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Original Article

Clinicopathological Features, Prognostic Factors, and Survival Outcomes of Retroperitoneal Lesions

Mahmood Reza Roknaldini [1] MD, Maryam Vajihinejad*[2] MD

[1] Faculty of Medicine, Shahid Sadoughi University of Medical Sciences and Health Services, Yazd, Iran
[2] Department of Pathology, Faculty of Medicine, Shahid Sadoughi University of Medical Sciences and Health Services, Yazd, Iran
*Corresponding Author: Dr. Maryam Vajihinejad, Assistant professor of pathology, Department of Pathology, Shahid Sadoughi University of Medical Sciences and Health Services, Yazd, Iran. Email: maryamvajihinejad@gmail.com. ORCID ID: 0000-0001-5682-5165.

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Abstract

Background: Retroperitoneal tumors (RPTs) are rare and heterogeneous neoplasms that show distinct biological and clinical features across age groups. This study aimed to assess the clinicopathological characteristics of RPTs in pediatric and adult patients.

Materials and Methods: This retrospective cohort study included patients diagnosed with RPTs from 2016 to 2021. The clinical data, histopathological findings, and outcomes were reviewed and compared between the children (< 18 years) and adults (≥ 18 years). Statistical analyses were performed using chi-square and Fisher's exact tests, independent t-tests, Kaplan–Meier survival analysis, and Firth's penalized logistic regression.

Results: Among 109 patients, 14 (12.8%) were children and 95 (87.2%) were adults. Metastatic tumors were the most common lesion type (72.5%), followed by primary malignant (21.1%) and benign tumors (6.4%). Metastatic tumors were the predominant histopathological category (72.5%), followed by primary malignant mesenchymal tumors (16.5%). Histopathological distributions were similar between children and adults, with no significant differences observed across categories (all $p>0.05$). Overall survival was similar between children and adults ($p=0.35$). Abdominal pain was the most common symptom (51.4%), while nausea occurred more frequently in children ($p=0.01$). Firth's penalized logistic regression identified no significant associations between clinicopathological factors and recurrence or necrosis (all $p>0.05$).

Conclusion: Metastatic tumors predominated in both age groups, followed by primary malignant mesenchymal tumors. No significant age-related differences were observed in histopathological categories, tumor origin, or survival.

Keywords: Histopathology, Metastasis, Retroperitoneal neoplasms, Survival rate

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Introduction

Retroperitoneal tumors (RPTs) are a heterogeneous group of neoplasms that originate within the retroperitoneal space, an anatomically deep compartment situated between the posterior parietal peritoneum and the transversalis fascia (1, 2). This space contains vital organs and major vascular, lymphatic, and neural structures, allowing tumors to grow considerably before causing symptoms (1). Although RPTs are uncommon, they are clinically significant due to their tendency for local invasion, late presentation, and complex surgical management requirements (3). RPTs comprise a broad range of benign and malignant subtypes that may arise from multiple tissue origins, including mesenchymal, neurogenic, lymphatic, and germ cell components (2, 4). Such diversity in cellular origin accounts for the wide biological variability and histopathological heterogeneity among these tumors, influencing their behavior, treatment response, and prognosis (3, 5). Consequently, understanding the nature and tissue derivation of RPTs is crucial for accurate diagnosis and tailored therapeutic planning.

RPTs often have low overall incidence, with retroperitoneal sarcomas (RPS) accounting for approximately 10-15% of all soft tissue sarcomas and an overall incidence estimated at 0.3 to 0.4 per 100,000 in the population of adults (6, 7). The range and prevalence of RPTs differ dramatically between children and adults, largely reflecting their distinct origins and biological pathways (8). In the adult population, the peak incidence is typically in the fifth to seventh decades of life, and the vast majority of primary RPTs are malignant soft tissue sarcomas (9). The most common histological subtypes in adults are Liposarcoma, and Leiomyosarcoma, which preferentially arise in the retroperitoneal cavity (10, 11). In contrast, the profile of RPTs in children is dominated by tumors of a neurogenic and embryonal origin (8, 12). The two most frequent malignant RPTs in the pediatric age group are neuroblastoma and nephroblastoma (12, 13). These two subtypes typically present at a much younger age (mostly under 5 years) and are only exceptionally rare in the adult retroperitoneum (14). These clear age differences highlight major contrasts in RPT presentation and management between children and adults.

