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REVIEW

Epidemiology of Malignant Bone Tumors in a Tertiary Care Hospital of the Himalayan Region of India: a Review of 97 Cases

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Abstract

Bone tumors remain a difficult challenge for orthopedic surgeons to date. This challenge is heightened in developing countries like India due to limited diagnostic and therapeutic facilities as well as due to ignorance of patients. A specialty clinic was started with this intention. We describe the early experience of our bone tumor clinic. The purpose of this study is to determine the pattern of malignant bone tumors including their relative frequencies, age, and sex distribution, anatomical sites of occurrence, and clinicopathological characteristics as seen in a newly established tertiary care hospital in India, and to compare our data with the available date of India and other countries. This data could be potentially useful to plan management and provide a perspective for developing advanced facilities in the future. A retrospective review was performed for all the histopathological confirmed cases of malignant bone tumors seen in the initial 2 years of the bone tumor specialty clinic. An audit was done with the available resources and our data was compared with other available literature. Ninety-seven cases of malignant bone tumors were reported, the peak age of incidence of primary and metastatic bone tumors was in the age group of 11–20 years (37.5%) and 51–60 years (35.7%), respectively. Osteosarcoma accounted for 26.08% of all the primary malignant tumors in the study. The femur was the most common site for primary malignant bone tumors and accounted for 22 cases out of 48 cases (45.8%) and the spine was the most common site for secondaries accounted for 15 cases (53.57%) followed by the femur which accounted for 10 cases (35.7%) out of 28 patients of metastatic bone disease. Primary malignant bone tumors occur mainly in the second decade of life with a male preponderance. Osteosarcoma is the most common followed by Ewing sarcoma which is in line with other available literature. In our study, the most common primary foci for metastatic bone tumors are from the lungs followed by the thyroid and the most common site for metastasis in bones is the spine followed by the femur.

Keywords Bone tumors · Osteosarcoma · Ewing sarcoma · Metastasis

Introduction

Cancer is one of the leading causes of death worldwide, of which bone tumors constitute only 0.2%. Primary bone tumors are the ones that originate from the bone. They are ranked as the third leading cause of death in patients who are younger than 20 years [1]. Their true incidence is difficult to estimate because of their rarity [2]. Osteosarcoma, chondrosarcoma, and Ewing sarcoma/primitive neuroectodermal tumor (PNET) are the common primary bone sarcomas with rare tumors such as fibrosarcoma, chordomas, and undifferentiated pleomorphic sarcoma (UPS) constituting as the remaining subtypes [3]. Bone tumors remain a difficult challenge for orthopedic surgeons especially in developing countries like India due to limited diagnostic and therapeutic facilities as well as ignorance. There is published literature available showing the incidence of various tumors coming to their institute [4–6]. We here started a dedicated musculoskeletal tumor clinic and recorded the incidence of various primary malignant tumors coming to our hospital and compared our data with the available national and international data.

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Materials and Methods

A retrospective review of the clinical and histopathological records of the patient with an established diagnosis of bone tumors presenting in the tumor clinic in the period 2017–2019 was performed. The data were procured from the hospital information system (HIS) and medical record department (MRD) and only histological confirmed cases were included in the study. Benign musculoskeletal tumors and bone tumors of odontogenic origin and infectious lesions were excluded from the study. The data was extracted in the MS office excel sheet (Professional plus 2019) and the statistical analysis was done using SPSS software. Classification of the tumors was done based on the current World Health Organization (WHO) histological classification of bone tumors [7].

Primary malignant bone tumors are the ones originating from the bone which may be malignant or benign while secondary bone tumors are the metastatic deposits of malignant cells in the bone from other organs of the body [8].

