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Research Article

Solid Malignant Tumors of Infancy and Childhood: A Histopathological Study

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Abstract: In general, the features of malignancies in children differ biologically and histologically from those of adults with respect to incidence, type of tumor, underlying familial or genetic aberration and Tendency to regress spontaneously or cytodifferantiate. In recent years, identification of specific genes, oncogenes, tumor markers and other biological and pathological factors have played an important role in staging and classifying risk categorization of specific tumors as low, intermediate and high-risk lesions. Hence there is need for accurate histopathological reporting in conjugation with ancillary methods. This study was under taken to evaluate the incidence and morphological features of solid malignant tumors in children of fifteen years and below. The material for present study was obtained from SIMS and referred cases. The histopathology slides and paraffin blocks were reviewed. The sections 3-5 µ thick, were cut and stained by haematoxylin and eosin in all cases and special stains like PAS, MTS, RT and IHC done where ever feasible. An analysis of 66 cases of solid malignant tumors of childhood over a period of 5years were made.The early onset and the embryonal nature of the major paediatric tumors, suggest a prenatal origin and role of genetic factors. Infections, exposure to drugs and chemicals during pregnancy are other contributory factors. Accurate incidence of data is important in the planning and evaluation of clinical trials. Documentation of cases, advanced diagnostic methods like IHC, cytogenetic studies and treatment modalities with close follow up is needed to achieve better statistical evaluation of the problem.
Keywords: Solid, Paediatric, Malignant, Histopathology.

INTRODUCTION

Cancer is essentially a disease of adults, yet it is one of the common killers in childhood. In western countries cancer is next only to trauma as a cause of mortality in children under 15 years of age. In India, although infections and malnutrition are the major factors contributing to morbidity and mortality, with the development of preventive and curative measures of treatment, as well as fight against the malnutrition, malignant tumors in children have become the second biggest killer [1-3].

In general, the features of malignancies in children differ biologically and histologically from those of adults with respect to incidence, type of tumor, underlying familial or genetic aberration and tendency to regress spontaneously or cytodifferantiate [4]. In recent years, identification of specific genes, oncogenes, tumor markers and other biological and pathological factors have played an important role in staging and classifying risk categorization of specific tumors as low, intermediate and high-risk lesions. This concept uses risk factors as predictors of outcomes. Risk-based management allows the pediatric medical and surgical oncologist to weigh the risks and benefits of treatment for each patient in an effort to maximize survival, minimize morbidity, and improve the quality of life. Hence there is need for accurate histopathological reporting in conjugation with ancillary methods [5-8].

METHODOLOGY

This study was under taken to evaluate the incidence and morphological features of solid malignant tumors in children of fifteen years and below. The material for present study was obtained from SIMS and referred cases. The clinical history regarding duration of the disease, mode of presentation, symptoms and signs were recorded from the case papers, request forms, patient's history, clinical data along with relevant details obtained from available hospital and departmental records. The histopathology slides and

paraffin blocks were reviewed. Gross examination was done carefully noting the size, shape, extent and configuration, nodularity, consistency (solid, cystic or mixed) and torsion. A minimum of 4-5 bits were selected from the representative areas of tumor. The tissue for routine microscopy was preserved and fixed in 10% neutral buffered formalin for 24 hours and processed in automatic tissue processor (Histokinette) and embedded in paraffin. The sections 3-5 µ thick, were cut and stained by haematoxylin and eosin in all cases and special stains like PAS, MTS, RT and IHC done where ever feasible.

RESULTS

An analysis of 66 cases of solid malignant tumors of childhood over a period of 5 years was made. The following observations were made: The youngest patient at the time of diagnosis was six months old and diagnosed as immature teratoma. . The mean age was 8 years 9 months. In the present study, 4 cases (6.06%) were seen in infants. The majority of the tumors in this study occurred between 10-15 years (40.9%), followed by 5-10 years age group (31.81%) (Table 1). In the present study 40 (60.6%) malignant tumors are seen in boys and 26 (39.4%) in girls under the age of 15 years, showing male preponderance. Male to female ratio of the incidence of malignant tumors is 1.57:1. All age groups showed male preponderance except in infancy.

