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Patterns of Presentation, Histopathology, and Outcomes of Wilms Tumor in Children: Experience from a Tertiary Care Hospital

By

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Abstract

Background: *Wilms tumor is the most common malignant renal neoplasm in childhood and remains a major contributor to pediatric cancer morbidity and mortality, particularly in low- and middle-income countries where delayed diagnosis and treatment abandonment continue to affect outcomes. Despite substantial improvements in multimodal therapy, variations in clinical presentation, histopathological characteristics, and survival outcomes remain evident across different healthcare settings.*

Objective: *To evaluate the patterns of clinical presentation, histopathological characteristics, treatment outcomes, and factors associated with prognosis among children diagnosed with Wilms tumor at a tertiary care hospital.*

Methods: *A prospective observational study was conducted among 120 pediatric patients diagnosed with Wilms tumor. Clinical characteristics, radiological findings, histopathological patterns, tumor staging, treatment modalities, and outcomes were analyzed. Histopathological classification was performed according to the International Society of Pediatric Oncology criteria. Statistical analysis was performed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Associations between clinicopathological variables and outcomes were assessed using chi-square and independent t-tests.*

Results: *The mean age at diagnosis was 4.8 ± 2.1 years, with a male predominance (56.7%). Abdominal mass was the most common presenting symptom (78.3%), followed by abdominal pain (45.8%), hematuria (18.3%), and hypertension (15.8%). Favorable histology was identified in 82.5% of patients, whereas anaplastic histology was observed in 17.5%. Stage III disease constituted the largest proportion (35.8%), followed by Stage II (30.0%), Stage IV (18.3%), Stage I (12.5%), and Stage V (3.4%). Overall survival was 88.3%, while event-free survival reached 84.2%. Advanced stage disease and unfavorable histology demonstrated significant associations with mortality and recurrence ($p<0.001$).*

Conclusion: *Wilms tumor predominantly presents as an abdominal mass in early childhood. Favorable histology remains the most common subtype and is associated with improved survival. Early diagnosis, risk-adapted treatment, and multidisciplinary management significantly improve outcomes. The findings highlight the importance of prompt referral and optimized oncologic care pathways in tertiary healthcare settings.*

Keywords: *Wilms Tumor, Histopathology, Pediatric Oncology*

INTRODUCTION

Wilms tumor, also known as nephroblastoma, is the most common primary malignant renal tumor of childhood and accounts for approximately 90% of all pediatric kidney malignancies. It represents nearly 5–7% of all childhood cancers worldwide and remains one of the most extensively studied solid tumors in pediatric oncology. Significant advances in surgical techniques, chemotherapy protocols, radiotherapy planning, and supportive care have substantially improved survival rates over recent decades. Nevertheless, disparities in clinical presentation, disease stage at diagnosis,

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treatment accessibility, and long-term outcomes continue to exist, particularly in developing countries where delayed healthcare access remains a significant challenge [1-2].

The disease predominantly affects children younger than five years of age, with the highest incidence reported between two and five years. Although the exact etiology remains incompletely understood, multiple genetic alterations have been implicated in tumorigenesis, including mutations involving WT1, WT2, CTNNB1, and TP53 genes. Certain congenital syndromes such as WAGR syndrome, Beckwith-Wiedemann syndrome, and Denys-Drash syndrome are recognized risk factors for the development of Wilms tumor. These genetic associations have contributed significantly to understanding the molecular mechanisms underlying nephroblastoma development and progression [2-4].

The clinical presentation of Wilms tumor varies considerably among patients. Most children present with a painless abdominal mass detected incidentally by caregivers. Other manifestations may include abdominal pain, hematuria, fever, hypertension, weight loss, anorexia, and respiratory symptoms secondary to pulmonary metastases. In resource-limited settings, delayed recognition of symptoms frequently results in advanced-stage disease at presentation, thereby negatively affecting prognosis. The identification of common presentation patterns within specific populations remains essential for promoting early diagnosis and timely referral [4-6].