Table 1 Histological types of bone tumors

Type of tumors	Number of cases
Primary malignant bone tumors (48)	
• Osteosarcoma	18
• Ewing sarcoma	17
• Chondrosarcoma	4
• Hematogenous malignancies	8
• Malignant GCT	1
Soft tissue tumors	21
Secondaries	28
	97

GCT, giant cell tumors

Hematogenous malignancies include multiple myeloma

Soft tissue tumors include melanoma (1), liposarcoma (1), pleomorphic sarcoma (5), squamous cell carcinoma (1), spindle cell sarcoma (2), synovial sarcoma (11)

Secondaries include lung cancer (9), breast cancer (4), thyroid (4), renal cancer (3), gall bladder (1), prostate cancer (1), unknown (6)

Results

The incidence of various malignant bone and soft tissue tumors is summarized in Table 1. A total of 97 patients (aged 5 to 87 years) with a mean age of 38.56 years were studied.

The yearly distribution of musculoskeletal tumors presenting to our institute is shown in Fig. 1.

Of the total 97 cases, 53 patients (54.6%) were male and 44 patients (45.4%) were females (Fig. 2).

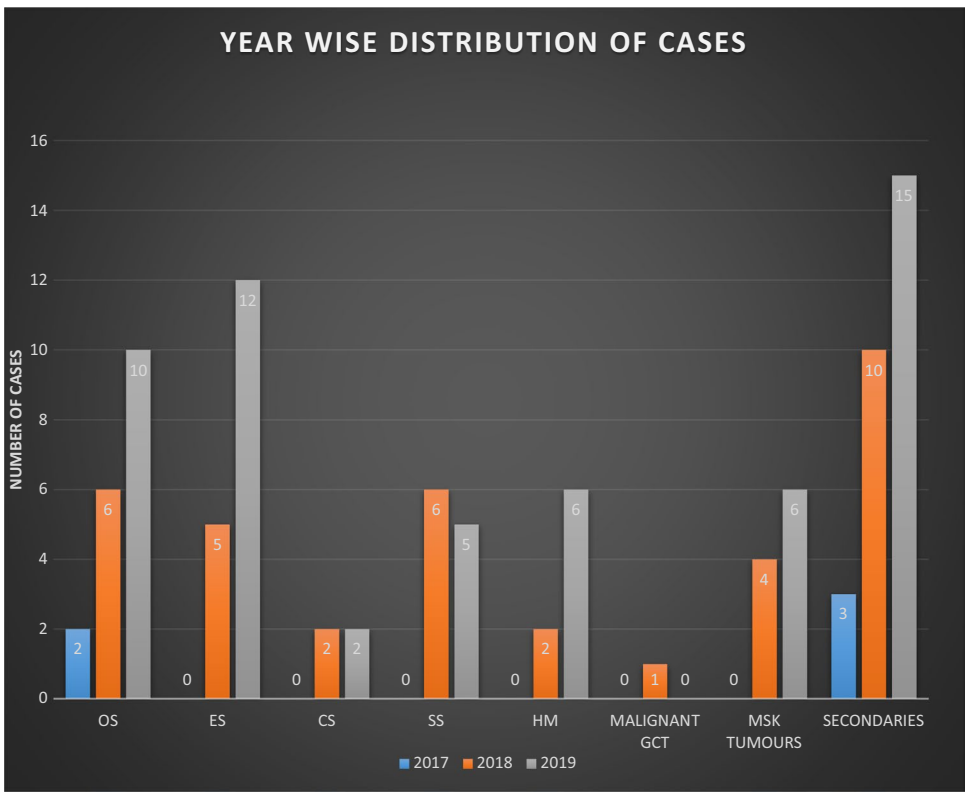

Fig. 1 Year-wise distribution of cases of all the malignant musculoskeletal tumors presenting in our institute showing an increasing trend from the year 2017 to 2019. OS, osteogenic sarcoma; ES, Ewing sarcoma; CS, chondrosarcoma; SS, synovial sarcoma; HM, hematogenous malignancies; MALIGNANT GCT, malignant giant cell tumors with metastasis. Hematogenous malignancies include multiple myeloma. Soft tissue tumors include melanoma (1), liposarcoma (1), pleomorphic sarcoma (5), squamous cell carcinoma (1), spindle cell sarcoma (2), synovial sarcoma (11) (synovial sarcoma has been mentioned separately in this chart despite soft tissue tumor due to increased number of cases). Secondaries include lung cancer (9), breast cancer (4), thyroid (4), renal cancer (3), gall bladder (1), prostate cancer (1), unknown (6)