RPTs often present late because of their deep anatomical location and the capacity for significant expansion before symptom onset (15). More than 70% of adult patients present with large, asymptomatic masses or abdominal discomfort, while pediatric patients more commonly exhibit abdominal distension or palpable masses (16, 17). Non-specific symptoms such as pain, early satiety, urinary or bowel compression, and lower limb edema are frequent but diagnostically imprecise (18). Histopathological examination is essential for definitive diagnosis, as imaging cannot reliably distinguish between benign and malignant RPTs (19). Tumor histology, grade, and completeness of resection are the most significant determinants of outcome (20). Achieving complete macroscopic (R0/R1) resection offers the greatest survival advantage in patients with retroperitoneal sarcoma, whereas incomplete (R2) resections are associated with markedly reduced survival and local recurrence rates (21).

Given the marked epidemiological, clinical, and histopathological differences between pediatric and adult RPTs, the comparative data of both age groups remain limited. A clearer understanding of age-related differences in tumor origin, histological patterns, and survival outcomes is essential for improving diagnostic accuracy, prognostic stratification, and clinical decision-making.

Therefore, this retrospective cohort study aimed to compare clinicopathological characteristics of RPTs in pediatric and adult patients, with a focus on tumor histological subtype, anatomical (organ-based) origin, clinical presentation, and overall survival.

Material and Methods

Study design and setting

This analytical retrospective cohort study was conducted on patients diagnosed with RPTs whose biopsy or surgical specimens were referred to the Department of Pathology, Shahid Sadoughi Hospital, Yazd, Iran, from 2016 to 2021. The hospital is a tertiary referral center affiliated with Shahid Sadoughi University of Medical Sciences.

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The inclusion criteria were a) histopathologically confirmed RPT in the pediatric (< 18 years) and adult (≥ 18 years) patients diagnosed from 2016 to 2021 and b) the availability of their biopsy or surgical specimens for review. The exclusion criteria were cases with incomplete medical records, uncertain tumor origin or diagnosis, duplicate records, and cases for which the outcome data could not be obtained despite follow-up attempts.

Study population

All the patients with histopathologically confirmed RPT during the study period were included. The cases with incomplete medical records or uncertain tumor origin or diagnosis were excluded. A total of 109 patients met the inclusion criteria and were enrolled in the study, comprising 14 pediatric (< 18 years) and 95 adult (≥ 18years) cases.

During the study period, a total of 134 cases were initially identified. Of them, 21 cases were excluded due to incomplete medical records, and four cases were excluded because their outcome data could not be obtained through telephone follow-up. No cases were excluded due to early death prior to the data collection. Ultimately, 109 patients were included in the final analysis.

Data collection

The patient data were retrospectively obtained from pathology archives and hospital medical records. For each case, demographic characteristics including age and sex were recorded. The clinical information, including symptoms, was extracted from the patient charts. The tumor-related variables including lesion category, tumor origin, and histopathological diagnosis were reviewed. For descriptive analyses, histopathological diagnoses were grouped into metastatic tumors, primary malignant mesenchymal tumors, primary malignant epithelial tumors, and benign mesenchymal tumors. Specifically, the metastatic tumor category included metastatic lymph node involvement, metastatic germ cell tumors, and metastatic adenocarcinomas. The primary malignant mesenchymal tumor category included sarcomas and lymphomas. The primary malignant epithelial tumor category included primary carcinomas. The benign mesenchymal tumor category included fibroma, neurofibroma, leiomyoma, lipoma, and fibromatosis. These categories were created to facilitate statistical analysis and reduce data sparsity resulting from the low frequency of individual histopathological diagnoses.

Tumor origins were grouped as retroperitoneal, gastrointestinal, gonadal, gynecological, and other origins according to the primary anatomical site. The lesions were classified as benign, primary malignant, and secondary/metastatic. Primary malignant tumors were defined as the malignant neoplasms arising primarily within the retroperitoneal space, whereas secondary/metastatic tumors were defined as the lesions involving the retroperitoneum due to spread from an identified primary tumor at another anatomical site. Tumor origin referred to the anatomical or cellular source of the neoplasm as determined from the histopathological findings and available clinical records. Histopathological diagnoses were assigned according to the final pathology report.

