DOI: https://doi.org/10.53350/pjmhs211582057

ORIGINAL ARTICLE

Accuracy of MRI in the Differential Diagnosis of Wilms Tumor

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ABSTRACT

Background & Objective: Renal tumors are a common finding in diagnostic imaging; these lesions usually are solid or cystic, benign or malignant, and the correct diagnosis may be difficult. The current study aims at to determine the diagnostic accuracy of magnetic resonance imaging for the diagnosis of Wilms tumor taking histopathology as gold standard.

Methodology: This cross-sectional study was carried at the Department of Radiology, The Children's Hospital & Institute of Child Health Lahore over 6 months from March 2019 to September 2019. The study involved 125 children of both genders aged between 2 years to 14 years presenting with a neoplastic mass in the retroperitoneum on ultrasound abdomen during initial workup. These children were assessed on MRI for the diagnosis of Wilms tumor. Later the diagnosis was confirmed on histopathology which was taken as gold standard and the diagnosis of MRI was judged accordingly as true/false and positive/negative. A written informed consent was obtained from every patient.

Results: The mean age of the children was 5.8±3.9 years having a male predominance with male to female ratio of 1.8:1. Wilms tumor was suspected in 13 (10.4%) children on MRI. The diagnosis of Wilms tumor was confirmed in 13 (10.4%) children on histopathology. MRI was found to be 76.9% sensitive, 97.3% specific and 95.2% accurate with positive and negative predictive values of 76.9% and 97.3% respectively.

Conclusion: In the present study, MRI was found to be 95.2% accurate in the differential diagnosis of Wilms tumor in children presenting with retroperitoneal mass which along with its non-invasive and radiation free nature advocates the preferred use of MRI in the diagnostic evaluation of such children in future oncologic practice.

Keywords: Retroperitoneal Tumor, Wilms Tumor, MRI, Diagnostic Accuracy

INTRODUCTION

In pediatric age group, most common renal cancer is nephroblastoma which is overall fourth common pediatric cancer. It was named as Wilms tumor (WT) after name of Dr. Max Wilms who was a German physician and first to describe it in 1899[1,2]. Exact cause of Wilms tumor is not yet known however it is supposed to be an outcome of genetic alterations dealing with genitourinary tract development of a normal embryo[2]. Few genetic markers related with Wilms tumor are CTNNB1, WTX and WT1 gene alterations that have been noted in about 1/3rd of total Wilms tumor patients[1,3].

Annually about 500 new cases are reported in the US and its occurrence is uniform throughout the world[4]. In Pakistan, 28.3% of all the pediatric cases in oncology are Wilms tumor[5]. Its successful treatment demands correct staging of tumor, meticulous attention and joint efforts between specialist surgeons, pathologists, oncologists, radiologists and radiation oncologists. With advancements in chemotherapy, its survival rate is as good as 92% in the US; however, it is about 78% in developing countries with limited resources[6,7].

The gold standard for the diagnosis of Wilms tumor is histopathologic examination of the tissue biopsied from lesion. On histopathology, WT has two categories i.e. classic nephroblastoma and anaplastic WT. Histological components of former are blastemal, epithelial and stromal cells, out of which any one may be predominant or all have equal proportion. While in the later, tumor cells contain hyperchromasia with enlarged cells, multipolar mitotic figures, or nuclei having size three times larger than adjacent cells[8]. However, due to invasive nature of the biopsy, there is need for non-invasive diagnostic methods[9]. Use of magnetic resonance imaging (MRI) is increasing in pediatric oncology owing to fast scanning technique, best soft tissue contrast, accuracy in depicting primary tumor along with its renal origin and relation between tumor and other organs. Especially when the pediatric patient is suspected with bilateral renal lesions, MRI is highly helpful as it reduces exposure to radiations[10,11].