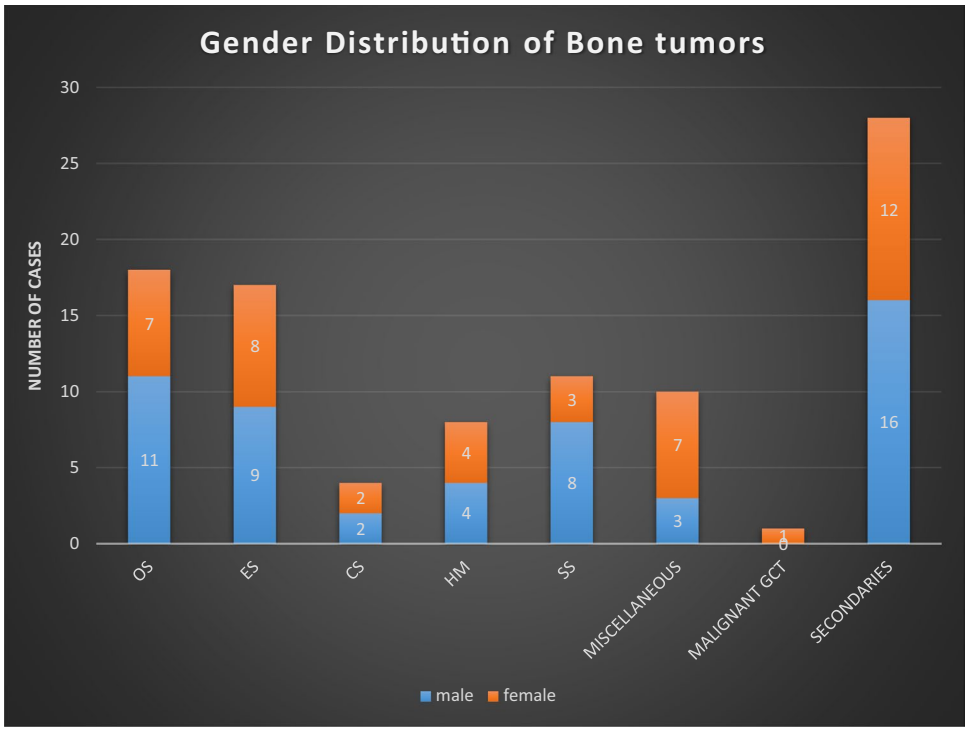

Fig. 2 Sex distribution of all the cases of malignant musculoskeletal tumors. OS, osteogenic sarcoma; ES, Ewing sarcoma; CS, chondrosarcoma; SS, synovial sarcoma; HM, hematogenous malignancies; MALIGNANT GCT, malignant giant cell tumors with metastasis. Hematogenous malignancies include multiple myeloma. Soft tissue tumors include melanoma (1), liposarcoma (1), pleomorphic sarcoma (5), squamous cell carcinoma (1), spindle cell sarcoma (2), synovial sarcoma (11) (synovial sarcoma has been mentioned separately in this chart, but it is also a soft tissue tumor). Secondaries include lung cancer (9), breast cancer (4), thyroid (4), renal cancer (3), gall bladder (1), prostate cancer (1), unknown (6)

Age distribution of various malignant musculoskeletal tumors is shown in Fig. 3.

Osteosarcoma accounted for 38.77% (18 cases) of primary malignant bone tumors in this study. The peak age incidence for primary bone tumors was in the 11–20 years (37.5%). Femur being the most common site (distal > proximal) for primary bone tumors accounted for 22 cases followed by tibia (8 cases) and fibula (1 case).

Osteosarcoma accounted for 18.55% of all the tumors and was found to be the most common primary malignant bone tumor. The male to female ratio was 1.6:1. The frequency of anatomical sites of osteosarcoma is shown in Fig. 4. The majority were conventional osteosarcoma while there was one case of chondroblastic sarcoma and one case of small cell osteosarcoma which is an extremely rare variant.

