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Clinicopathological Profile of Pediatric Testicular Tumors: A Retrospective Analysis

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ABSTRACT

Pediatric testicular tumors (TTs) are rare neoplasms accounting for approximately 1% of all childhood solid tumors. They differ significantly from adult testicular tumors in their histopathological spectrum, biological behavior, and clinical outcomes. The study aims to evaluate the clinical presentation and histopathological spectrum of pediatric testicular tumors diagnosed at a tertiary care center. This retrospective observational study included all patients younger than 18 years diagnosed with testicular tumors in the Department of Pathology, Wanless Hospital, Miraj, over a five-year period. Clinical details, including age, presenting symptoms, and laterality, were obtained from hospital records. Histopathological examination was performed on formalin-fixed, paraffin-embedded specimens stained with hematoxylin and eosin, with special stains used when indicated. Thirteen cases were identified, with a mean age of 10 years. Scrotal swelling was the most common presenting complaint. Malignant tumors constituted 69% (n=9) of cases, while benign tumors accounted for 31% (n=4). Mature teratoma was the most common benign tumor (n=4). Among malignant tumors, yolk sac tumor and mixed germ cell tumor (GCT) were the most frequent histological types (n=3 each), followed by leukemic infiltration (n=2) and non-Hodgkin lymphoma (n=1). Right-sided involvement was more common, and no cases showed bilateral disease. To conclude pediatric TTs demonstrate a diverse histopathological spectrum, with yolk sac tumor being the most common malignancy along with mixed GCT and mature teratoma the predominant benign lesion in our cohort. Early accurate histopathological diagnosis, and multidisciplinary management are essential for optimal patient outcomes.

KEYWORDS

Pediatric testicular tumor, yolk sac tumor, mature teratoma, germ cell tumor

INTRODUCTION

Testicular tumors (TT) are uncommon neoplasms in the pediatric population, constituting approximately 1% of all childhood solid tumors, with a reported incidence of 0.5–2 cases per 100,000 children.[1] Their frequency varies across different racial groups and appears to be relatively higher in Asian populations.[1] These tumors demonstrate a bimodal age distribution, with an initial peak occurring around two years of age and a second rise in incidence during the postpubertal period.[2] Pediatric testicular neoplasms differ significantly from those seen in adults; germ cell tumors comprise approximately 60–77% of cases in children compared with nearly 95% in adults. Furthermore, benign lesions are encountered more frequently in the pediatric population, influencing both the diagnostic approach and treatment strategies.[3]

According to the 2022 WHO classification, testicular germ cell tumors (GCTs) are the most common testicular neoplasms and are categorized into germ cell neoplasia in situ (GCNIS)-associated and non-GCNIS-associated tumors. GCNIS-related tumors include seminoma, embryonal carcinoma, choriocarcinoma, postpubertal yolk sac tumor (YST), postpubertal teratoma, and mixed germ cell tumors (GCT), whereas non-GCNIS tumors comprise spermatocytic tumors, prepubertal YST, and prepubertal teratomas.[4]

Pediatric TTs differ markedly from those seen in adolescents and adults in terms of pathology, biological behavior, and clinical outcome.[5] Unlike adults, in whom seminoma predominates, prepubertal tumors are most commonly yolk sac tumors and teratomas. More than half of prepubertal TTs are benign, with mature teratomas and epidermoid cysts representing the most frequent benign histological types.[6] Pediatric tumors generally have a favorable prognosis with a low rate of metastasis, while metastatic disease is considerably more common in adults. Secondary testicular involvement by leukemia is also encountered more frequently in children. [1]

Clinically, painless scrotal swelling is the most common presenting symptom across pediatric cohorts [7] Radiologically, ultrasonography is the preferred initial modality.[8] Although abdominal CT/magnetic resonance imaging (MRI) contribute to preoperative diagnosis when clinical suspicion of malignancy is high.[9]

Grossly, YSTs commonly exhibit soft, grey-yellow, necrotic cut surfaces, whereas teratomas show variegated patterns reflecting their diverse somatic components. Accurate gross examination and optimal sampling are critical due to the small size of pediatric testes and the possibility of mixed or rare components [10]

Despite their rarity, pediatric TTs represent a distinct group of neoplasms with unique clinical, pathological, and therapeutic characteristics. Given the limited pediatric data available and the evolving emphasis on accurate diagnosis and testis-sparing management, this study was

undertaken to evaluate the clinical presentation, histopathological spectrum, treatment approaches, and outcomes of paediatric testicular tumors at our center.