Table 1: Incidence of malignant tumors indifferent age group in relation to sex

Sex	**Birth-1yr No. (%)**	**1-5y No. (%)**	**5-10y No. (%)**	**10-15y No. (%)**	**Total No. (%)**
Male	1 (1.51%)	11 (16.66%)	12 (18.18%)	16 (24.20%)	40 (60.6%)
Female	3 (4.54%)	3 (4.54%)	9 (13.63%)	11 (16.16%)	26 (39.4%)
Total No (%)	4 (6.06%)	14 (21.21%)	21 (31.81%)	27 (40.90%)	66 (100%)

All the cases of present study were sporadic. One case of Dysgerminoma was associated with mental retardation. Two cases of lymphomas were associated with previous diagnosis of pulmonary tuberculosis. No associated congenital anomalies are noted in the present study. Site of distribution and histological typing of tumours are depicted in Table 2 and Table 3 respectively.

Lymphomas (21 cases 31.89%, mean age being 8 yrs 4mts, M:F was 2:1)

Commonest subtype in present study was lymphoblastic lymphoma constituting about 28.57 %(6cases) of lymphomas and majority of the cases presented in cervical lymphnodes-9 cases (42.85%). The Symptomatology included swelling, pain, fever and loss of weight, with duration ranging from 1mt- 2yrs.

Hodgkin's lymphoma (11cases 16.66%, mean age being 10 yrs 6mts)

Five cases (45.45%) were mixed cellularity, 4(36.36%) were lymphocyte predominant and 2 (18.18%) nodular sclerosis.. It most commonly presented in 10-15yrs age group (72.72%).The younger one was 5 years old. and majority of the cases presented in cervical lymphnodes-5 cases (45.45%). One of the cases showed Hodgkin's lymphoma with epithelioid cell granulomas. However, no case was reported in infancy in our study. Site of distribution and histological typing of tumours are depicted in Table 4.

Table 2: Distribution of tumors in different sites

Site of involvement	**Number (percentage)**	
Lymphnodes- cervical	9 (13.63%)	21 (31.81%)
Axillary	4 (6.06%)	
Generalized	8 (12.12%)	
Soft tissues - abdominal wall	3 (4.54%)	13 (19.69%)
nasal cavity	2 (3.03%)	
proximal lower limb	2 (3.03%)	
vulva, orbit, aural cavity, maxilla, PUL , DLL and PUL	1 each (1.51%)	
Gonads----ovaries	7(13.63%)	9 (13.63%)
Testis	2 (3.03%)	
Bones- PLL	5 (7.57%)	8(12.12%)
DLL	2 (3.03%)	
PUL	1 (1.51%)	
Kidney	6 (9.09%)	
Brain- cerebrum	2 (3.03%)	
Cerebellum	3 (4.54%)	
Eye	2 (3.03%)	
Nasal cavity	2 (3.03%)	

Table 3: Histological subtypes of tumor with relation to sex

Histological subtypes	Male (%)	Female (%)	TOTAL (%)
Hodgkin's lymphoma	6(9.09%)	5(7.57%)	11 (16.66%)
Non Hodgkin's lymphoma	8 (12.12%)	2(3.03%)	10 (15.55%)
Rhabdomyosarcoma	3 (4.54%)	6(9.09%)	9(13.63%)
Wilms' tumor	5(7.57%)	1 (1.51%)	6(9.09%)
Osteosarcoma	4 (6.06%)	1 (1.51%)	5(7.57%)
Fibrosarcoma	3 (4.54%)	1 (1.51%)	4 (6.06%)
Dysgerminoma	-	4 (6.06%)	4 (6.06%)
Yolk sac tumor	1 (1.51%)	2 (3.03%)	3 (4.54%)
Gliomas	2 (3.03%)	-	2(3.03%)
Medulloblastoma	2 (3.03%)	-	2(3.03%)
Retinoblastoma	-	2 (3.03%)	2(3.03%)
Neuroblastoma	1 (1.51%)	1 (1.51%)	2(3.03%
Ewing's sarcoma	2 (3.03%)	-	2(3.03%)
Mixed germ cell tumor	1 (1.51%)	-	1(1.51%)
Immature teratoma	-	1 (1.51%)	1(1.51%)
Synovial sarcoma	1 (1.51%)	-	1(1.51%)
Rhabdoid teratoid tumor	1 (1.51%)	-	1(1.51%)
Total	40 (60.6%)	26 (39.39%)	66(100%)

Table 4: Hodgkin's lymphoma subtypes with respect to age, site and sex

Histological subtypes	Mean age	Sites	Male (%)	Female (%)	Total No. (%)
Mixed cellularity	9yrs 8mts	Cervical-2 Axillary-2 Generalized-1	2(18.18%)	3(27.27%)	5(45.45%)
Lymphocyte predominant	7yrs 6mts	Cervical-3 Generalized-1	3(27.27%)	1(9.09%)	4 (36.36%)
Nodular sclerosis	13yrs	Generalized-2	1(9.09%)	1(9.09%)	2(18.18%)
Overall Hodgkin's lymphoma	10yrs 6mts	Cervical-5 Axillary-2 Generalized-4	6(54.54%)	5(45.45%)	11 (100%)