Dombrovskii[12] (2001) reported diagnostic accuracy of MRI to be 91.1% in detection of Wilms tumor that recommends adoption of MRI in diagnosing Wilms tumor over other conventional techniques. But, Cox et al.[13] (2014) reported that MRI alone was not able to distinguish between WT and other lesions and necessitated continued vigilance. One of the probable limitations with both the studies was small sample size. Moreover, no other local or international such published material was available. Therefore, this study was aimed to determine the diagnostic accuracy of MRI for diagnosis of Wilms tumor taking histopathology as gold standard. This study was conducted over a large sample size in local settings so that results of this study may help in the selection of more appropriate diagnostic approach among such patients in future practice.

Received on 24-01-2021
Accepted on 16-07-2021

METHODOLOGY

This cross sectional survey was conducted from March 2019 to September 2019 at radiology department of the Children's Hospital & Institute of Child Health, Lahore. With expected accuracy of MRI as 91.1%, sample size of 125 children was calculated with 5% margin of error and 95% confidence interval[12]. Children from both the genders having age between 2-14 years already diagnosed of retroperitoneal neoplasm on ultrasound and planned to undergo biopsy were included after taking written informed consent to participate in the study. However, children having medical record of recurrent disease and/ or malignancy in other body parts were excluded. Demographic details i.e. age and gender was noted. MRI of all the patients was done by a single senior radiologist. On the basis of findings of MRI, cases were labeled as negative or positive. Wilms tumor was diagnosed on MRI if there was slice thickness ≤5mm, "fat-suppressed T2-weighted images in at least two planes, pre-contrast T1-weighted image in at least one plane and post-contrast T1-weighted images with fat saturation in two planes". After that, biopsy was performed in all these children. Negative and positive cases were further confirmed by sending samples to pathology department. Comparative analysis was made between these reports and MRI and findings were recorded in the proforma as true/false and positive/negative. Patient's age has represented by Mean±SD. Wilm's tumor (both on MRI and histopathology) and gender has been shown in frequency and percentage. Diagnostic accuracy of MRI has been calculated taking histopathologic findings as gold standard.

RESULTS

The demographic information of the children included in this study has been summarized in Table-I. Wilms tumor was suspected in 13 (10.4%) children on MRI. The diagnosis of Wilms tumor was confirmed in 13 (10.4%) children on histopathology. There were 10 true positive, 3 false positive, 3 false negative and 112 true negative cases which yielded 76.9% sensitivity, 97.3% specificity and 95.2% accuracy with positive and negative predictive values of 76.9% and 97.3% respectively for MRI in the diagnosis of Wilms tumor taking histopathology as gold standard as shown in Table-II.

Table-I: Demographic features of studied children

Characteristics	Participants (n=125)
Age (years)	5.8±3.9
• ≤5 years	74 (59.2%)
• >5 years	51 (40.8%)
Gender	
• Male	81 (64.8%)
• Female	44 (35.2%)

Table-II: Diagnosis of Wilms tumor on MRI and histopathology

MRI	Histopathology		Total
	Yes	No	
Yes	10[a]	3[c]	13
No	3[b]	109[d]	112
Total	13	112	125

[a]True Positive = 10, [c]False Positive = 3, [b]False Negative = 3, [d]True Negative = 109

Statistic	Formula	Value
Sensitivity	$\frac{a}{a+b}$	76.9%
Specificity	$\frac{d}{c+d}$	97.3%
Accuracy	$\frac{a+d}{a+b+c+d}$	95.2%
Disease prevalence	$\frac{a+b}{a+b+c+d}$	10.4%
Positive Predictive Value	$\frac{a}{a+c}$	76.9%
Negative Predictive Value	$\frac{d}{b+d}$	97.3%

DISCUSSION

About 40% of pediatric abdominal masses are due to anomalies of development, neoplasms, or inflammatory conditions[1]. Definitive treatment strategy can only be made once benign or malignant nature of lesion is ascertained which requires tissue biopsy. However, it's an invasive procedure and is therefore mostly performed after surgical excision of the mass[9]. But malignancy diagnosed after the surgical excision greatly affects the prognosis. Thus there is need to develop methods of early and pre-operative diagnosis of malignancy so that extent of surgery and appropriate treatment approach can be planned[9]. MRI is widely acknowledged as a non-invasive and radiation free diagnostic tool with good soft tissue contrast in the diagnostic evaluation of neoplastic and inflammatory conditions[10,11]. The present study was an assessment of diagnostic performance of MRI in the differential diagnosis of Wilms tumor in children presenting with retroperitoneal mass.