Ewing sarcoma accounted for 17.53% of all the tumors (2nd most common primary malignant bone tumor) in our study. The male to female ratio was 1.2:1. The frequency of anatomical sites of Ewing sarcoma is shown in Fig. 5.

Chondrosarcoma accounted for 8.3% (4 out of 48 cases) of primary malignant bone tumors in the study with equal male and female incidence and pelvis as the most common site. Other sites of involvement were the spine and chest wall. Multiple myeloma and plasmacytoma together accounted for 8.24% of bone tumors with multiple myeloma being more common in males (M:F 3:1) and plasmacytoma in females (M:F 1:3). Most of the myeloma cases had multiple sites of involvement with a predilection to the axial skeleton including the skull, spine, and pelvis.

We had 28 cases of metastatic bone tumors in our study with a male to female ratio of 1.33:1; most of the cases were of more than 50 years of age (71.4%). The frequencies of anatomical sites of bone metastasis of primary cancers are shown in Fig. 6. Of all the radiographic patterns of metastatic deposits, osteolytic type accounted for the majority of cases followed by osteosclerotic and mixed types.

Synovial sarcoma was the most common soft tissue malignancy (39.28%) in our study with the knee as the most common site and males predominantly affected (Fig. 7). Eight out of 11 cases of synovial sarcoma had localized disease and 3 cases had metastatic disease at presentation.

Discussion

Primary bone tumors are rare neoplasms, early and correct diagnosis of which is essential to guide an appropriate and definitive treatment. For bone tumors, clinical evaluation, radiologic studies, and demographic characteristics are the most important pieces of information physicians use in generating a pertinent differential diagnosis. Histologic examination of the tumor and relevant laboratory studies are then used to determine the final diagnosis.

The above retrospective review of cases was done to analyze the spectrum of malignant musculoskeletal tumors among patients presenting to our institution, a tertiary care referral center in India. We compared our data to existing Asian and western literature (Table 2).