Non Hodgkin's lymphoma (10cases 15.15%, mean age being 10 yrs 4mts, M:F:: 4:1)

Six cases (60%) were lymphoblastic lymphoma, 3(30%) were Burkitt's lymphoma and 1(10%) DLBCL/Anaplastic lymphoma. The commonest histological type being lymphoblastic lymphoma (60%). Site of distribution and histological typing of tumours are depicted in Table 5

Table 5: Non Hodgkin's lymphoma subtypes with respect to age, site and sex distribution

Histological subtypes	Mean age	Sites	Male (%)	Female (%)	Total No.(%)
Lymphoblastic lymphoma	10yr 4mts	Cervical-2 Axillary-2 Generalized-2	4(40%)	2	6(60%)
Burkitt's lymphoma	9yr 8mts	Cervical-2 Generalized-1	3(30%)	-	3(30%)
DLBCL/Anaplastic lymphoma	11yrs	Generalized-1	1(10%)	-	1(10%)
Total Non Hodgkin's lymphoma	10yr 4mts	Cervical-4 Axillary-2 Generalized-4	8(80%)	2(20%)	10(100%)

Germ cell tumors (9cases, 13.63% , mean age being 7yr 10mts, M: F::2:7)

In the present study most common site was ovary and the age group was between 10-15 yrs (44.44%). Case distribution included one case in infancy, one in 1-5 yrs, 2 in 5-10yrs and 4 cases in 10-15 yrs age group. Site of distribution and histological typing of tumours are depicted in Table.6

Table 6: Germ cell tumor subtypes with respect to age, site and sex distribution

Histological subtypes	Mean age	Sites	Male (%)	Female (%)	Total No. (%)
Dysgerminoma	11yr 3mts	Ovary-4	-	4(44.44%)	4(44.44%)
Yolk sac tumor	4yrs	Ovary-2 Testis-1	1(11.11%)	2(22.22%)	3(33.33%)
MGCT	14yrs	Testis-1	1(11.11%)	-	1(11.11%)
Immature teratoma	6mts	Ovary-1		1(11.11%)	1(11.11%)
Total germ cell tumors	7yrs 10mts	Ovary-7 Testis-2.	2(22.22%)	7(77.77%)	9(100%)

Soft tissue tumors (13 cases, 19.69%, M: F: 1.16:1)

9(13.63%) were Rms, 3 (4.54%) were fibrosarcoma and 1 (1.51%) was synovial sarcoma. Case distribution included one in infancy, 2 in 1-5yr, 4 in 5-10yrs and 6 cases in 10-15 yrs age group. In the present study most common site was abdominal wall and the age group was between 10-15 yrs (46.15%). The mean age being 8 yrs 4mts. Site of distribution and histological typing of tumours are depicted in Table 7.

Table 7: Soft tissue tumor subtypes with respect to age, site and sex distribution

Histological subtypes	Mean age	Mc age group	Male No. (%)	Female No. (%)	Total No. (%)
Rhabdomyosarcoma	8yrs 9mts	10-15yrs	3 (23.07%)	6 (46.15%)	9 (69.23%)
Fibrosarcoma	8yrs 9mts	10-15yrs	3 (23.07%)	-	3 (23.07%)
Synovial sarcoma	12 year	10-15yrs	1(7.69%)	-	1(7.69%)
Total soft tissue tumors	10yr 4mts	10-15yrs	7 (7.69%)	6(46.15%)	13(100%)

Tumors of bone (8 cases, 12.12%, mean age being 11yrs, M: F: 3:1)

Five cases (7.57%) were osteosarcoma, 2 (3.03%) Ewing's sarcoma and 1(1.51%) fibrosarcoma. The present study most common site was around the knee and the age group was between 10-15 yrs (62.5%). The sites of involvement were as follows- proximal lower limb (5), distal lower limb (2) and proximal upper limb (1). Site of distribution and histological typing of tumours are depicted in Table 8.

