000 till 2017) 1229 (60.7%) patients underwent treatment of metastatic tumors, 683 (33.8%) — of primary tumors, and 111 (5.5%) — of new growth of spine of unspecified etiology (Fig. 1). Section „Other" included rare tumor types — 40 (2%) including primary malignant tumors (hemangioendothelioma — 5, Ewing's sarcoma — 3, fibrosarcoma — 3), intermediate tumors (chondroblastoma — 5), benign tumors (fibrous dysplasia — 5, adipose tumor — 4). The following origins of secondary tumors were identified: adrenal — 3, ovary — 3, maxillary sinus — 2, gallbladder — 2, pleural mesothelioma — 2, soft tissue sarcoma — 2, tonsil — 1.

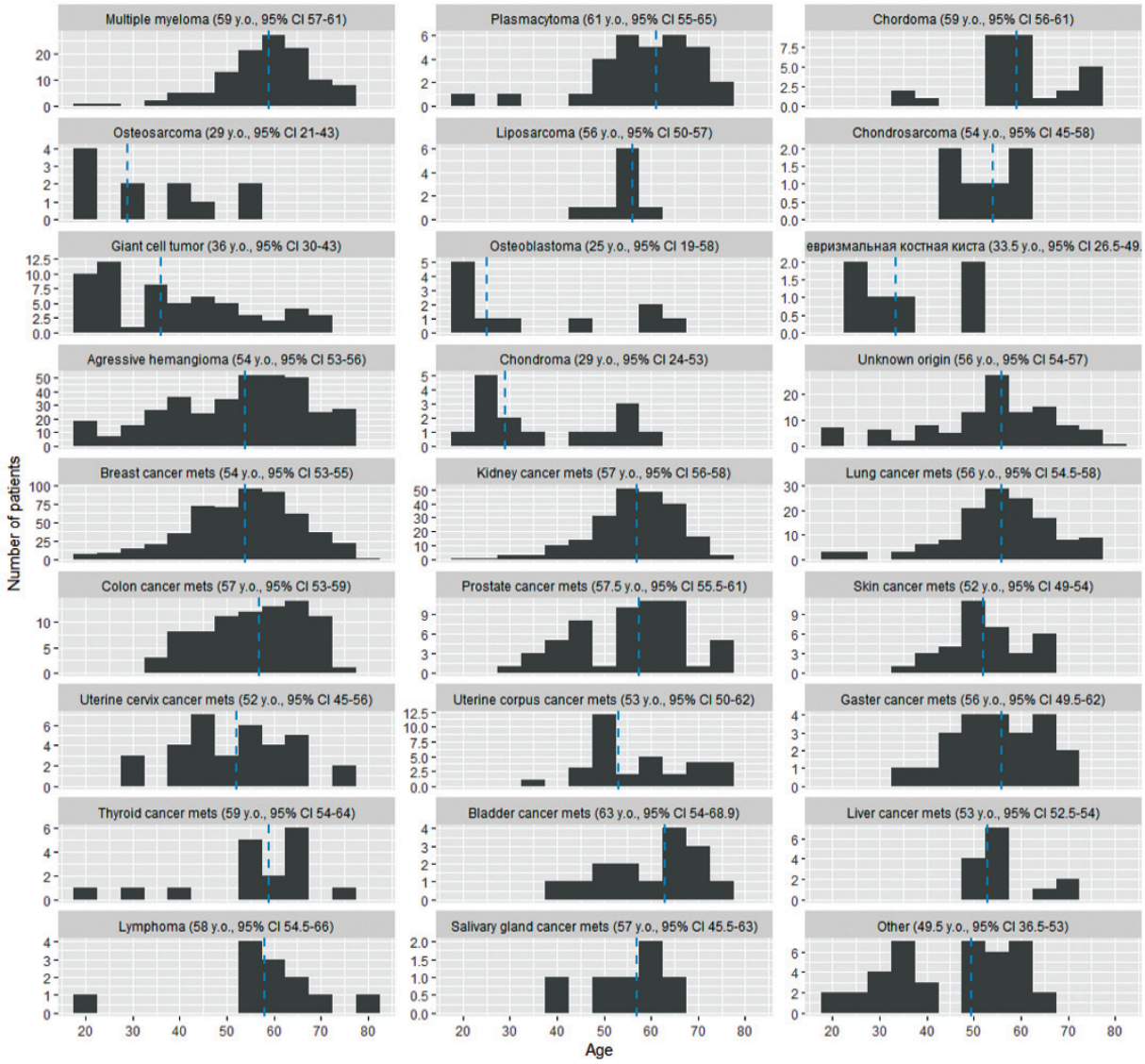

Fig. 1. Age distribution of patients

Young age of patients is typical for primary spine tumors, especially in subgroup of tumors with local aggressive growth (aneurismal bone cyst, giant cell tumor, chondroblastoma). One third of patients — 704 (34.8%) — were aging over 60. Age distribution is presented on Figure 2. The most frequent tumor location was thoracic spine — 1194 (57.5%), followed by lumbar spine — 574 (28.4%), cervical spine — 153 (7.6%) and sacrococcygeal spine — 132 (6.5%) (Table 2).