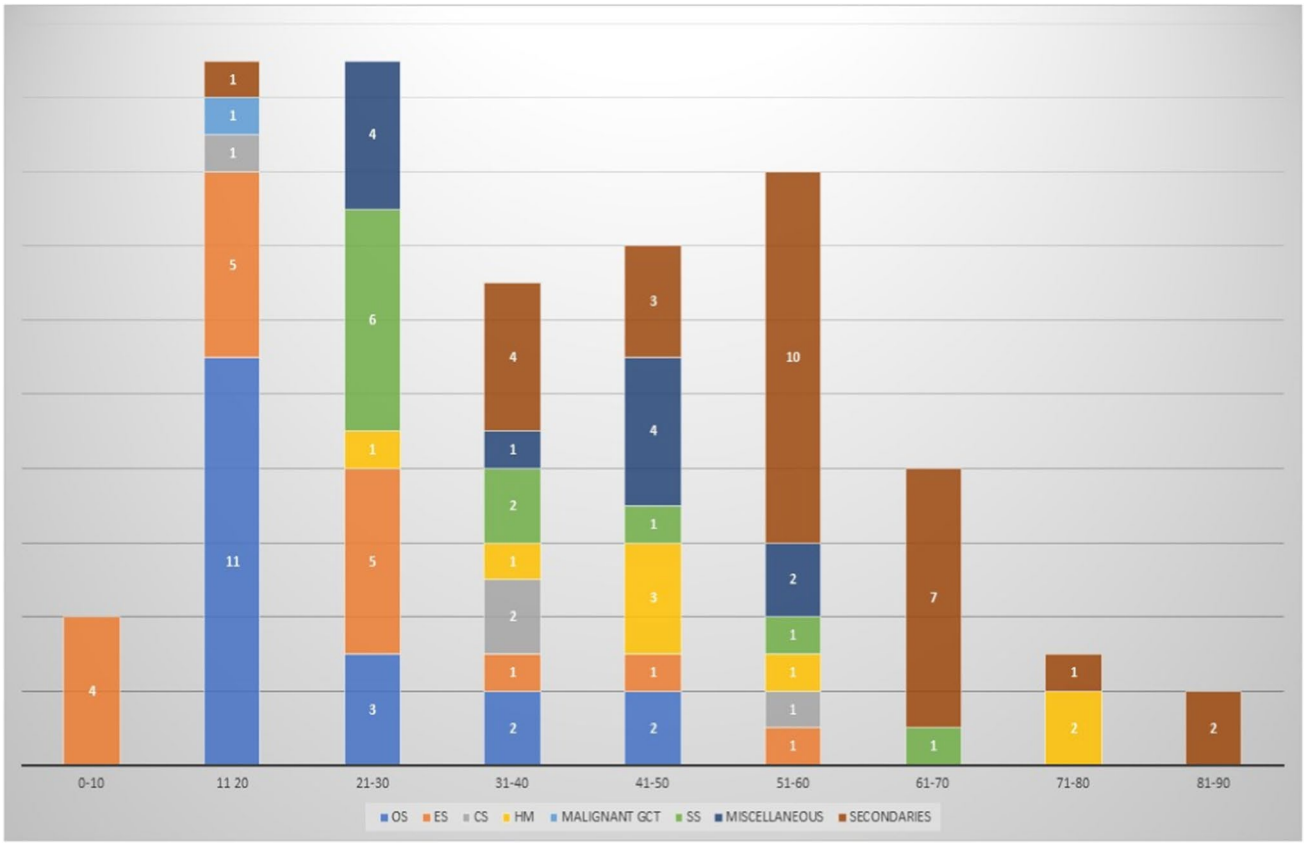

Fig. 3 Age group frequencies of all the bone tumors. OS, osteogenic sarcoma; ES, Ewing sarcoma; CS, chondrosarcoma; SS, synovial sarcoma; HM, hematogenous malignancies; GCT, giant cell tumor. Hematogenous malignancies include multiple myeloma and plasmacytoma. Soft tissue tumors include melanoma (1), liposarcoma (1), pleomorphic sarcoma (5), squamous cell carcinoma (1), spindle cell sarcoma (2), synovial sarcoma (11) (synovial sarcoma has been mentioned separately in this chart, but it is also a soft tissue tumor). Secondaries include lung cancer (9), breast cancer (4), thyroid (4), renal cancer (3), gall bladder (1), prostate cancer (1), unknown (6)