Pathological features such as tumor type, presence of necrosis, perineural invasion, and lymph node involvement were documented. The outcome information on tumor recurrence, survival duration, and mortality was gathered via follow-up telephone interviews to compare the pediatric and adult patients. The follow-up time was calculated from the date of histopathological diagnosis (biopsy or surgical specimen) to the last follow-up date or death. Tumor recurrence was defined as the radiologically, histologically, or clinically documented reappearance of the disease at the primary or metastatic site after the initial diagnosis or treatment.

Access to hospital medical records and pathology archives was granted by Shahid Sadoughi Hospital following the ethics committee approval (IR.SSU.MEDICINE.REC.1401.134). To minimize selection bias, all the consecutive patients with histopathologically confirmed RPT during the study period were included. Recall bias was reduced by prioritizing the information

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obtained from the medical records, while telephone follow-up was used only to supplement the outcome data when necessary.

Histopathological evaluation

All the specimens were fixed in 10% neutral buffered formalin and processed using standard paraffin embedding techniques. Hematoxylin and eosin (H&E) stained sections were reviewed by expert pathologists. The tumors were classified according to the World Health Organization (WHO) Classification of Tumors of Soft Tissue and Bone (5th edition). All the histopathological slides were independently reviewed by at least two experienced pathologists. In cases of diagnostic discrepancy, a consensus diagnosis was reached through a joint review.

Statistical analysis

All the data were analyzed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics served to summarize the categorical variables as frequencies and percentages, and continuous variables as mean ± standard deviation (SD). Comparative analyses between the pediatric and adult groups were also performed using the Chi-square test or Fisher's exact test for categorical variables and independent t-test for continuous variables. The Kaplan–Meier method was used to estimate the overall survival, and the log-rank test was applied to compare the survival curves between the groups. A p-value less than 0.05 was considered statistically significant.

Due to the limited sample size and low event frequency, Firth's penalized logistic regression was performed using the "logistf" package in R software version 4.3.3 (R Foundation for Statistical Computing, Vienna, Austria) to reduce small-sample bias in maximum likelihood estimation. Histopathological diagnoses and tumor origins were consolidated into broader clinically meaningful categories for descriptive and regression analyses to reduce data sparsity and improve interpretability and model stability. Odds ratios (ORs), 95% confidence intervals (CIs), and p-values were calculated. Regression analysis for perineural invasion was not performed because the low number of events resulted in unstable model estimates.

Results

Characteristics of the participants

A total of 109 patients with RPTs were included in the study, comprising 14 children (12.8%) and 95 adults (87.2%). The clinical characteristics of the participants are presented in Table I. Overall, 67 patients (61.5%) were male and 42 (38.5%) were female, but there was no significant sex difference between these groups ($p = 0.40$).

Regarding the tumor type, secondary metastatic tumors were the most prevalent, observed in 79 patients (72.5%), followed by primary malignant tumors in 23 patients (21.1%) and benign tumors in 7 patients (6.4%). There was no statistically significant difference between the children and adults regarding the tumor type distribution ($p > 0.05$). Histopathologically, metastatic tumors were the most common category, accounting for 79 cases (72.5%), followed by primary malignant mesenchymal tumors (18 cases, 16.5%), benign mesenchymal tumors (7 cases, 6.4%), and primary malignant epithelial tumors (5 cases, 4.6%). Metastatic tumors constituted the largest category in both children and adults. No statistically significant differences were observed between pediatric and adult patients in the distribution of histopathological categories (all $p > 0.05$).

Regarding tumor origin, gonadal tumors constituted the largest category (34.9%), followed by retroperitoneal tumors (31.2%), other origins (13.8%), gastrointestinal tumors (11.9%), and gynecological tumors (8.3%). No significant differences in the distribution of tumor-origin categories were observed between pediatric and adult patients ($p = 0.35$).

Complications, survival, and clinical presentation

Perineural invasion and tumor necrosis were identified in 13.8% and 19.3% of the cases, respectively (Table II). Tumor recurrence occurred in 27.5% of the patients, with no significant difference between the two groups ($p = 1.0$). The mean overall survival time for the study population was 4.06 ± 0.28 years. The overall survival was

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evaluated using the Kaplan–Meier method. The pediatric patients had a shorter estimated survival compared to the adults; however, the difference between the survival curves was not statistically significant according to the log-rank test (3.61 ± 0.49 vs. 4.13 ± 0.14 years; p = 0.35). The comparative survival curves of the adults and children obtained with the Kaplan–Meier method is presented in Figure 1.