Histopathological examination remains the cornerstone for definitive diagnosis and risk stratification. The histological classification of Wilms tumor broadly categorizes tumors into favorable and unfavorable histology. Favorable histology, characterized by the classic triphasic pattern comprising blastemal, epithelial, and stromal components, is associated with excellent treatment outcomes. In contrast, diffuse anaplasia and unfavorable histological variants are associated with increased resistance to therapy and poorer survival outcomes. The prognostic significance of histological subtype has been consistently demonstrated across international treatment protocols and continues to guide therapeutic decision-making [5-7].

Tumor staging is another critical determinant of prognosis and treatment planning. International staging systems classify disease based on local extension, lymph node involvement, residual tumor burden, and distant metastasis. Patients presenting with Stage I and Stage II disease generally demonstrate excellent survival rates exceeding 90%, whereas outcomes decline among those with Stage III, IV, and bilateral Stage V disease. Consequently, accurate staging through clinical evaluation, imaging studies, surgical assessment, and pathological examination is fundamental for optimizing management strategies [6-8].

The treatment of Wilms tumor requires a multidisciplinary approach involving pediatric surgeons, oncologists, radiologists, pathologists, and radiation oncologists. Current management protocols employ combinations of nephrectomy, chemotherapy, and radiotherapy according to stage and histological risk group. Advances in risk-adapted therapy have significantly reduced treatment-related toxicity while maintaining high cure rates. However, recurrence, treatment abandonment, chemotherapy resistance, and late complications remain ongoing concerns in pediatric oncology practice [7-9].

Recent studies have emphasized the importance of evaluating institutional experiences to identify local patterns of disease presentation, histopathological distribution, treatment responses, and survival outcomes. Such analyses provide valuable insights into healthcare delivery effectiveness and facilitate comparisons with international benchmarks. Furthermore, understanding factors associated with adverse outcomes can support the development of targeted interventions aimed at improving survival and quality of care [8-10].

Despite substantial improvements in treatment outcomes globally, limited contemporary data are available regarding the clinicopathological characteristics and outcomes of Wilms tumor in many tertiary care hospitals. Variations in socioeconomic conditions, healthcare infrastructure, diagnostic facilities, and treatment adherence may significantly influence patient outcomes. Therefore, continuous evaluation of institutional experiences remains essential for identifying gaps in care and informing evidence-based clinical practice [9].

The present study was conducted to assess the patterns of clinical presentation, histopathological characteristics, and treatment outcomes among children diagnosed with Wilms tumor at a tertiary care hospital. Additionally, the study aimed to determine the relationship between clinicopathological variables and survival outcomes, thereby contributing to the growing body of evidence regarding pediatric renal malignancies and supporting efforts to optimize patient management strategies [10].

METHODOLOGY

A prospective observational study was conducted at M.Islam Medical and Dental College. The study included pediatric patients diagnosed with Wilms tumor based on radiological findings and histopathological confirmation following nephrectomy or biopsy. Ethical approval was obtained from the Institutional Review Board before commencement of data collection. Verbal informed consent was obtained from parents or legal guardians after explanation of study objectives, procedures, confidentiality measures, and voluntary participation.

The sample size was calculated using Epi Info version 7.2. Assuming a prevalence of favorable histology of 80%, confidence level of 95%, margin of error of 7%, and statistical power of 80%, the minimum calculated sample size was 110 participants. To compensate for potential losses during follow-up and incomplete data, 120 patients were enrolled consecutively.

Children aged less than 15 years with newly diagnosed and histopathologically confirmed Wilms tumor were included in

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the study. Patients with recurrent Wilms tumor diagnosed before the study period, other renal malignancies, incomplete histopathological records, or refusal of consent were excluded. Demographic characteristics including age, sex, residence, nutritional status, family history of malignancy, and duration of symptoms were recorded using a structured data collection form.

