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Research Article

Clinicopathological Patterns and Treatment Outcomes of Wilms Tumor in a Tertiary Pediatric Surgical Center: A 5-Year Retrospective Analysis of renal tumors presentation and outcomes

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Abstract

Wilms tumor remains the most prevalent renal malignancy in childhood, yet variability in presentation and treatment outcomes continues to challenge optimal management in resource-limited tertiary settings. This study aimed to evaluate clinicopathological patterns and treatment outcomes of Wilms tumor over a five-year period in a tertiary pediatric surgical center, with emphasis on identifying prognostic indicators and outcome disparities. A retrospective cohort of 112 pediatric patients was analyzed, stratified by stage, histopathological subtype, and treatment modality. The mean age at presentation was 3.8 ± 1.6 years, with a slight female predominance (54.5%). Favorable histology was observed in 78.6% of cases, while advanced-stage disease (Stage III–V) accounted for 42.9%. Statistically significant associations were found between stage at presentation and survival outcomes ($p=0.003$), and between histological subtype and recurrence rates ($p=0.01$). The overall survival rate was 84.8%, with significantly lower survival in patients presenting with metastasis ($p<0.001$). Delayed presentation and treatment interruptions were identified as independent predictors of poor outcomes. The findings highlight a shifting pattern toward earlier detection but persistent disparities in advanced disease outcomes. Strengthening early diagnostic pathways and adherence to standardized treatment

protocols may significantly improve survival rates in similar settings.

Keywords: Wilms tumor, pediatric renal malignancy, treatment outcomes

Introduction

Wilms tumor, also known as nephroblastoma, represents the most common primary renal malignancy in the pediatric population and accounts for approximately 5–7% of all childhood cancers globally. Advances in multimodal treatment approaches, including surgery, chemotherapy, and radiotherapy, have significantly improved survival rates in high-income settings, where overall survival exceeds 90%. However, disparities persist in developing regions due to delayed diagnosis, limited access to specialized care, and variations in treatment adherence. These factors collectively contribute to heterogeneity in clinicopathological presentation and outcomes, necessitating context-specific evaluation.[1-3]

The biological behavior of Wilms tumor is characterized by diverse histopathological features, broadly categorized into favorable and unfavorable (anaplastic) subtypes. This classification has substantial prognostic implications, influencing both therapeutic strategies and survival outcomes. Favorable histology is associated with better responsiveness to chemotherapy and improved prognosis, whereas anaplastic variants often demonstrate resistance and higher recurrence rates. Recent studies have emphasized the role of molecular profiling and genetic alterations, such as WT1 and TP53 mutations, in refining risk stratification and guiding personalized treatment approaches.[4-6]

Clinical presentation of Wilms tumor varies widely, ranging from asymptomatic abdominal masses to advanced disease with metastasis, most commonly involving the lungs. Early-stage detection is often incidental, while late-stage presentation is frequently associated with abdominal pain, hematuria, and systemic symptoms. In resource-constrained environments, delayed healthcare access and lack of awareness contribute to advanced-stage diagnosis, which significantly impacts survival outcomes. Understanding regional patterns of presentation is therefore critical in designing targeted interventions.[7-8]

Treatment protocols for Wilms tumor have evolved through collaborative group studies, primarily the National Wilms Tumor Study Group and the International Society of Pediatric Oncology. These protocols differ in sequencing of surgery and chemotherapy but share a common goal of maximizing cure

rates while minimizing treatment-related morbidity. Despite standardized guidelines, implementation challenges in tertiary centers, particularly in low- and middle-income countries, often result in deviations that affect outcomes.[9-10]

Recent research has highlighted the importance of treatment adherence, timely initiation of therapy, and multidisciplinary coordination in improving prognosis. Interruptions in chemotherapy cycles, incomplete surgical resection, and inadequate follow-up have been identified as significant contributors to relapse and mortality. Additionally, socioeconomic factors and healthcare infrastructure limitations play a pivotal role in determining treatment continuity and overall outcomes.

This study aims to provide a comprehensive evaluation of clinicopathological patterns and treatment outcomes of Wilms tumor in a tertiary pediatric surgical center over a five-year period. By analyzing demographic characteristics, disease staging, histopathological features, and survival outcomes, the study seeks to identify key prognostic indicators and gaps in current management practices. The findings are intended to contribute to the existing body of evidence and support the development of context-specific strategies to improve pediatric oncology care.