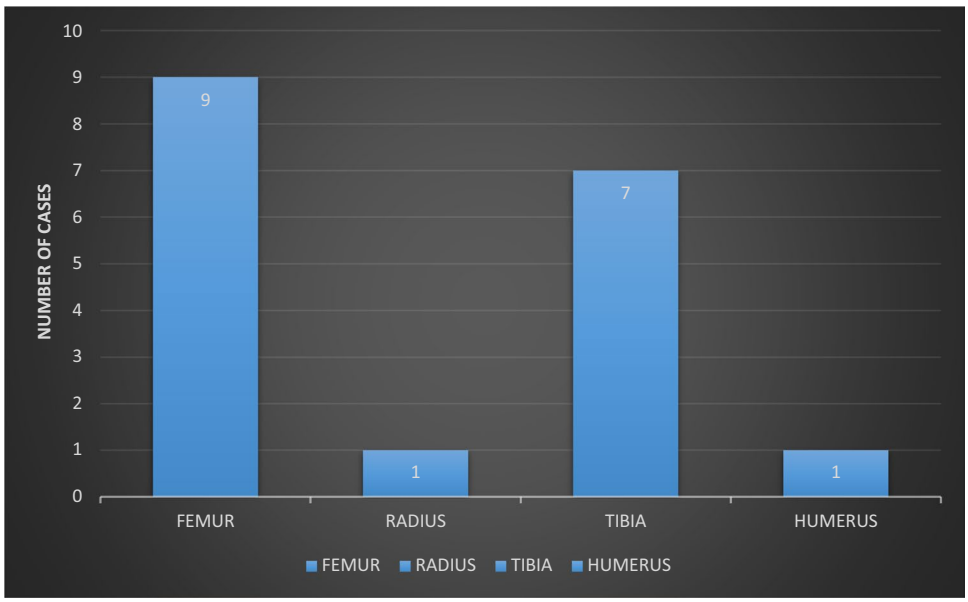

Fig. 4 Frequency of anatomical sites of osteosarcoma

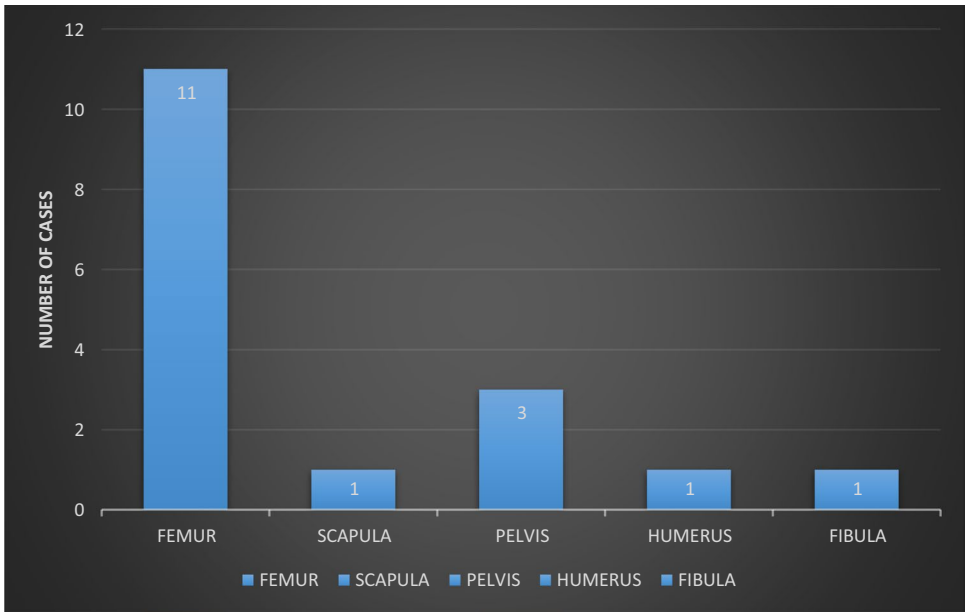

Fig. 5 Frequency of anatomical sites of Ewing sarcoma

Of the ninety-seven cases of malignant musculoskeletal tumors, the percentage of primary tumors (sixty-nine cases) was higher than secondaries (twenty-eight cases). The reason behind this may be the high number of pediatric and young adult cases in the series in which primary malignant bone tumors are more common than secondary bone tumors. The majority of primary malignant bone tumors occurred in the 11–20 years followed by the third decade and 36% of secondary bone tumors occurred in the age group of 51–60 years followed by the seventh decade. The most common symptom at the time of presentation in the case of primary bone tumors was pain and bony swelling (88.3%). One patient of osteosarcoma of distal femur presented with pathological fracture. These findings are like other studies from other regions of the Indian subcontinent [4, 5, 8].

Osteosarcoma is the most common primary malignant bone tumor in our series followed by Ewing sarcoma and chondrosarcoma. Our results are similar to that of other studies from the Indian subcontinent [4–6, 9, 10]; however, in contrast, western studies show chondrosarcoma to be the second most common primary malignant tumor followed by Ewing sarcoma [9, 10]. In the Chinese JST as well as the Mayo clinic database, the most common histologic type of malignant bone tumor was osteosarcoma followed by chondrosarcoma and Ewing sarcoma [1]. In our study, we observed that the incidence of osteosarcoma was just one more than cases of Ewing sarcoma. This is in contrast

