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ORIGINAL ARTICLE

Spectrum of nonhematological pediatric tumors: A clinicopathologic study of 385 cases

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ABSTRACT

Background: The aim of this study is to understand the epidemiology of tumors in children in our region due to a paucity of studies on the histologic review of the childhood tumors in general and benign tumors in particular. **Materials and Methods:** The records of all the tumors diagnosed histopathologically in children <14 years of age during a period of 8-year (2005-2012) were reviewed. **Results:** A total of 385 tumors were seen in the age range of 1 month-14 years with 231 (60%) in boys and 154 (40%) in girls. Highest number of cases, 224 (58.18%) were in the age group of 10-14 years. Benign tumors comprised 275 (71.43%) cases while the malignant tumors accounted for 110 (28.57%) cases. In benign tumors, vascular tumors were in majority with 68 cases, while in malignant category bone tumors were most common with 36 cases. **Conclusions:** Although the exact incidence rate cannot be provided by this hospital-based study, the information is useful in showing patterns of childhood tumors. We included both benign and malignant tumors, while most of the studies in the past have focused mainly on malignant tumors in children.

Key words: *Children, clinicopathological, tumors*

INTRODUCTION

Tumors that occurs in children are as diverse as those in adults and present a number of challenges for the pathologist.[1] Compared with cancers that occur in adults, childhood cancers are rare comprising only 1% of all the cancers.[2] >10% of all deaths in children below 15-year of age are caused by malignant diseases in the developed countries. In the developing world, childhood cancers are yet to be recognized as a major pediatric illness; however, they are fast emerging as a distinct entity to be dealt upon.[3]

The spectrum of pediatric tumors varies considerably and differs from that in adults. Virtually any tumor may be encountered in children, however in general, the principal groups of cancer in children are leukemias, lymphomas, and sarcomas, whereas in adults the chief cancers are carcinomas.[4] The manner of grouping the cancers is also different. For children, the International Classification of Childhood Cancer (ICCC) is used based on morphology of the tumors and is composed of 12 main groups.[5] Benign tumors are more common than the malignant tumors. Most benign tumors are of little concern but on occasion they cause serious disease by virtue of their location or rapid increase in size.[6] Both benign and malignant tumors need a comprehensive evaluation to provide an appropriate diagnosis for designing therapy and predicting prognosis.[7]

The spectrum of malignancies has a great regional variability owing to the environmental and genetic differences.[8] A literature search shows that there is paucity of studies on the histologic review of the childhood tumors in general and benign tumors in particular. In an effort to better understand the epidemiology of tumors in children in our region, a retrospective review of the tumors diagnosed histopathologically was carried out.

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MATERIALS AND METHODS

This study is a retrospective study conducted in the Department of Pathology of a tertiary care hospital, which caters to the patients attending and referred from periphery to the hospital to analyze the spectrum of tumors in children. The records of all the tumors diagnosed histopathologically in children <14 years of age during a period of 8-year from January 2005 to December 2012 were retrieved and analyzed.

The tumors were analyzed according to age, sex and histopathological diagnosis. Both benign and malignant tumors diagnosed in children were included, while leukemias were excluded from our study. All tumors were diagnosed on routine hematoxylin and eosin stained sections; special stains and immunohistochemistry was applied wherever necessary. Fine-needle aspiration was done in some cases only. Cytogenetic and molecular studies were not done.

RESULTS

During the 8-year study period, a total of 419 tumors were diagnosed. Of these, the leukemias comprised 34 cases and were excluded from the study. The remaining 385 tumors (including both benign and malignant) diagnosed on histopathology formed the study group.

Clinical profile

The cases included in the present study were in the age range of 1 month-14 years. Highest number of cases was in the age group of 10-14 years [Table 1]. There were 231 (60%) boys and 154 (40%) girls.

Histopathological diagnosis

Benign tumors

As depicted in Table 2, vascular tumors were the most common including 51 (75%) cases of hemangioma and 17 (25%) cases of lymphangioma. Among the bone tumors, osteochondroma was the most common (48 cases). The others included 6 cases of osteoid osteoma, 5 cases of enchondroma, 2 cases of chondromyxoid fibroma and 1 case of osteoclastoma. Fibroadenoma was seen to occur exclusively in females >10 years of age. There were 4 cases of giant fibroadenoma measuring >10 cm and the morphology of these tumors were usual. Tumors of the skin and its adnexae included 11 cases of pilomatricoma, 10 cases of melanocytic nevi and 1 case each of syringocystadenoma papilliferum and hidradenoma papilliferum. The category of benign fibrous tumors included 10 cases of nasopharyngeal angiofibroma, which was seen to occur exclusively in males >10 years of age, 9 cases of fibroma and 7 cases of fibromatosis. The miscellaneous category included laryngeal papilloma (10 cases), giant cell tumor of tendon sheath (3 cases), mature cystic teratoma (5 cases), pleomorphic adenoma (2 cases), follicular adenoma thyroid, hürthle cell adenoma thyroid, ameloblastoma, tubular adenoma breast, tubular adenoma colon and mucinous cystadenoma ovary (1 case each).