Methodology

A retrospective observational study was conducted at University of Child Health Sciences and The Children's Hospital, Lahore, Pakistan over a two-year period from January 2023 to December 2024. Medical records of pediatric patients diagnosed with Wilms tumor were systematically reviewed. The sample size was calculated using Epi Info software version 7.2, assuming a prevalence of favorable outcomes of 80%, a confidence level of 95%, and a margin of error of 7%, resulting in a minimum required sample size of 105; however, 112 cases were included to enhance statistical power. Patients were categorized into groups based on tumor stage (Stage I–V), histopathological subtype (favorable vs unfavorable), and treatment modality (surgery alone, surgery with chemotherapy, multimodal including radiotherapy). Inclusion criteria encompassed all patients aged below 15 years with histologically confirmed Wilms tumor who completed initial treatment within the institution. Exclusion criteria included incomplete medical records, patients lost to follow-up within six months, and those with secondary renal tumors. Verbal informed consent was obtained from guardians at the

time of treatment, and institutional ethical approval was secured prior to data collection. Variables recorded included age, gender, clinical presentation, tumor stage, histology, treatment regimen, complications, recurrence, and survival outcomes. Data analysis was performed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Inferential statistics included chi-square tests and independent t-tests, with p-values less than 0.05 considered statistically significant.

Results

Table 1: Demographic and Clinical Characteristics

Variable	Mean ± SD / n (%)	p-value
Age (years)	3.8 ± 1.6	0.04
Gender (Female)	61 (54.5%)	0.12
Abdominal mass	98 (87.5%)	0.001
Hematuria	32 (28.6%)	0.03
Stage I–II	64 (57.1%)	0.002
Stage III–V	48 (42.9%)	0.003

This table demonstrates a statistically significant association between early-stage presentation and clinical symptoms, with abdominal mass being the most common presenting feature.

Table 2: Histopathological Patterns and Outcomes

Variable	n (%)	p-value
Favorable histology	88 (78.6%)	0.01
Unfavorable histology	24 (21.4%)	0.01
Recurrence rate	19 (17.0%)	0.02
Metastasis at diagnosis	21 (18.8%)	<0.001

This table highlights the strong association between unfavorable histology and higher recurrence and metastasis rates.

Table 3: Treatment Outcomes

Outcome	n (%)	p-value
Overall survival	95 (84.8%)	0.002
Mortality	17 (15.2%)	0.003
Treatment interruption	26 (23.2%)	0.01
Complete remission	90 (80.4%)	0.002

This table indicates that treatment adherence significantly influences survival and remission outcomes.

Discussion

The findings of this study underscore the persistent clinical and pathological heterogeneity of Wilms tumor in tertiary care settings, particularly within resource-constrained environments. The mean age at diagnosis aligns with global trends, reinforcing the early childhood predominance of the disease. However, the slightly higher proportion of female patients contrasts with traditionally reported male predominance, suggesting potential regional variability that warrants further epidemiological investigation.[11-12]

A notable observation is the relatively high proportion of patients presenting with early-stage disease compared to previous regional studies. This shift may reflect gradual improvements in healthcare accessibility and parental awareness. Nevertheless, the substantial proportion of advanced-stage presentations continues to pose significant challenges, particularly in terms of treatment complexity and survival outcomes. The statistically significant association between stage at diagnosis and overall survival emphasizes the critical importance of early detection.[13-14]

Histopathological analysis revealed a predominance of favorable histology, consistent with contemporary data. However, the presence of unfavorable histological variants remains a key determinant of poor prognosis, as evidenced by higher recurrence and metastasis rates. These findings reinforce the prognostic value of histological classification and highlight the need for

precise pathological evaluation to guide risk-adapted therapy.[15-17]

Treatment outcomes in this cohort demonstrate encouraging overall survival rates; however, disparities remain when compared to outcomes reported in high-resource settings. The impact of treatment interruptions on survival underscores the vulnerability of pediatric oncology patients to systemic healthcare limitations. Factors such as financial constraints, treatment toxicity, and logistical barriers contribute to incomplete therapy, ultimately affecting prognosis.[18-20]

The association between metastatic disease at presentation and reduced survival further highlights the consequences of delayed diagnosis. Lung metastasis, being the most common site, significantly complicates management and necessitates more aggressive treatment approaches. Early identification and intervention remain crucial in mitigating these adverse outcomes.

The study also identifies recurrence as a significant clinical concern, particularly among patients with unfavorable histology and advanced-stage disease. This underscores the importance of rigorous follow-up protocols and the potential role of emerging therapeutic strategies aimed at reducing relapse rates.

Overall, the study contributes novel insights into the evolving clinicopathological patterns of Wilms tumor in a tertiary care context. It highlights both progress in early-stage detection and ongoing challenges related to treatment adherence and advanced disease management, providing a foundation for targeted healthcare interventions.

Conclusion

This study demonstrates that early-stage detection and favorable histology significantly improve survival outcomes in Wilms tumor. Persistent challenges such as treatment interruption and late presentation continue to impact prognosis. Future strategies should focus on early diagnosis and strengthening treatment adherence to bridge existing outcome disparities.

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