Clinically, the most frequent symptom was abdominal pain, observed in 56 patients (51.4%). The other common manifestations included nausea (33.9%), urinary symptoms (37.6%), abdominal distension (31.2%), and diarrhea (27.5%). Among them, nausea was significantly more common in the children than in the adults (64.3% vs. 29.5%; p = 0.01), while the other symptoms did not differ significantly between the groups.

Firth's penalized logistic regression analysis did not identify any significant predictors of recurrence or necrosis (Table III). Compared with pediatric patients, adults showed no increased odds of recurrence (OR=1.45, 95% CI: 0.37–5.62, p=0.58) or necrosis (OR=1.50, 95% CI: 0.30–7.27, p=0.61). Similarly, sex, tumor type, histopathological group, and tumor origin were not significantly associated with either outcome (all p>0.05). Although some histopathological and tumor-origin categories demonstrated higher or lower odds ratios relative to the reference groups, the confidence intervals were wide and included unity. Estimates for certain categories were unstable because of the low number of outcome events. Regression analysis for perineural invasion was not performed because the limited number of events precluded stable model estimation.

Table I: Characteristics of included participant and species

Parameter	Children (N=14)	Adults (N=95)	Total (N=109)	P-value
Male	7 (50)	60 (63.2)	67 (61.5)	0.4
Female	7 (50)	35 (36.8)	42 (38.5)	
Tumor type				
Secondary	9 (64.3)	70 (73.7)	79 (72.5)	0.51
Primary malignant	3 (21.4)	20 (21.1)	23 (21.1)	0.72
Benign	2 (14.3)	5 (5.3)	7 (6.4)	0.20
Histopathology				
Metastatic tumors	9 (64.3)	70 (73.7)	79 (72.5)	0.46
Primary malignant mesenchymal tumors	3 (21.4)	15 (15.8)	18 (16.5)	0.59
Primary malignant epithelial tumors	0 (0)	5 (5.3)	5 (4.6)	1.0
Benign mesenchymal tumor	2 (14.3)	5 (5.3)	7 (6.4)	0.22
Origin of tumor cells				
Retroperitoneal	7 (50)	27 (28.4)	34 (31.2)	0.35
Gastrointestinal	1 (7.1)	12 (12.6)	13 (11.9)	
Gonadal	5 (35.7)	33 (34.7)	38 (34.9)	
Gynecological	1 (7.1)	8 (8.4)	9 (8.3)	
Other	0	15 (15.8)	15 (13.8)	

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Abbreviations: ALL (acute lymphoblastic leukemia), WBC (white blood cells), PPR (prednisone poor response), MRD (measurable residual disease), *Yates Continuity Correction, **Fisher Exact Probability Test

Table II: Complications, survival and clinical presentation of participants.

Parameter	Children (N=14)	Adults (N=95)	Total (N=109)	P-value
Complications				
Recurrence	3 (21.4)	27 (28.4)	30 (27.5)	1.0
Necrosis	2 (14.3)	19 (20)	21 (19.3)	1.0
Perineural invasion	0 (0)	15 (15.8)	15 (13.8)	0.12
Survival (Mean ± SD)	3.61 ± 0.49	4.13 ± 0.14	4.06 ± 0.28	0.35
Clinical presentation				
Abdominal pain	7 (50)	49 (51.6)	56 (51.4)	0.90
Urinary symptoms	7 (50)	34 (35.8)	41 (37.6)	0.29
Nausea	9 (64.3)	28 (29.5)	37 (33.9)	**0.01**
Abdominal distention	3 (21.4)	31 (32.6)	34 (31.2)	0.55
Diarrhea	3 (21.4)	27 (28.4)	30 (27.5)	0.76

Data presented as number and percentage (%) unless otherwise stated, significant p-values are bolded.