MATERIALS AND METHODS

This is a retrospective observational study . The study included all patients of the pediatric age group who presented with testicular lesions during the study period. All cases of testicular tumors encountered in patients less than 18 years diagnosed in the Department of Pathology at Wanless Hospital, Miraj for five years were included in this study. Relevant clinical details such as age, clinical presentation and side of involvement of the testis were also recorded from the hospital records. Exclusion criteria included patients with incomplete medical records. Tumor like lesions of testis, paratesticular tumors and tumors of testicular adnexae were excluded from this study. 10% formalin was used as preservative and fixative for all specimens. The gross examination of the specimens was performed and adequate representative sections were obtained. Paraffin-embedded sections were stained routinely with haematoxylin and eosin. Special stains like PAS, reticulin, etc., were used in selected cases.

RESULTS

A total of 13 patients meeting the inclusion criteria were included in the study. The mean age at diagnosis was 10 years, ranging from 2 years to 18 years. Most children were above 5 years of age, accounting for 77% (n=10) of the total. Majority of the cases belonged to 6–10 years age group, which constituted 38.4 % (n=5). The duration of symptoms in children with pediatric TTs ranged from 2 months to 3 years. The most common presenting symptom was scrotal swelling, observed in all the patients, followed by pain in 23% (n=3). One case had preceding history of trauma, and two cases had clinical evidence of metastasis at the time of diagnosis.

On histopathological examination, there were 9 malignant tumors (69%) and 4 benign tumors (31%).While benign tumors consisted mainly of Mature teratomas (n=4) the malignant tumors varied histologically. Yolk sac tumor was the commonest malignant tumor, seen in 3 cases (33%) followed by Mixed germ cell tumors seen in 3 cases, leukemic infiltration of testis seen in 2 cases and one case of extranodal non Hodgkin's lymphoma involving the testis. Pure seminomatous germ cell tumors were not seen in any case.

Right sided testis was more commonly involved (9/13, 69.2%) than left testis. Bilateral involvement was not seen in any case.

On gross examination, masses ranged from 2 cm to 7cm in the greatest dimension. The largest of the testicular masses was that of an 8 year old boy with a testicular mass measuring about

10x7x2cm, grossly it was a solid lesion and microscopically it was diagnosed as Non Hodgkins lymphoma of the testis. The gross appearance of most of the specimens was distorted with grey white to grey yellow, necrotic areas to areas having a variegated appearance.

Microscopic examination revealed that there were 4 benign lesions all of which were mature teratomas. All four of these cases were composed of elements resembling somatic tissues derived from one or more germ layers. However there was no evidence of GCNIS in either of the four cases.

A detailed examination of malignant cases revealed that YST was seen in 3 cases. Gross examination of these showed large masses with greyish to yellow cut surfaces with soft, necrotic areas. Microscopically all the three cases showed a broad spectrum of patterns along with presence of characteristic Schiller Duval bodies. (Fig. 1)

There were 3 cases of mixed germ cell tumors which consisted of more than one germ cell tumor component. Gross appearance was variegated in all the three cases. Two cases were composed of embryonal carcinoma along with teratoma. While the other case consisted of teratoma and YST elements. (Fig. 2)

There were 3 cases of hematolymphoid neoplasms involving the testis. Two of which were secondary involvement of the testis in a known case of Acute lymphoblastic leukemia one aged 6 years and the other aged 12 respectively. Both presented with scrotal swellings and on biopsy both showed leukemic infiltration into testis. The other case was a slide for second opinion belonging to an 8 year old boy with scrotal swelling and was diagnosed as Non Hodgkins Lymphoma favouring Lymphoblastic Lymphoma.(Fig 3). The above findings have been summarised in Table 1.

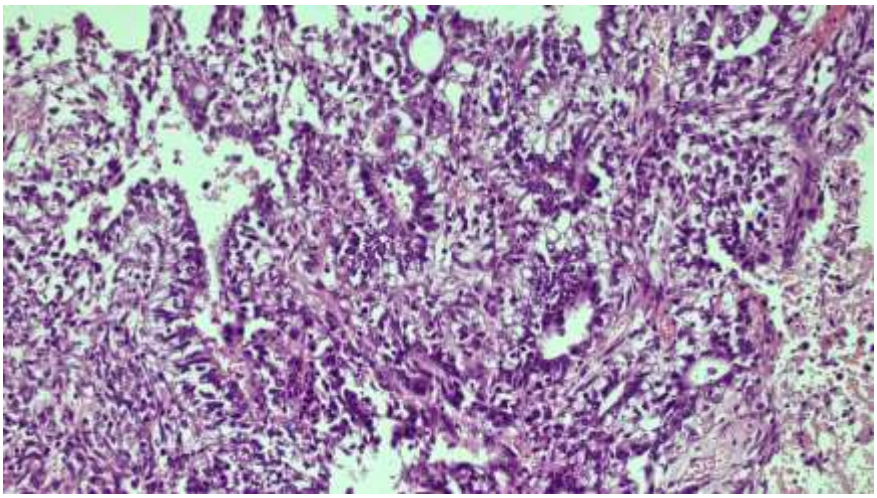

Fig.1 Histopathological section of yolk sac tumor demonstrating reticular growth pattern