Clinical presentation variables included abdominal mass, abdominal pain, hematuria, fever, hypertension, weight loss, anorexia, and respiratory symptoms. Diagnostic investigations comprised abdominal ultrasonography, contrast-enhanced computed tomography, chest imaging, complete blood count, renal function tests, and liver function assessment. Tumors were staged according to established pediatric oncology staging guidelines.

Histopathological evaluation was performed by experienced pediatric pathologists. Tumors were classified into favorable histology and unfavorable histology groups based on microscopic examination. Additional pathological variables including capsular invasion, lymph node involvement, vascular invasion, necrosis, and anaplasia were documented.

Treatment protocols consisted of radical nephrectomy followed by stage-specific chemotherapy. Radiotherapy was administered when indicated according to disease stage and pathological findings. Patients were followed regularly through outpatient visits and hospital records. Follow-up outcomes included treatment completion, recurrence, mortality, overall survival, and event-free survival.

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Independent sample t-tests were used to compare continuous variables between outcome groups. Chi-square tests were employed for categorical data analysis. Survival outcomes were assessed using Kaplan-Meier analysis. A p-value less than 0.05 was considered statistically significant.

RESULTS

Table 1. Demographic and Baseline Characteristics of Patients (n=120)

Variable	Frequency (%)
Age (years), Mean ± SD	4.8 ± 2.1
Male	68 (56.7)
Female	52 (43.3)
Urban Residence	72 (60.0)
Rural Residence	48 (40.0)
Underweight	39 (32.5)
Family History of Malignancy	12 (10.0)
Duration of Symptoms (weeks), Mean ± SD	7.4 ± 3.2

Explanation: The majority of patients were male and younger than five years of age. Delayed presentation was evident from the average symptom duration of more than seven weeks before diagnosis.

Table 2. Clinical Presentation Patterns

Clinical Feature	Frequency (%)
Abdominal Mass	94 (78.3)
Abdominal Pain	55 (45.8)
Hematuria	22 (18.3)
Fever	31 (25.8)
Hypertension	19 (15.8)
Weight Loss	28 (23.3)
Anorexia	34 (28.3)
Respiratory Symptoms	11 (9.2)

Explanation: Abdominal mass represented the predominant presenting symptom followed by abdominal pain. Systemic manifestations were less common but frequently associated with advanced disease.

Table 3. Histopathological Characteristics and Disease Stage

Variable	Frequency (%)
Favorable Histology	99 (82.5)
Unfavorable Histology	21 (17.5)
Stage I	15 (12.5)
Stage II	36 (30.0)

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Variable	Frequency (%)
Stage III	43 (35.8)
Stage IV	22 (18.3)
Stage V	4 (3.4)
Lymph Node Involvement	27 (22.5)
Vascular Invasion	18 (15.0)

Explanation: Favorable histology was the dominant pathological subtype. Stage III disease constituted the largest proportion, indicating delayed presentation in a significant number of patients.

Table 4. Factors Associated with Mortality and Recurrence

Variable	Survivors (n=106)	Non-Survivors (n=14)	p-value
Age (years)	4.6 ± 2.0	6.2 ± 2.5	0.012
Favorable Histology (%)	92 (86.8)	7 (50.0)	<0.001
Stage III-IV-V (%)	55 (51.9)	14 (100.0)	<0.001
Lymph Node Involvement (%)	18 (17.0)	9 (64.3)	<0.001
Recurrence (%)	10 (9.4)	8 (57.1)	<0.001

Explanation: Advanced disease stage, unfavorable histology, recurrence, and lymph node involvement were significantly associated with poor outcomes and mortality.

DISCUSSION

The present study evaluated the patterns of presentation, histopathological characteristics, and treatment outcomes of Wilms tumor among children managed at a tertiary care hospital. The findings demonstrated that Wilms tumor predominantly affected children younger than five years of age, with a slight male predominance. These observations are consistent with contemporary epidemiological reports indicating peak disease incidence during early childhood and a relatively balanced sex distribution. The mean age of 4.8 years observed in this study corresponds closely with recent international data and supports the understanding that Wilms tumor remains primarily a malignancy of early renal development [11-12].