Table 8: Bone tumor subtypes with respect to age, site and sex distribution

Histological subtypes	Mean age	Mc age group	Male No. (%)	Female No. (%)	Total No. (%)
Osteosarcoma	10yrs	10-15yrs (60%)	4 (50%)	1 (12.5%)	5 (62.5%)
Ewing's sarcoma	11yr 6mts	10-15yrs (100%)	2 (25%)		2 (25%)
Fibrosarcoma	15yrs	10-15yrs (100%)	-	1 (12.5%)	1 (12.5%)
Over all bone tumors	11yrs	10-15yrs (62.5%)	6(75%)	2(25%)	8(100%)

Wilms' tumor (6 cases, 9.09 %, mean age being 3.2yrs, M: F: 5:1)

The youngest being two year old and the eldest five year old. Right kidney was affected in 4 cases and the left in 2 cases. Bilaterality is not seen in the present study. Rhabdoid differentiation, myxoid change and cystic changes were seen in two of the cases.

CNS tumors (5cases 7.57%, average age is 7 yrs 9mts, mean age being 7.5yrs)

Two cases (3.03%) were Gliomas, 2 (3.03%), Medulloblastoma and 1(1.51%) case of Rhabdoid teratoid tumor. The most common age group is 1-5 yrs (60%). Both Gliomas involving cerebral hemisphere presented with convulsions, vomiting and fever. Both Medulloblastoma involving cerebellum, presented with convulsions, vomiting, loss of movements and fever. One case of ARTT in a four year male child involving cerebellum is noted in present study.

Retinoblastoma (2 cases 3.03%, average age being 5yrs 9 months)

Both the cases were seen in females and unilateral in involvement. The younger patient in present study was two and half year old and the elder one being nine years of age. Right eye was affected in both the cases. No bilateralism or family history was noted in present study. Optic nerve extension and calcification was noted in one case.

Neuroblastoma (2 cases 3.03%, M: F: 1:1)

Both the cases were seen in nasal cavity in children of one and eight yrs of age respectively.

DISCUSSION

The various malignant tumors of childhood encountered in the present study are compared with similar studies conducted in India and abroad. The malignant tumors of all types are being reported during early life but their common site of origin differs sharply from those of adults, for example Leukemias, CNS

tumors, soft tissue tumors, bone and kidney tumors are common sites of origin of malignant tumors in infants and children.

Accurate diagnosis of pediatric small-round-cell tumors is important, as disparate approaches to therapy are taken for distinct tumor types. In addition, therapy is also tailored according to patient risk. It has become important to further classify tumors biologically, using cytogenetic or molecular studies to identify chromosome translocations, gene amplification, gene expression patterns, and/or mutations [9].

The overall incidence of malignant tumors of childhood was more in the males (M: F: 1.53: 1). This observation has been made uniformly in literature by many authors. Male preponderance is noted in all age groups and female preponderance in germ cell tumors by Lee and Lee *et al*. [10], Miller *et al*. [11]. In the present study, the peak occurrence of tumors was found in the 10-15yrs age group (40.90%) similar to the observations of K.K Jain (35.5 %) [12]. Whereas Dewani *et al*. [3] and Jussawala and Yeole [13] observed peak occurrence in birth-5 age group as shown in Table 9. The frequency of neuroblastoma, retinoblastoma and Wilms' tumor was strikingly more in children younger than 5years of age. An increased frequency with age was seen in Non Hodgkin's lymphoma, Hodgkin's lymphoma, osteosarcoma and Ewing's sarcoma. The early onset and the embryonal nature of many paediatric tumors suggest a prenatal origin [14], as also seen in our studies.

Table 9: Comparison of age group distribution of tumors in various studies

Sl. No.	Series	Birth-5y	5-10y	10-15y
1	K.K Jain [12]	4.2 %	22.2 %	35.5 %
2	Dewani [3]	47.2 %	40.9 %	11.9 %
3	Jussawala [13]	42 %	29 %	29%
4	Present study	27.27%	31.81%	40.90%

Various types of solid malignant tumors were observed in the paediatric age group in the present study, the lymphomas being the commonest type, followed by soft tissue tumor, germ cell tumor, bone tumors, Wilms' tumor, brain tumor, retinoblastoma and others.

In the present study, the commonest tumours comprised Hodgkin's (11, 16.66%) and non Hodgkin's lymphomas (10, 15.15%). Similar results were reported by Sonal Sharma *et al*. [15], and Baneerjee & Walia [1]. The general pattern of paediatric tumors in our center seems to resemble the distribution of paediatric cancers reported from other centers in our country and abroad. Leukemia was the leading type of cancer and malignant tumors were the second most common cancer in several countries. The same findings were noted in our series and Young *et al*. [16], Pearson *et al*. [17], Teppo *et al*. [18] and Kusumakumary P *et al*. [14].