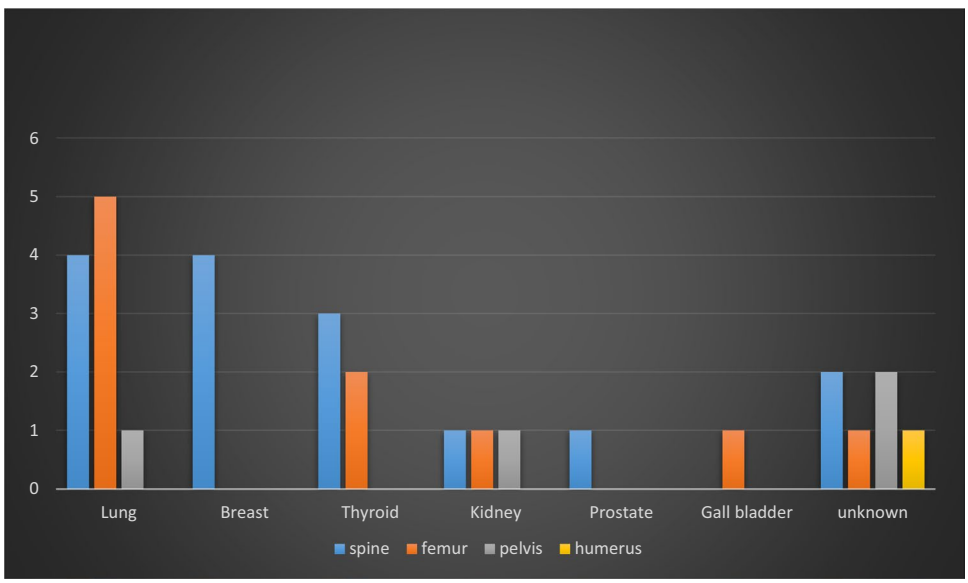

Fig. 6 Frequency of primary cancer origin metastasizing to bones

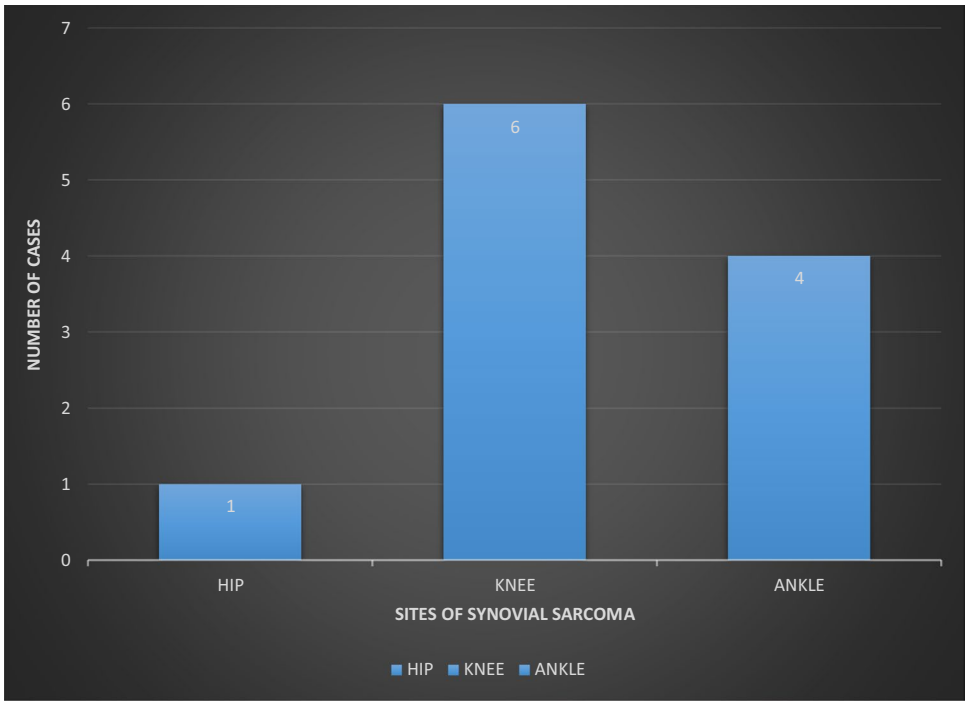

Fig. 7 Frequency of anatomical sites of synovial sarcoma

to other studies conducted by Gulia et al. in 2010; Rahul et al. in 2018; and Jain et al. in 2011 where the incidence of osteosarcoma was almost twice that of Ewing sarcoma. The common site of occurrence of osteogenic sarcoma is in the metaphysis, mostly in the lower end of the femur followed by the upper end of the tibia [11]. In our study, we observed a similar pattern.