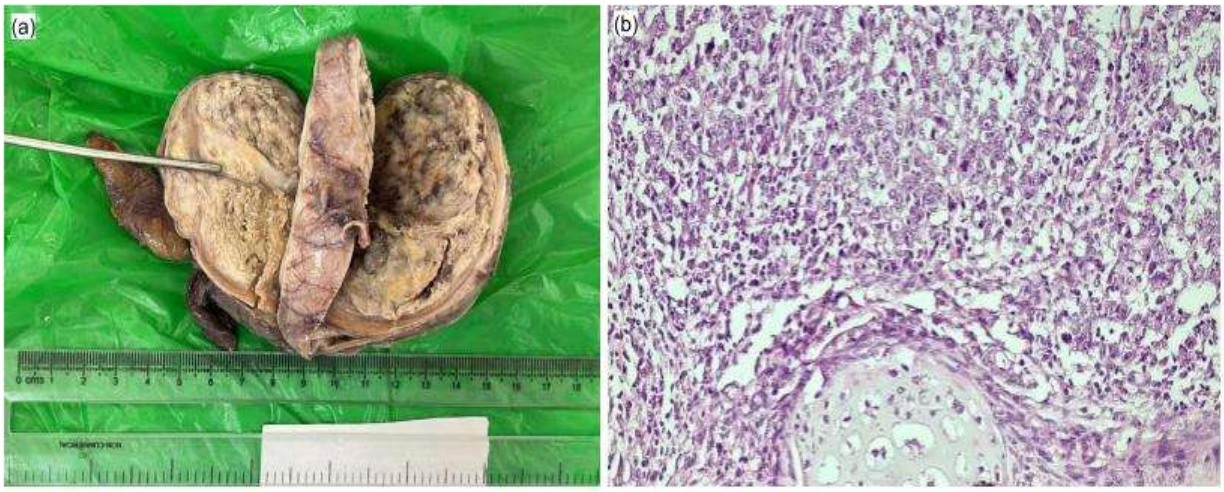

Fig 2. (a) Gross specimen of mixed germ cell tumor demonstrating variegated cut surface with grey white solid areas admixed with yellow, hemorrhagic and necrotic foci.
(b) Photomicrograph of mixed germ cell tumor demonstrating admixture of embryonal carcinoma component (upper half) composed of pleomorphic cells with high mitotic activity and areas of necrosis alongside mature teratomatous elements (lower half)

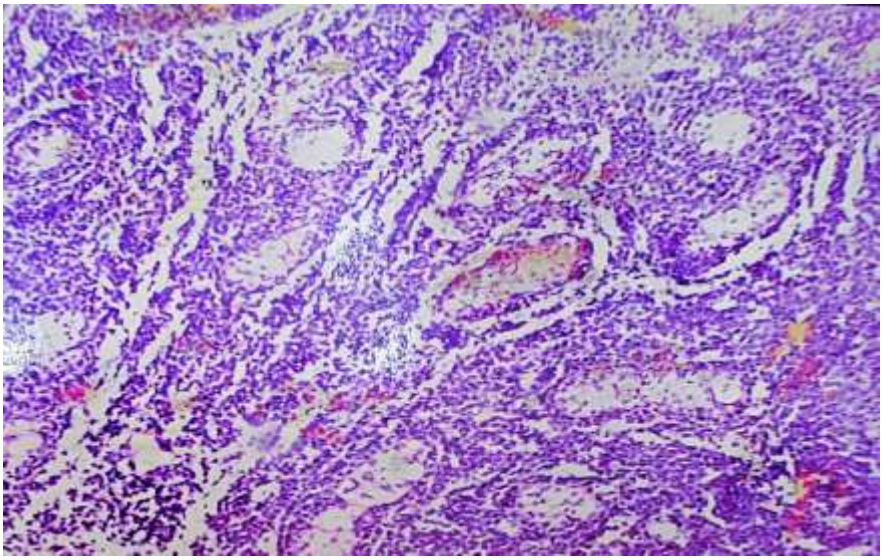

Fig 3 Photomicrograph demonstrating diffuse sheets of atypical lymphoid cells with hyperchromatic nuclei replacing the normal parenchyma, consistent with Non Hodgkin's Lymphoma