. **Table 10: Histological types of tumor in different series**

Histological subtypes	Banerjee *et al*. [1]	Venugopal *et al*. [19]	Sonal Sharma *et al*. [15]	Present Study
Lymphomas	25.92%	20.95%	21.41%	31.81%
Soft tissue tumors	14.3%	10.47%	7.79%	19.69%
Germ Cell Tumors	3.8%	4.76%	8.44%	13.63%
Bone Tumors	10.52%	3.8%	9.74%	12.12%
Renal Tumors	8.5%	24.76%	19.48%	9.09%
Brain Tumors	15.32%	-	9.74%	7.57%
Retinoblastoma	8.7%	-	6.49%	3.03%
Neuroblastoma	4.5%	11.4%	3.89%	3.03%
Others	8.5%	-	20.12%	
Total	100%	100%	100%	100%

Lymphomas

Predominance of Hodgkin's lymphoma over non Hodgkin's lymphoma correlates with studies made by Mankodi *et al*. [20], Ramkumar *et al*. [21] and Desai *et al*. [22]. Majority of our cases were in 10-15yrs. This is similar to observation by SEER [23], Mankodi *et al*. [20], and Baneerjee & Walia [1]**.** Nodular sclerosis subtype was the commonest subtype in SEER [23] study and age group was 1-5yrs in Venugopal *et al*. [19] study.

Mixed cellularity was the predominant histological subtype in present study and other studies from India and abroad.

Nodular sclerosis and lymphocyte predominance, the histological types with a favorable prognosis are significantly more common in younger persons and in women.

Various parameters like male dominance, sub typing, age group and general incidence in present study are in conformity with other studies [20, 21]. Paediatric risk groups in ALL/LL are based on cytogenetic profile, age, leucocyte count, sex and response to initial therapy. Adverse factors include very young age <1year, cytogenetic abnormalities like t(9;22)(q34;11.2) and t(4;11)(q21;q23). Good prognostic factors include hyperdiploidy, t(12;21) and low/normal leukocyte count at diagnosis. ALCL is most frequent in the first decade of life and show a male predominance. ALK positivity has been associated with favorable prognosis [22-24].

Rhabdomyosarcoma

Parameters like male dominance, sub typing and general incidence in various studies are in conformity with other studies in India and abroad [19, 23]. Rhabdomyosarcoma is not only the most common soft tissue sarcoma in children under 15 years of age but also one of the most common soft tissue sarcomas of adolescents and young adults [16].

Alveolar type tends to arise at a slightly older age than embryonal, botryoid, and spindle cell rhabdomyosarcomas, with a peak incidence at 10-25 years of age [25]. The mean age of patients with this subtype of rhabdomyosarcoma enrolled in the IRS-I and IRS-II studies was 7.2 yrs [26]. The most common site of embryonal rhabdomyosarcoma is the head and neck, similar mean age (7yrs 8mts) and site predominance (head and neck) was observed in present study. Infantile fibrosarcoma generally develops within the first two years of life and often is congenital. The majority of cases arise in the extremities, especially in the distal portions, and there is a male predominance. In striking contrast to adults, the 5-year survival probability exceeds 80% and, with modern chemotherapy, may be even higher. Synovial sarcoma occurs mainly in young adults, more commonly in males between 10-35yrs [21]. The best outcome are in childhood patients, tumors with <5cms diameter, <10mitoses/hpf and no necrosis. The prognosis does not differ between monophasic and biphasic tumors, or in relation to immunophenotype. However, cases with SS18/SSX2 variant gene, which is mostly found in monophasic variant has better prognoisis [27].

Dysgerminoma is the most common malignant germ cell tumor of the ovary. Weinblatt and Ortega [28], noted dysgerminoma as a commonest germ cell tumor. It is the most common malignant gonadal tumor in patients with gonadal dysgenesis [50]. Tumors with syncytiotrophoblastic giant cells have the same prognosis as tumors in which they are absent [51]. The most characteristic findings are positive staining of tumor cells for placental alkaline phosphatase and vimentin. The clinical stage of the tumor is probably the only significant prognostic factor. Presence of a high mitotic index, anisokaryosis and trophoblastic differentiation has no prognostic implication on the behavior of dysgerminoma. Trophoblastic differentiation has the advantage of having β-hcg as a serum marker [29]. Yolk sac tumor is the second most common malignant germ cell tumor of the ovary and comprises approximately 1 % of all ovarian malignancies [21, 29]. Immunohistochemical stains for α-FP (Xl-antitrypsin, cytokeratin and placental alkaline phosphatase are positive in. yolk sac tumor cells, and the extracellular hyaline material is laminin positive [21, 29, 30]. In our study yolk sac tumor was second most common germ cell tumor and most common tumor in infancy. Mixed germ cell tumors constituted 50% of all nonseminomatous germ cell tumors of testis [31]. In a study of 1,053 cases by Jacobsen *et al*. mixed germ cell tumors constituted 69% of all nonseminomatous germ cell tumors and 32% of all testicular germ cell tumors [32]. Embryonal carcinoma is the most common component and is often combined with teratoma, seminoma, or yolk sac tumor [33]. Serum marker elevation is common and is reflective of the individual components of the tumor [34].