Table III. Firth's penalized logistic regression analysis of factors associated with recurrence and necrosis among patients with retroperitoneal tumors

Predictor	Category	Recurrence			Necrosis		
		OR	95% CI	P-value	OR	95% CI	P-value
Age	Children	Reference value					
	Adults	1.45	0.37-5.62	0.58	1.50	0.30-7.27	0.61
Sex	Female (ref)	Reference value					
	Male	0.75	0.32-1.78	0.52	1.32	0.48-3.60	0.58
Tumor type	Benign	Reference value					
	Primary malignant	*	*	0.99	*	*	0.99
	Secondary	0.82	0.28-2.34	0.71	0.78	0.23-2.60	0.68
Histopathology	Metastatic tumors	Reference value					
	Primary malignant mesenchymal tumors	0.88	0.28-2.74	0.82	1.04	0.30-3.58	0.94
	Primary malignant epithelial tumors	0.57	0.06-5.40	0.62	*	*	0.99
	Benign mesenchymal tumor	*	*	0.99	*	*	0.99
Origin of tumor	Retroperitoneal (ref)	Reference value					
	Gastrointestinal	1.44	0.35-5.97	0.61	0.48	0.05-4.58	0.52
	Gonadal	1.00	0.34-3.00	0.98	1.80	0.53-6.02	0.34
	Gynecologic	2.60	0.56-12.06	0.22	2.90	0.54-15.55	0.21
	Other	1.62	0.42-6.17	0.47	1.45	0.29-7.05	0.64

Note: OR = odds ratio; CI = confidence interval. * Unstable estimates due to a low number of outcome events.

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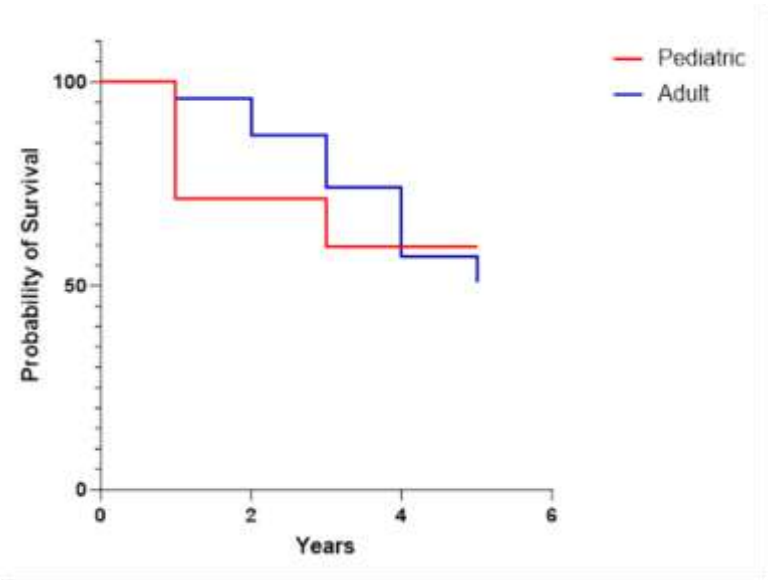

Figure 1 Figure 1: Kaplan–Meier survival curves comparing pediatric and adult patients with retroperitoneal tumors

Discussion

In this retrospective cohort study of 109 patients with RPTs, no significant sex difference was found between the pediatric (N = 14) and adult groups (N = 95). Most of the cases in this study had secondary tumors (72.5%). The largest histopathological category was metastatic tumors (72.5%), followed by primary malignant mesenchymal tumors (16.5%). No significant differences were observed between pediatric and adult patients regarding histopathological categories. The mean overall survival for the population was 4.06 ± 0.28 years, and there was no significant difference between the children and the adults (3.61 ± 0.49 vs 4.13 ± 0.14 years; p = 0.35).

The predominance of metastatic tumors in this study differs from reports focused exclusively on primary retroperitoneal sarcomas, in which liposarcoma and leiomyosarcoma are generally the most common histological subtypes (21). This difference is expected because the present study included a substantial proportion of secondary metastatic lesions. Primary malignant mesenchymal tumors represented the second largest histopathological category, while primary malignant epithelial tumors and benign mesenchymal tumors accounted for smaller proportions of cases.