Abdominal mass was identified as the most common presenting feature, occurring in more than three-quarters of patients. This finding is consistent with reports from both developed and developing healthcare settings, where painless abdominal swelling remains the hallmark clinical manifestation of nephroblastoma. The relatively high frequency of abdominal pain, anorexia, and constitutional symptoms observed in the present cohort may reflect delayed healthcare-seeking behavior and progression of disease prior to diagnosis. Similar observations have been reported in recent pediatric oncology studies, where delayed presentation remains a significant contributor to advanced-stage disease at diagnosis [12-13].

A notable finding of this study was the predominance of Stage III disease at presentation. Although improvements in awareness and diagnostic imaging have facilitated earlier detection in many healthcare systems, advanced-stage disease continues to represent a substantial proportion of Wilms tumor cases in tertiary referral centers. The predominance of Stage III and Stage IV disease in this cohort suggests ongoing challenges related to referral pathways, access to specialist care, and recognition of early warning signs. Previous investigations have similarly demonstrated that delayed diagnosis is associated with larger tumor burden, increased risk of metastasis, and inferior survival outcomes [13-14].

Histopathological analysis revealed that favorable histology constituted 82.5% of all tumors, while unfavorable histology accounted for 17.5%. These findings are consistent with contemporary international treatment databases in which favorable histology typically represents approximately 80–90% of cases. The predominance of favorable histology likely contributed to the relatively high overall survival observed in the present study. Nevertheless, patients with unfavorable histology experienced significantly worse outcomes, highlighting the continued prognostic importance of pathological classification in risk-adapted treatment protocols [14-15].

The association between advanced stage disease and poor clinical outcomes was highly significant in this investigation. All non-survivors presented with Stage III, IV, or V disease, emphasizing the critical role of disease extent in determining prognosis. Advanced-stage tumors are more likely to exhibit local invasion, nodal involvement, vascular extension, and distant metastasis, all of which complicate treatment and increase the likelihood of recurrence. Similar relationships between tumor stage and survival have been consistently reported in contemporary pediatric oncology literature and continue to guide treatment stratification strategies worldwide [15-16].

Lymph node involvement emerged as another significant predictor of adverse outcomes. Patients with nodal metastasis demonstrated substantially higher mortality rates compared with those without lymphatic spread. This finding aligns with recent studies demonstrating that lymph node status serves as

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an independent prognostic marker even after adjustment for stage and histological subtype. Comprehensive surgical staging and meticulous pathological assessment therefore remain essential components of optimal disease management [16-17].

The overall survival rate of 88.3% and event-free survival rate of 84.2% observed in the present study compare favorably with outcomes reported by many contemporary tertiary care centers. These encouraging results likely reflect the effectiveness of multimodal treatment strategies incorporating surgery, chemotherapy, and selective radiotherapy. However, survival outcomes remain lower than those reported in some high-income healthcare systems, where survival frequently exceeds 90–95%. Continued efforts to improve early diagnosis, treatment adherence, supportive care, and long-term follow-up may further enhance outcomes among children with Wilms tumor. The findings of this study therefore reinforce the importance of multidisciplinary management and support ongoing initiatives aimed at reducing disparities in pediatric cancer care [18-20].

CONCLUSION

Wilms tumor most commonly presented as an abdominal mass in children younger than five years, with favorable histology representing the predominant pathological subtype. Advanced-stage disease, unfavorable histology, lymph node involvement, and recurrence were significant predictors of poor outcomes. Early diagnosis, accurate pathological assessment, and multidisciplinary treatment remain essential for improving survival and reducing disease-related mortality in pediatric patients.

Authors' contribution:
1st Author: Draft of article, Results, Discussion
2nd Author: Data Collection, Discussion writing
3rd Author: Setting of Reference
4th Author: Introduction write-up
5th Author: Literature Searching

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