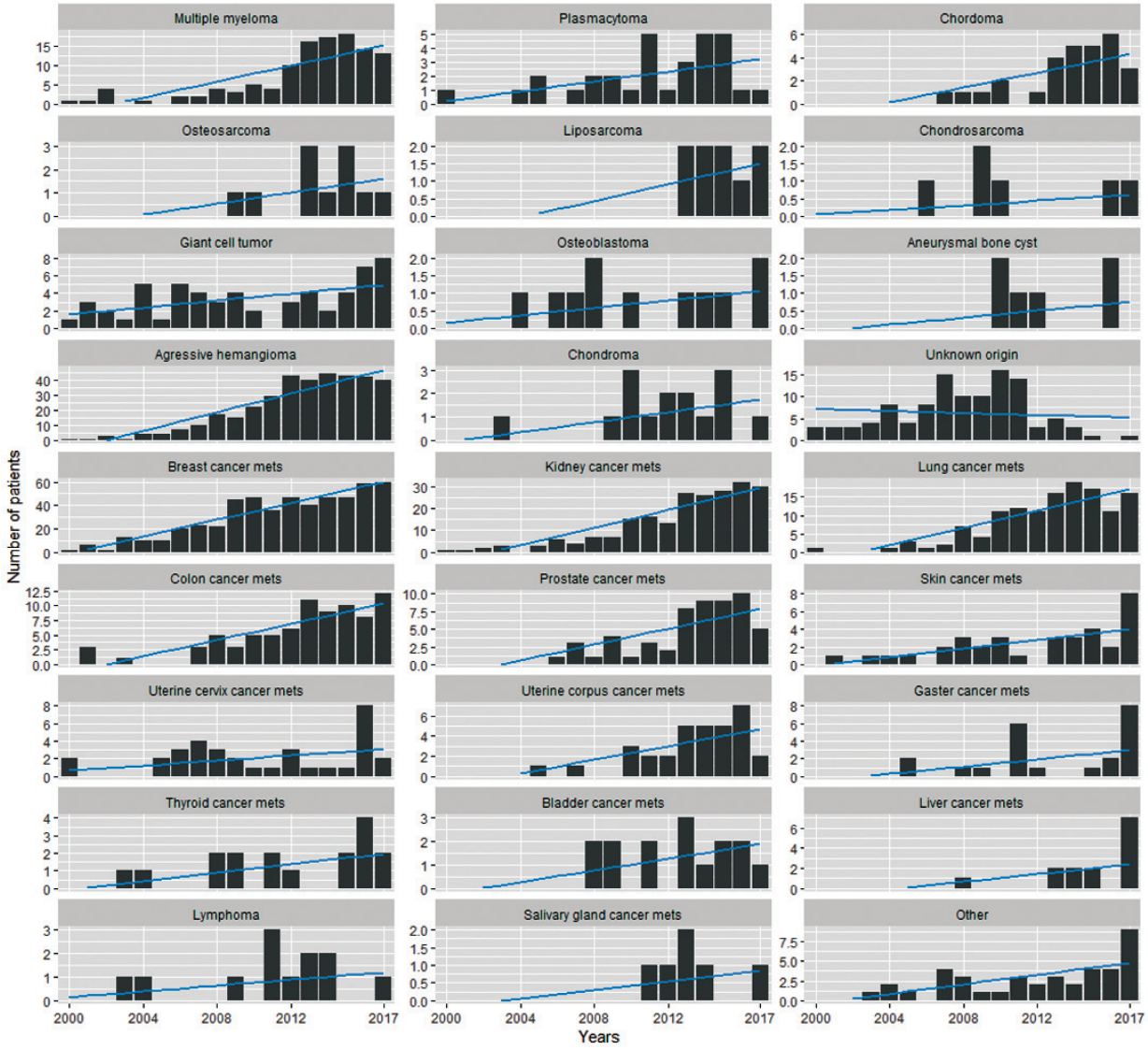

Fig. 2. Annual frequency rate of each tumor type. Line indicates a trend based on regression analysis

Table 2

Localization of lesion in the spine

Nosology	Cervical region, *n* (%)	Thoracic region, *n* (%)	Lumbar region, *n* (%)	Sacral region, *n* (%)
Primary	31 (4.5)	395 (57.8)	196 (28.7)	61 (8.9)
– malignant	20 (9.4)	94 (44.3)	59 (27.8)	39 (18.4)
– intermediate	3 (3.7)	46 (56.8)	17 (21)	15 (18.5)
– benign	8 (2.1)	255 (65.4)	120 (30.8)	7 (1.8)
Metastatic	109 (8.9)	713 (58)	341 (27.7)	66 (5.4)
Neoplasm	13 (11.7)	56 (50.5)	37 (33.3)	5 (4.5)
T o t a l	153 (7.6)	1164 (57.5)	574 (28.4)	132 (6.5)

The following indications for surgery were reported: pain or neurological deficit related to spine instability due to tumor lesion, compression of neural structures by growing tumor or by vertebra fragments after its pathological fracture; pain resistant to other treatment; presence of primary spine tumor with local aggressive or malignant growth.

The majority of patients (92.8%) complained of pain syndrome. Compression of neural structures was identified by clinical signs (neurological deficit, radiculopathy) and by X-ray examination (intracanal dissemination) in 255 (37.3%) patients with primary tumors, in 709 (57.7%) patients with metastatic tumors and in 83 (74,7%) patients with new growth of unspecified etiology ($p<0.0001$).

In the group of secondary tumors 678 (60.4%) patients underwent removal of primary tumor focal site, 595 (53.8) patients underwent systemic therapy of the primary lesion, 324 (29.2%) patients underwent radiotherapy of secondary focal sites.

Discussion

Destruction of spine elements on the background of tumor lesion can result in loss of support ability of the vertebral column and development of neural compression [10, 11]. Clinically it's manifested by intensive pain syndrome and neurological deficit leading to limitation of daily activities and decrease of life quality of patients [12].

New growth in the spine can originate from local sources — primary tumors of bone, adipose, fibrous neural tissues, neural membranes or adjacent paravertebral soft tissues and lymphatic vessels. On the other side, new growth can get into the spine by hematogenous or lymphatic way from remote malignant lesion focus [13, 14].

It's well known that primary spine tumors are observed much rarely than metastatic ones [8]. In the present study the ratio between primary and secondary tumors is less significant while the authors evaluated patients with hemangiomas who also underwent surgery. All primary new growth were identified on the stage of clinical manifestation: pain or neurological symptoms.