The most frequent tumor-origin categories were gonadal tumors and tumors arising primarily within the retroperitoneum. Adult tumors often arise from the secondary extension or metastasis of visceral malignancies. In contrast, pediatric tumors originate mainly from the embryonal tissues that persist in the retroperitoneum, such as neural crest and nephrogenic remnants. Other studies show that

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true primary retroperitoneal soft-tissue tumors are less common than metastatic or organ-derived tumors when pathology archives or general hospital populations are sampled (22). In contrast, sarcoma registries or referral centers report a higher relative proportion of true primary retroperitoneal sarcomas (21).

In the present study, the mean overall survival time of all the patients with RPTs was 4.06 ± 0.28 years. Although the pediatric patients showed a numerically shorter estimated survival, the difference in the overall survival between the pediatric and adult patients was not statistically significant based on the Kaplan–Meier analysis. This finding may reflect limited statistical power due to the small pediatric sample size. Similar survival durations have been reported in some previous studies that included both primary and metastatic retroperitoneal lesions, where the average 3- to 5-year survival ranged from 3.5 to 4.5 years (20, 22). However, the studies on primary retroperitoneal sarcomas often show longer median survival times (5 to 7 years after complete resection) (3, 21). These differences and the relatively shorter survival may be explained by the higher proportion of metastatic tumors in this study. Large meta-analyses and single-center reviews consistently identify complete (R0/R1) surgical resection, tumor grade, and histological subtype as the most accurate independent predictors of long-term survival (3, 21, 23). High-grade sarcomas, de-differentiated liposarcomas, and non-resectable or metastatic carcinomas are associated with markedly reduced survival. These findings emphasize that tumor pathology and stage, rather than age alone, are the key determinants of the outcome in RPTs (24, 25).

In this study, the most frequent symptoms were abdominal pain (51.4%), urinary symptoms (37.6%), nausea (33.9%) and abdominal distension (31.2%). Nausea was significantly more frequent in the children than in the adults (64.3% vs 29.5%, p = 0.01). Tumor recurrence was observed in 30 patients (27.5%) across the study. The recurrence rates were 21.4% in the children and 28.4% in the adults.

Previous studies on primary RPTs commonly report abdominal pain, palpable mass, early satiety or weight loss. They also occasionally refer to limb edema from venous or lymphatic compression as the first manifestation of the disease (9, 15). Studies on surgical cases or sarcoma tumors often report a palpable mass or a large, asymptomatic lesion found incidentally on imaging as the main clinical presentation (15, 26). In contrast, the results of this study showed that abdominal pain and urinary symptoms were more common. Pediatric studies describe yet another pattern. Studies of childhood RPTs report that palpable abdominal mass, distension and gastrointestinal symptoms (nausea or vomiting) are common, especially with neuroblastoma and Wilms' tumor (8, 16, 27). The higher frequency of nausea in children matches these pediatric reports. Rapid growth of embryonal tumors and compression of adjacent bowel may explain the greater frequency of nausea and distension in the pediatric subgroup.

Tumor necrosis was reported in 19.3%, recurrence in 27.5%, and perineural invasion in 13.8% of all the tumors. These complication rates are higher than those reported in most surgical series focused exclusively on primary retroperitoneal sarcomas (RPs), where recurrence rates typically range from 20% to 30% after complete resection (R0/R1) (21, 26, 28). Several large studies and meta-analyses have shown that local recurrence is the most frequent complication after RPs surgery as well as the major cause of treatment failure (20, 21, 28). Recurrence rates vary according to histological subtype, margin status, and tumor grade. Liposarcomas, for example, tend to recur locally, while leiomyosarcomas more often metastasize hematogenously (26, 29). Perineural invasion and necrosis, found in a subset of patients, are also recognized as adverse prognostic markers associated with higher recurrence and poorer survival (20, 30).

Compared to the adult cases, the children had similar recurrence but fewer necrotic and perineural lesions, consistent with the pediatric studies showing that most retroperitoneal

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malignancies (e.g., neuroblastoma, Wilms' tumor, lymphoma) respond well to systemic therapy but relapse in aggressive or advanced-stage cases (27, 31). Thus, the higher overall complication rate in this study may reflect the disease stage and biology rather than surgical factors. These findings align with some earlier reviews concluding that tumor grade, completeness of resection, and metastatic status are the strongest predictors of complications and recurrence across all age groups (20, 21).