Ewing sarcoma occurs predominantly in the diaphysis of long bones, in the 0–20 years age group with male and female predominance by different groups [4, 5, 13]. We observed a similar finding except that we noted almost equal incidence in both the sexes.

Among 4 cases of chondrosarcoma in our study, two cases had involvement of pelvis, followed by one case of chest wall and spine each. There was an equal number of males and females affected (1:1). However, in a similar study by Gulia et al. in 2016, male predominance was reported and in the study conducted by Jain et al. in 2011, female predominance was reported [4, 5].

Synovial sarcoma was the most common soft tissue malignancy in our study with the knee as the most common site and males predominantly affected. Eight out of eleven cases of synovial sarcoma had localized disease and three cases had metastatic disease at presentation. In our study, the incidence of synovial sarcoma was much higher compared to the study done by Gulia et al. in 2010 [4].

The skeletal system is the third commonest site to be involved by metastatic tumors after lung and liver and metastatic carcinoma is the most frequent malignancy of bone. Metastatic bone tumors most frequently occur in patients older than 50 years and commonly originate from the lung, gastrointestinal system, prostate, breast, and liver. Metastases can occur in any bone but usually are located in the axial or proximal appendicular skeleton [11]. In our study, metastatic bone tumors were most commonly reported in the 51–60-year age group (ten out of twenty-eight cases) with lungs being the most common primary followed by thyroid and breast. Most of the lesions presented with osteolytic features. Metastasis with an unknown origin accounted for six cases in our series. These observations are in contrast to other similar studies where the breast is the second most common primary cancer of origin [4–6]. Out of the seventy cases of malignant bone tumors, five patients under the age of 40 years had a metastatic bone tumor, which is ten times higher compared to other Asian and western literature [4–6, 9, 10]. In our series, there was

Table 2 Comparisons of incidence of primary malignant bone tumors in Indian population [4–6, 11–13]

Primary bone tumors (malignant)	Osteosarcoma (%)	Ewing sarcoma (%)	Chondrosarcoma (%)
Our study	37.5	35.4	8.3
Gulia et al	43	27	11
Jain et al	35.1	16.2	16.2
Rahul et al	56.7	31.7	8.33
Deka et al	32.35	17.64	29.41
Shah et al	27.2	12.4	8.3
Solooki et al	50.1	15.9	8

one case of malignant GCT distal femur (Enneking stage 3) with pulmonary metastasis.

The present study, however, has limitations. Our study is hospital-based showing an audit of the tertiary center and so cannot reflect the incidence of malignant musculoskeletal bone tumors in the population as a whole and so has an inherent selection bias. Patients of all age groups coming to musculoskeletal oncology OPD with a histopathological confirmed diagnosis of tumor were included from Jan. 2017 to Dec. 2019. Moreover, we have an audit of 3 years in a newly established musculoskeletal oncology center so the incidence of referrals may not be the same as other established centers.

Conclusion

In the early experience of our bone tumor clinic, osteosarcoma mainly in the second decade of life with a male preponderance was the most common primary malignancy of bone. The most common site for metastatic bone tumors is the spine followed by the femur and the most common primary are lungs followed by the thyroid. The above epidemiological data are encouraging and seem to be in line with world literature and can help in prioritizing the facilities for early diagnosis and better management of these cases.

Author Contribution Dr. Aakash Jain (first author): data procurement and compiling. Dr. Mohit Dhingra (corresponding author): manuscript drafting and table formatting.

Data Availability All the data is with the first author and can be provided at any point in time.

Declarations

Ethics Approval Institutional ethical approval is taken.

Consent to Participate The patient's consent is not required as the patient's identity is not disclosed or compromised.

Consent for Publication Institutional ethical clearance taken.

Conflict of Interest The authors declare no competing interests.

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