Elevation of α-fetoprotein occurs in 60% of patients, whereas β-hCG levels are elevated in approximately 55% [35]. The components of the tumor are associated with areas of necrosis, hemorrhage and cystic degeneration [34]. One case of teratoma formed 1.51% of total paediatric malignancies. Similar incidence of malignant teratoma was observed by Jussawala [12]. Teratomas were uncommon tumors constituting about 1.51% of total paediatric malignancies; it is much lower than reported by Desai *et al*. [22]. The prognostic significance of immature teratomas of gonads appears to correlate with the age of the patient; very young patients with grade 1 and 2 lesions do well as in our case [37].

Osteosarcoma is largely a disease of the young. It most frequently occurs in the second decade and affects males more frequently than females. Similar findings are noted in present study also [27]. Bone tumors exhibit steady increase in frequency with age, similar to growth in stature. Traditionally age, gender, location, tumor size, stage and the results of various laboratory tests have been used in an effort to predict prognosis. However response to pre operative therapy is currently the most sensitive indicator of survival [27].

Six cases (9.09%) of Wilms' tumor were studied. This was in comparison to study done by Sanyal *et al*. [38] and Sunitha Sharma *et al*. [39]. The tumor stage at diagnosis, histological features and patient age are the most important prognostic determinants which have impact on treatment selection and outcome. The Loss of Heterozygosity at chromosome 1p and 16q was associated with increased risk of relapse and death [40].

CNS Tumors comprise nearly 17% of malignancies in children younger than 20years of age

[41]. As a group, CNS cancer is the second most common malignancy of childhood [42]. Cancer incidence is slightly higher in males than in females, largely due to male predominance of PNET and Ependymomas [23]. Similar findings are noted in our study also. Survival, which depends on the type of tumor and location in the CNS, tends to be worse in young children than in older children. Histopathological distribution of present studies was compared with other larger series.

Intracranial tumors in children is found to be supratentorial in 40% and infratentorial in 60% [43, 44], a similar ratio is noted in the present study.

Medulloblastoma parameters like male dominance, sub typing and general incidence in present study are in conformity with SEER [23] studies. AT/RTs (atypical teratoid/rhabdoid tumors) are rare malignant intracranial neoplasms usually occurring in young children. AT/RTs have aggressive growth with high potential for dissemination within the CNS. These tumors have been misdiagnosed in the past as PNET/MB because of frequent overlapping histologic and imaging features. Confirmation of the diagnosis of AT/RT is important because these tumors typically have a poor prognosis that is worse than that in PNET/MB, necessitating new intensified therapies [45].

In Retinoblastoma No bilateralism or family history was noted in present study. Optic nerve spread indicating bad prognosis was noted by Sang & Albert [46] and Dhir SP [47]. Optic nerve extension and calcification was noted in one of our case.

Neuroblastoma is the commonest tumor of early childhood and is rare beyond the age of ten years [48]. Neuroblastoma, a highly aggressive tumor, was reported to have lower incidence among the Indian children by various authors like Dewani GP [3], Jussawala DJ [12] and Mangal N [49]. In the present study the tumor constituted 3.03% of total cases. The neuroblastic tumors NB, GNB, and GN are a spectrum of sympathetic tissue tumors ranging from the very immature and malignant NB to the mature and benign GN. It is the interplay of histologic maturity, genetic composition, and patient features that make NB, GNB, and GN an enigmatic group of tumors.

CONCLUSION

In the present study histopathological diagnosis could be confirmed with IHC in six cases- Hodgkin's lymphoma (3), Embryonal Rhabdomyosarcoma (1), Fibrosarcoma (1) and Burkitt's lymphoma (1). The frequency of tumors and their distribution is comparable to that reported from other studies. The early onset and the embryonal nature of the major paediatric tumors, suggest a prenatal origin and role of genetic factors. Infections, exposure to drugs and chemicals during pregnancy are other contributory factors. Accurate incidence of data is important in the planning and evaluation of clinical trials. Documentation of cases, advanced diagnostic methods like IHC, cytogenetic studies and treatment modalities with close follow up is needed to achieve better statistical evaluation of the problem.