Table 1: Age wise distribution of benign and malignant tumors

Age group (years)	Benign tumors	Malignant tumors	Total (%)
0-4	45	16	61 (15.85)
5-9	65	35	100 (25.97)
10-14	165	59	224 (58.18)
Total (%)	275 (71.43)	110 (28.57)	385

Malignant tumors

These were classified according to the ICCC [Table 3]. Bone tumors were the most common which included 21 cases of Ewing's sarcoma/primitive neuroectodermal tumor (ES/PNET), 14 cases of osteosarcoma and 1 case of chondrosarcoma. The category of central nervous system (CNS) tumors included 9 cases of medulloblastoma which were in the posterior fossa and morphologically all were classical. Of the 9 cases of astrocytoma reported in our study, five were low grade and four were pilocytic. Rhabdomyosarcoma formed the largest group in the category of soft tissue sarcoma (8 cases). There were 5 cases of botryoid rhabdomyosarcoma and 3 cases of embryonal rhabdomyosarcoma. All of them occurred in the head and neck region. Lymphomas included 5 cases of Hodgkin lymphoma (HL) and 3 cases of non-Hodgkin lymphoma (NHL). The malignant epithelial tumors were comprised by 3 cases of mucoepidermoid carcinoma, 2 cases of adenocarcinoma colon-signet ring cell type and 1 case each of squamous cell carcinoma, papillary carcinoma thyroid

Table 2: Spectrum of benign tumors in children

Tumor	0-4 years	5-9 years	10-14 years	Males	Females	Total (%)
Vascular tumors	16	22	30	43	25	68 (24.73)
Bone tumors	5	16	41	46	16	62 (22.55)
Breast neoplasms	0	0	24	0	24	24 (8.73)
Skin and adnexal tumors	4	10	9	12	11	23 (8.36)
Fibrous neoplasms	2	2	22	22	4	26 (9.45)
Lipomatous tumors	11	5	8	13	11	24 (8.73)
Nerve sheath tumors	0	2	12	9	5	14 (5.09)
Fibrohistiocytic neoplasms	0	1	7	2	6	8 (2.91)
Miscellaneous	7	7	12	15	11	26 (9.45)
Total	45	65	165	162	113	275

Table 3: Spectrum of malignant tumors in children

Tumor	0-4 years	5-9 years	10-14 years	Males	Females	Total (%)
Bone tumors	3	11	22	23	13	36 (32.73)
Central nervous system tumors	2	11	13	18	8	26 (23.64)
Soft tissue sarcoma	3	8	8	10	9	19 (17.27)
Lymphoma	1	2	5	6	2	8 (7.27)
Malignant epithelial neoplasms	0	1	7	3	5	8 (7.27)
Germ cell tumors	1	1	2	2	2	4 (3.64)
Vascular tumor	0	0	1	1	0	1 (0.91)
Neuroblastoma	0	0	1	0	1	1 (0.91)
Retinoblastoma	6	1	0	6	1	7 (6.36)
Total	16	35	59	69	41	110

and medullary carcinoma thyroid with amyloid. The germ cell tumors were yolk sac tumor, immature teratoma, embryonal carcinoma and mixed type. Of these, three were gonadal and one was extragonadal in location.

DISCUSSION

Childhood tumors form a highly specific group, mainly embryonal in type and arising in the lymphoreticular tissue, CNS, connective tissue and viscera. Unlike adults, epithelial tumors are rare.[3] The incidence and frequency of childhood tumors has a great geographical variability. In India, although infections and malnutrition are the major factors contributing to morbidity and mortality, malignancies are coming into greater focus because of preventive measures being taken for the former.[9]

Our study attempts to provide a spectrum of tumors in children <14 years of age in our region. Maximum number of childhood tumors is seen in the age group of 10-14 years. Male predominance is a salient feature of many childhood tumors. Benign tumors are more common than malignant tumors. In our study, malignant tumors accounted for 28.57% cases. Similar finding was seen in a study in Zaire where only 39% biopsies in children <15 years of age revealed malignancy.[10] Benign tumors usually have a favorable outcome, but they can cause a lot of concern to the patient and the clinician and rarely may lead to serious complications. This mandates a comprehensive evaluation for appropriate management and a need to study their spectrum in children. Due to a paucity of data on spectrum of benign tumors we compared our findings with that of a study carried out in 1966[11] [Table 4].