In the present study, Firth's penalized logistic regression did not identify significant associations between age, sex, tumor type, histopathological group, or tumor origin and either recurrence or necrosis. Several estimates were characterized by wide confidence intervals, reflecting the low frequency of outcome events and the heterogeneity of tumor subtypes. Regression analysis for perineural invasion could not be performed because the number of events was insufficient to generate stable model estimates. Therefore, the absence of statistically significant associations should be interpreted cautiously and may reflect limited statistical power rather than a true lack of biological relationships. Previous studies on RPTs and retroperitoneal sarcomas have reported that recurrence is associated with adverse clinicopathological characteristics including histologic subtype, tumor grade, incomplete resection margins, multifocal disease, tumor necrosis, and aggressive pathological behavior (23, 32, 33). In addition, the studies evaluating retroperitoneal residual tumors demonstrated that pathological necrosis may correlate with specific tumor histology and radiologic tumor response patterns (34, 35). However, evidence regarding the predictors of perineural invasion in RPTs remains limited because of the rarity and heterogeneity of these neoplasms. The absence of statistically significant associations in the current study may, therefore, reflect the relatively small sample size, low event frequency, and heterogeneity of tumor subtypes rather than the absence of biological associations.

The differences between the present findings and previous studies are most likely related to variations in study population, case selection, and referral setting. Many earlier reports focused only on primary retroperitoneal sarcomas treated in specialized surgical centers, where liposarcoma and leiomyosarcoma are more common and survival is generally better after complete resection (23). In contrast, the current study included both primary and secondary tumors, resulting in a higher proportion of metastatic adenocarcinoma and germ-cell tumors and relatively shorter overall survival. The inclusion of pediatric patients increased the relative proportion of primary malignant mesenchymal tumors, including lymphoma, compared with many adult-only series. Clinically, these findings indicate that results from sarcoma-only cohorts should not be generalized to all retroperitoneal tumors. Diagnostic evaluation should consider patient age and the likelihood of a metastatic disease, while prognosis and treatment planning should be based primarily on tumor histology, stage, and resectability rather than age alone.

This study used a comparative design, which evaluated a population of both pediatric and adult patients with RPTs over a six-year period. Unlike most previous reports limited to either surgical or single-pathology series, this study provides a comprehensive clinicopathological overview that includes both primary and metastatic lesions, offering a broader picture of real-world disease patterns. All the cases were histologically verified and classified according to the latest WHO criteria, ensuring diagnostic accuracy. However, this study has several limitations. The relatively small number of pediatric cases limits the strength of comparisons. Additionally, the limited sample size and low number of outcome events precluded robust multivariable modeling and may have reduced the ability to detect significant associations. So, survival comparisons between the groups should be interpreted with caution. The lack of detailed treatment and surgical margin data also restricts the interpretation of outcome predictors. Future prospective multicenter studies with standardized follow-up

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and treatment documentation are recommended to validate and expand the findings.

Conclusion

This comparative analysis of pediatric and adult RPTs demonstrated that secondary metastatic lesions are the predominant tumor category in both groups. Metastatic tumors were the predominant histopathological category, followed by primary malignant mesenchymal tumors. No significant differences were observed between both groups regarding histopathological categories. The overall distribution of tumor-origin categories and survival outcomes was also similar between the two groups. The mean overall survival was approximately four years, and the difference was not statistically significant between the two groups. Firth's penalized logistic regression identified no significant predictors of recurrence or necrosis. Clinically, abdominal pain was the most frequent symptom, and nausea was significantly more common in the children. Future multicenter studies with larger sample sizes are needed to validate these findings and further clarify age-related differences in RPTs.

Availability of Data

All the data are available in the manuscript.

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Conflict of Interest

The authors declare no conflict of interests regarding this research.

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Ethical Considerations

The study was performed according to the Declaration of Helsinki, and its design was approved by the ethics committee of Shahid Sadoughi University (IR.SSU.MEDICINE.REC.1401.134).
Informed consent was obtained from the individual patients or their relatives to use their data for educational or research purposes. No personal information was used at the time of data extraction.

Authors' Contributions

M.R.R. contributed to the study conception and design, data collection, data interpretation, and drafting of the manuscript. M.V. contributed to the study design, histopathological evaluation, supervision of the project, critical revision of the manuscript for important intellectual content, and final approval of the version to be published. Both authors participated in the data analysis, approved the final manuscript, and agree to be accountable for all the aspects of the work.

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