It's considered that rate of primary spine tumors has age related deviations. Benign tumors are characteristic for younger patients, and frequency of malignant tumors is increasing with age [15, 16]. The data of the authors demonstrates rather even distribution among all age categories for patients with benign tumors. At the same time patients with intermediate tumors demonstrated a clear tendency to younger age in contrast to patients with

malignant lesions. In the groups with malignant tumors only the patients with osteosarcoma were of younger age.

According to the data of the authors patients with intermediate and malignant tumors featured more often the lesion of sacral spine, especially patients with chordoma which corresponds to the literature [18].

Hemangiomas prevailed among primary benign tumors (93,8%) which are observed in a fourth of patients [18]. The common sign of symptomatic hemangiomas was pain syndrome. 12% of cases demonstrated aggressive growth — hemangiomas with soft tissue component attaching into spinal canal and compressing neural structures. The following lesions were observed among benign new growth: chondroma, lipoma and fibrous dysplasia. The absolute majority of benign spine new growth require only dynamic observation. Surgical procedure is undertaken only in case of risk for pathological fracture or in case of tumor contact with neural structures [19].

The group of patients with intermediate tumors (local aggressive growth) was the smallest in the present study due to the rare type of such pathology [20]. Compression of neural structures by soft tissue tumor component (77%) was observed most often in this group.

Hematopoietic tumors (multiple myeloma, plasmocytoma) and notochord tumors (chordoma) prevailed in the group of primary malignant spine new growth.

Patients who underwent surgery without histological verification of diagnosis were included into the group of new growth of unspecified etiology. In the period from 2000 till 2017 the share of patients with unspecified etiology new growth decreased from 23.1 to 0.4%, a negative trend was observed. This fact is explained by increased oncology alertness, wider availability and application of current diagnostic methods (PET, CT, MRI) as well as performance of puncture biopsy for identification of histological pattern of tumor.

Some authors report that metastases of breast cancer, prostate and lung cancer are the most frequent causes for spine tumors due to high occurrence rate of such lesions [21, 22]. R.L. Siegel et al. report that more than half of oncology diseases are constituted by above mentioned tumors [23]. According to Russian authors the main sites for malignant new growth are skin, breast and lungs [1]. Metastatic bone lesions are observed in 70–80% of patients with breast cancer or prostate cancer and in 40% of patients with regional lung cancer [24].

In the present study the patients with oncological pathologies who underwent orthopaedic treatment most often suffered from metastases of breast cancer (43.6%), renal tumor (18%) and lung cancer (10.7%). The number of female patients, respectively, prevailed among patients with secondary tumors. Prostate cancer and malignant skin tumors were rarely observed. A big share of patients with renal tumors in the present study can be explained by the fact that these new growth cause aggressive lytic processes in the bone resulting in loss of support function of vertebral column and to neurological complications requiring surgical treatment. Besides such type of tumor lesions is radio-resistant which again demands surgery.

The majority of histological spine tumor types demonstrated an upward trend for increasing absolute number of patients. On the one hand it's related to the advanced diagnostics of oncological diseases and secondary bony alterations, in particular, which is mainly concerns primary spine tumors. On the other hand, the risk of development of symptomatic focal sites in the spine along with metastatic lesions is proportionally related to increased lifespan of patients with malignant tumors. While systemic and radiotherapy allow to gain control over metastatic focus sites in general and in the spine in particular, the probability of orthopaedic complications, such as pathological verte-

bral fractures, can be rather high [25–27]. For this reason, surgical treatment of orthopaedic consequences will keep its relevance for many years.

Despite global positive trend of last years in diagnostics and treatment for oncological diseases, the high demand for surgical care aimed at stabilization of vertebral column and decompression of neural structures is yet in place. The absolute number of patients who need surgical treatment is growing. Spine is mainly affected by secondary lesions where metastases of breast, renal and lung cancer prevail. Benign symptomatic hemangiomas are widespread. Primary malignant tumors are mainly presented by multiple myeloma. Other primary malignant tumors and tumors with local aggressive growth are rather rare.

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