Sl No	Age/Sex	Laterality	Diagnosis
1.	13/M	Left	Mature Teratoma
2.	2/M	Left	Yolk Sac tumor
3.	6/M	Right	Leukemic infiltration
4.	8/M	Right	Non Hodgkins lymphoma
5.	17/M	Right	Mixed germ cell tumor- Mature teratoma with embryonal carcinoma
6.	18/M	Right	Yolk Sac tumor
7.	2/M	Left	Yolk Sac tumor
8.	6/M	Left	Mature Teratoma
9.	18/M	Right	Mixed germ cell tumor-Mature teratoma with yolk sac tumor
10.	15/M	Right	Mixed germ cell tumor- Mature teratoma with embryonal carcinoma
11.	12/M	Right	Leukemic infiltration
12.	12/M	Right	Mature Teratoma
13.	11/M	Right	Mature Teratoma

Table 1: Summary of histopathological findings

DISCUSSION

Pediatric testicular tumors are uncommon and show distinct epidemiological and biological features compared with adult testicular neoplasms. In the present study, the mean age at diagnosis was 10 years, notably higher than the typical prepubertal peak described in literature, where most tumors occur below 5 years of age. This age pattern aligns more closely with the "intermediate age group" described by Karmazyn et al., who observed that children aged 5–12 years rarely develop malignant tumors and more commonly present with benign or incidental masses.[11] However, our series demonstrates a higher proportion of malignant tumors (69%), indicating that older prepubertal and peripubertal boys may still present with aggressive pathology, differing from the classic benign dominance in early childhood. Consistent with previous studies, scrotal swelling was the most common presentation, observed in all patients. Cakmak et al. similarly reported testicular swelling in 75% of their cohort as the predominant symptom.[2] Pain was infrequent in our study, and only one case reported preceding trauma, underscoring that most pediatric patients present with painless scrotal enlargement regardless of tumor type. Laterality patterns have varied across series; our cohort showed a right-sided predominance (66.6%), contrasting with the left-sided preference reported by Cakmak et al.[2]

Such variations are likely incidental given the small sample sizes typical of pediatric tumor studies.

Histopathological distribution in our study revealed yolk sac tumor and mixed germ cell tumor as the most common malignant lesion (three cases each), consistent with yolk sac tumors being known as the predominant malignant tumor in prepubertal children. These findings are in agreement with those of Cakmak et al who reported 4 cases each of teratoma and yolk sac tumors[2] and by Zhang et al who reported 82 benign teratomas and 37 yolk sac tumors in the prepubertal age group. Our study had 3 cases of Mixed germ cell tumors which were all in the pubertal age group. The presence of mixed germ cell tumors in adolescents supports the shift toward more complex, GCNIS-derived tumors during puberty, as emphasized in the WHO-based classifications discussed by Sangüesa et al.[12] The detection of hematolymphoid tumors including leukemic infiltration and Non-Hodgkin lymphoma aligns with observations from Chiu et al.[3],and zhang et al [1] who identified lymphomas and leukemic involvement as important differentials in pediatric testicular masses, particularly in older children and adolescents. Benign tumors in our series were exclusively teratomas, all lacking features of GCNIS. This is consistent with the established understanding that prepubertal-type teratomas behave benign and are unrelated to the malignant pathway seen in postpubertal teratomas.[1,2,12] The absence of seminoma in our cohort parallels findings from Nerli et al. [6], who also did not observe seminomatous tumors in children below puberty. The overall spectrum of tumors in our cases yolk sac tumors, teratomas, mixed germ cell tumors, hematolymphoid malignancies mirrors the heterogeneity reported across large pediatric series. The relatively large tumor sizes (up to 10 cm) observed in our study may indicate delayed presentation, a common issue in resource-limited settings. While testis-sparing surgery is increasingly supported for benign tumors, especially when AFP is normal and imaging suggests non-GCNIS pathology as highlighted by Hanaki et al [5]. All malignant cases in our study appropriately underwent radical orchiectomy. The presence of metastatic disease in two cases emphasizes the need for thorough staging and close collaboration with pediatric oncology teams.

CONCLUSION

Pediatric testicular tumors are rare neoplasms with a diverse histopathological spectrum. In our cohort, malignant tumors predominated, with yolk sac tumor being the most common malignancy, while mature teratoma was the most frequent benign lesion. The presence of hematolymphoid malignancies highlights the importance of considering secondary testicular involvement in the differential diagnosis. Early recognition of scrotal masses, thorough histopathological evaluation, and multidisciplinary management are essential for accurate diagnosis and optimal outcomes in affected children. This study contributes valuable regional data to the limited literature on pediatric testicular tumors. Given their rarity, further multicentric studies are needed to better define the epidemiological and pathological profile of pediatric testicular tumors in the Indian population.

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