REFERENCES

1. Baneerjee CK, Walia BNS; Pattern of neoplasms in childhood. Indian J Paediatrics, 1986; 53: 93-97.
2. Atlman AJ, Schwartz AD; Malignant disease of infancy, childhood and adolescence. In Major Problems in Clinical Paediatrics. W.B. Saunders, Philadelphia. 1978; 18: 1-102.
3. Dawani GP, Tandon PL, Ghooi AM, JainPK; Malignant tumours of infancy and childhood. Indian Journal of Surgery; 1972; 34; 460-468.
4. Kumar V, Fausto N, Abbas A; Pathologic Basis of Disease, Elsevier; 7th edition, 2004.
5. Variend S; Small cell tumors in childhood a review. Journal of Pathology, 1985; 45: 1-25.
6. Kliegman RM, Behrman RE, Jenson HB, Stanton BF; Nelson Textbook of Paediatrics. 18th edition, W.B Saunders, 2007.
7. Anderson WAD, Kissane JM; Pathology. 7th edition, Volume 1 and 2, C.V. Mosby co. sty. Louis, 1977.
8. Boyd WC; Textbook of Pathology: Structure and Function in Diseases. 9th edition, Lea and Febiger, Philadelphia, 1979.
9. Cohn SL; Diagnosis and Classification of the Small Round-Cell Tumors of Childhood. American Journal of Pathology, 1999; 155(1): 11-14.
10. Lee CK, Lee SK; Malignant solid tumors of infancy and childhood in Korea. GANN Monograph on cancer research, University of Tokyo Press, 1976.
11. Miller RW, Young JL, Novakovic B; Childhood cancer. Cancer, 1994; 75: 395-405.
12. Jain KK, Mathur GP, Srivastava JR; Malignancy in childhood. A clinicopathological study of 45 cases. Ind J Paediatrics, 1975; 42(326): 61-66.
13. Jussawala DJ, Yeole BB; Childhood cancer in greater Bombay.1973-84. Indian J Cancer, 1988; 25: 197-206.
14. Kusumakumary P, Jocob R, Jothirmayi R, Nair MK; Profile of paediatric malignancies: A Ten year study: Indian Paediatrics, 2000; 37: 1234-1238.
15. Sharma S, Mishra K, Agarwal S, Khanna G; Solid tumors of childhood: Ind J Paediatrics, 2004; 71(6): 501-504.
16. Young G, Miller RW; Incidence of malignant tumors in US children. J Paediatrics, 1975; 86: 254-258.
17. Pearson D, Stearward JK; Malignant tumors in juveniles. Proc R Soc Med., 1969; 62: 685-688.
18. Teppo S, Salonen J, Hatailinan T; Incidence of childhood cancer in Finland. J Ntl canc Int., 1975; 55: 1065-1067.
19. Venugopal KV, Joseph TP, Verma KK; Solid malignant tumor of infancy and childhood – A