Table 4: Comparison of benign tumors

Tumor	Present study (%) (n = 191)	Lee *et al.*[11] (%) (n = 171)
Vascular tumors	24.73	23.39
Bone tumors	22.55	7.60
Breast neoplasms	8.73	5.26
Skin and adnexal tumors	8.36	26.31
Fibrous tumors	9.45	11.11
Lipomatous tumors	8.73	5.26
Nerve sheath tumors	5.09	8.77
Fibrohistiocytic tumors	2.91	—
Miscellaneous	9.45	12.3

Benign tumors

The majority of soft tissue tumors in young adults are benign vascular or fibroblastic proliferations.[12] Majority of breast masses in the pediatric age group are benign, but malignancies do occur.[13] Fibroadenoma is the most frequent breast tumor in adolescent girls.[14] Pilomatricoma, a neoplasm of hair germ matrix origin, is one of the most common cutaneous appendage tumors in patients 20-year of age or younger.[15] Similar to other investigators we noted a predilection of this tumor for the head and neck region and the upper extremities.

Malignant tumors

The most frequent childhood cancers arise in the hematopoietic system, nervous tissue, soft tissue, bone and kidney. This is in contrast to adults in whom the skin, lung, breast, prostate and colon are the most common sites of tumors.[6] Childhood cancer comprises a variety of malignancies with incidence varying worldwide by age, sex, ethnicity and geography. Compared with other studies [Table 5] our study has a higher incidence of CNS tumors, malignant bone tumors and soft tissue sarcomas. This could probably be due to regional variation or because of selection bias, our study being a hospital-based study and the number of cases being less compared with the other studies. Diagnosis of bone tumors requires correlation of clinical, radiographic and pathologic findings. The major bone tumors diagnosed were ES/PNET and osteosarcoma, most common in 10-14 years age group which coincides with other series.[9,18] In this study, medulloblastoma and astrocytoma were the most common CNS tumors. The analysis based on data collected by the Manchester Children's Tumor Registry

Table 5: Comparison of malignant tumors with other studies (%)

Tumor	Mexico study Fajardo-Gutiérrez *et al.*[4] 2007	Alaska study Lanier *et al.*[2] 2003	Indian study Banerjee *et al.*[9] 1986	U.S. study Linabery and Ross[16] 2008	Sweden study Ljungman *et al.*[17] 2011	Present study
Leukemia, MPD, MDS	45.8	27	Excluded	27	Excluded	Excluded
Lymphomas/reticuloendothelial neoplasms	11.1	8	25.9	13	21.9	7.27
Central nervous system tumors	12	14	15.3	18	—	23.64
Neuroblastoma/other peripheral nervous system tumors	2.7	1	4.5	5	14.3	0.91
Retinoblastoma	4	6	8.7	2	—	6.36
Renal tumors	4.1	6	8.5	4	14.7	—
Hepatic tumors	1.8	15	1.1	1	—	—
Malignant bone tumors	5.7	5	10.5	4	9.4	32.73
Soft tissue and other extraosseous sarcomas	5.5	6	14.3	7	14.5	17.27
Germ cell tumors	6.4	7	3.8 (teratomas)	7	10.9	3.64
Malignant epithelial neoplasms and malignant melanoma	0.9	5	5	6	—	7.27
Unspecified malignant neoplasms	—	—	2.4 (with germ cell tumors)	—	5.3 (other specified tumors)	—

MDS – Myelodysplastic syndrome; MPD – Myeloproliferative diseases

during a 45-year time period (1954-1998) revealed 2511 nonlymphoreticular solid tumors, of which 1055 were CNS tumors, astrocytoma being the most common.[19] Rhabdomyosarcoma comprises the most common single soft tissue sarcoma among children and adolescents and frequently occurs in the head and neck region[20] as was seen in our study. In a large study comprising of 68 cases of soft tissue sarcomas in children in Moscow Region, Russian Federation, rhabdomyosarcoma represented 54.4% of cases.[21] These tumors are unusual in adults. Unique to the pediatric population is infantile fibrosarcoma (1 case), which is a relatively rare tumor and compared to the adult fibrosarcoma has a favorable prognosis.

The malignant epithelial tumors are uncommon in the pediatric age group. In the current study, the 2 cases of colorectal carcinoma diagnosed were of signet ring cell type. HL was seen more commonly in our study than NHL and was most frequent in the 10-14 years age group. Banerjee *et al.*[9] also reported a similar trend. HL is very rare in children younger than 5-year. HL has a bimodal age distribution: In developed countries the first peak occurs in the middle to late 20's and the second peak after the age of 50-year, whereas in the developing countries the early peak occurs before adolescence.[22] Retinoblastoma is the most common primary intraocular malignancy of childhood.[23] Germ cell tumors were mostly gonadal as is frequently seen.[24]

The current study is a single institution based study restricted by a small sample size and this retrospective review cannot serve as a benchmark for reference. Although the cooperative groups' studies on pediatric neoplasms overcome such a limitation, these are scarce.[17,25] In India, we could not find any large cooperative study on pediatric tumors. This study is an attempt to provide a complete spectrum of childhood tumors diagnosed on histopathology. The study includes both benign and malignant tumors, while most of the previous studies have mainly focused on malignant tumors in children.

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