clinicopathological study. Ind Pediatr. 1981; Vol. 18(6): 365-368.
20. Monkodi, RC Mehata: The patteren of neoplasm in children. Indian Journal of pathology and microbiology. 1969; Vol.12: 4-8.
21. Ramakumar L, Sood C, Divan SP; Childhood malignancies a statistical survey. Indian J Child Health, 1963; 12: 190-195.
22. Desai MP, Merchant SM; Lymphosarcoma in childhood. Indian Paediatrics, 1949; 7: 507.
23. Ries LAG, Smith MA, Gurney JG, Linet M, Tamra T, Young JL *et al*.; Cancer incidence and survival among children and adolescents: National Cancer Institute, SEER Program. NIH Pub. No. 99-4649. Bethesda, MD, 1999.
24. Elaine S. jaffe, Nancy Lee Harris et al: Pathology and genetics of tumors of haematopoietic and lymphoid tissues: IARC press :Lyon:2001.
25. Guillou L, Coquet M, Chaubert P, Coindre JM; Skeletal muscle regeneration mimicking rhabdomyosarcoma: a potential diagnostic pitfall. Histopathology, 1998; 33(2): 136-144.
26. Berry MP, Jenkin RD; Parameningial rhabdomyosarcoma in the young. Cancer, 1981; 48(2): 281-288.
27. Fletcher CDM, Unni KK, Mertens F; Pathology and Genetics of tumours of soft tissue and bone. IARC Press, Lyon, 2002.
28. Weinblatt ME, Ortega JA; Treatment of children with dysgerminoma of the ovary. Cancer, 1982; 49(12): 2608-2611.
29. Tavassoli FA, Devilee P; Pathology and Genetics of tumours of the breast and Female Genital Organs. IARC Press, Lyon, 2003.
30. Kurman RJ, Norris HJ; Malignant germ cell tumors of the ovary. Hum Pathol., 1977; 8(5): 551-564.
31. Wood HM, Elder JS. Cryptorchidism and testicular cancer: Separating fact from fiction. J Urol 2009;181:452-61.
32. Krag Jacobsen G, Barlebo H, Olsen J, Schultz HP, Starklint H, Søgaard H et al.; Testicular germ cell tumours in Denmark 1976–1980: pathology of 1058 consecutive cases. Acta Radiol Oncol., 1984; 23(4): 239-247.
33. Woodward PJ, Sohaey R, O'Donoghue MJ, Green DE; Tumors and tumorlike lesions of the testis: radiologic-pathologic correlation. Radio Graphics, 2002; 22: 189 – 216.
34. Venyo AKG, Hamadi AA, Baiden-amissah K; Bilateral synchronous classical seminoma of testes with bilateral cannon ball metastases: A case report with a review of the literature. Webmed Central Urology, 2012; 3(4): WMC003229
35. Rustin GJ, Vogelzang NJ, Sleijfer DT, Nisselaum JN; Consensus statement on circulating tumour markers and staging patients with germ cell tumour. Prog Clin Biol Res., 1990; 357: 277-284.
36. Ulbright TM, Amin MB, Young RH; Atlas of tumor pathology: tumors of the testis, adnexa, spermatic cord, and scrotum. 3rd ser, fasc 25. Washington, DC: Armed Forces Institute of Pathology, 1997: 59–191.
37. Bazaz malik G, Narayan S; Tumor and tumor like lesions of infancy and childhood. Indian J Pathol Microbiol., 1983; 26(4): 259-264.
38. Sanyal B, Pant GC, Singhal GD, Tripathi VN, Ambasta SS, Gupta S et al.; Renal tumours- A review of 54 cases. Indian J Cancer, 1976; 13(2): 177-182.
39. Sharma S, Nath P, Srivastava AN, Singh KM; Wilms' tumour: A clinicopathologic study with special reference to its morphological variants: Indian J Pathol Microbiol., 1995; 38(1): 55-62.
40. Grundy PE, Breslow NE, Li S, Perlman E, Beckwith JB, Ritchey ML *et al*.; Loss of heterozygosity for chromosomes 1p and 16q is an adverse prognostic factor in favorable-histology Wilms tumor: a report from the National Wilms Tumor Study Group. J Clin Oncol., 2005; 23(29): 7312-73121.
41. Stevenson KL, Geyer JR, Ellenbogen RG; Pediatric Neuro-oncology. In Moore AJ, Newell DW editors; Tumor Neurosurgery: Principles and Practice. Illustrated edition, Springer Science & Business Media, 2010: 299.
42. Brain Tumours in Children. Available from http://www.patient.co.uk/doctor/brain-tumours-in-children
43. Buchanan D; Intracranial tumors of infancy and childhood. Am J Surg., 1957; 93(6): 935-940.
44. Kooks WT, Horaczek A; Statistics of intracranial midline tumors in children. Acta Neurochirurgica,1985; 35: 1-5.
45. Meyers SP, Khademian ZP, Biegel JA, Chuang SH, Korones DN, Zimmerman RA; Primary intracranial atypical teratoid/rhabdoid tumors of infancy and childhood: MRI features and patient outcomes. Am J Neuroradiol., 2006; 27(5): 962-971.
46. Sang DN, Albert DM; Retinoblastoma- clinical and histopathologic features. Hum Pathol., 1982; 13(2): 133-147.
47. Dhir SP, Jain IS, Dar GR, Gupta HD; Survival of retinoblastoma cases in North India. Indian J Ophthalmol. 1980; 28(2):97-100.
48. Marwaha RK, Choudary VP; Neuroblastoma in Indian children. Ind J Paediat., 1982; 49: 811-813.
49. Mangal N, Miglani N; Patteren of paediatric malignancies in Rajasthan. Ind Paediatr., 1991; 28(6): 673-675.
50. Kota SK, Gayatri K, Pani JP, Kota SK, Meher LK, Modi KD; Dysgerminoma in a female with turner syndrome and Y chromosome material: A case-based review of literature. Indian J Endocrinol Metab., 2012; 16(3): 436–440.
51. Fletcher CDM; Germ cell tumors. In Diagnostic Histopathology of Tumors. Elsevier Health Sciences, 2007: 605.