In the present study, the mean age of the children was 5.8±3.9 years having a male predominance with male to female ratio of 1.8:1. Majority (59.2%) of the children were aged under 5 years. Our observation is in line with that of Younas et al.[14] (2020) who also reported similar male predominance with male to female ratio of 1.9:1 among children presenting with abdominal mass at Lady Reading Hospital, Peshawar. They also observed similar frequency of ≤5 year's age group (60.3%) in such children. Our observation is also in line with that of Jabbar et al.[15] (2018) who reported similar mean age of 5.4±4.4 years among such children at The Children's Hospital, Lahore with a male to female ratio of 1.6:1. In another study conducted at The Children's Hospital Lahore, Faizan et al.[16] (2018) reported similar higher proportion of males (m:f; 1.7:1) and under 5 years age group (59.0%) among children presenting with abdominal mass. In a similar study conducted at Aga Khan University Hospital, Karachi, Jawaid et al.[17] (2016) also observed similar mean age of 5.6±3.8 years among such children with 58.1% children aged 5 years and under. They too observed similar male

predominance among such children with male to female ratio of 1.5:1. Our results also match with those of Indian studies where Gupta et al.[18] (2018) and Mohan et al.[19] (2017) observed comparable higher proportion of under 5 year age group and reported it to be 58.0% and 59.9% respectively while Khan et al.[20] (2015) and Sharma et al.[21] (2014) reported similar male predominance with male to female ratio of 1.9:1 and 2:1 respectively among such children. In a similar study involving Iranian children with adnominal mass, Zareifar et al.[22] (2016) reported comparable mean age of 4.8±4.2 years with similar higher proportion of males (1.9:1) and under 5 years age group (62.4%). A comparable mean age of 6.1±5.2 years has been reported by Oh et al.[23] (2016) in Chinese children with abdominal mass while Solomon et al.[24] (2017) observed similar higher proportion of under 5 years children in Ethiopia.

Contrary to the previous study by Dombrovskii[12] (2001) who reported MRI to be 100% sensitive, 77.8% specific and 91.1% accurate in the detection of Wilms tumor, in the present study, MRI was found to be 76.9% sensitive, 97.3% specific and 95.2% accurate with positive and negative predictive values of 76.9% and 97.3% respectively in the diagnosis of Wilms tumor. A high accuracy of MRI advocates its preferred use in the non-invasive diagnosis of Wilms tumor. A relatively low sensitivity and high specificity means it can be a reliable tool in the differential diagnosis.

The present study is first of its kind in local population and adds to the limited already published research evidence on the topic. The present study favors the use of MRI in the non-invasive diagnostic workup of children with retroperitoneal mass as it can aid in the diagnosis without exposing the patient to undue radiations. A very strong limitation to the present study was that we didn't compared the diagnostic performance of MRI with other modalities like USG and CT which could have further helped in the selection of more appropriate tool in the diagnostic workup of children with retroperitoneal mass. Such a study is highly recommended in future clinical research.

CONCLUSION

In the present study, MRI was found to be 95.2% accurate in the differential diagnosis of Wilms tumor in children presenting with retroperitoneal mass which along with its non-invasive and radiation free nature advocates the preferred use of MRI in the diagnostic evaluation of such children in future oncologic practice.

Acknowledgement: None
Conflict of Interest: All authors disclose no conflict of interest.
Grant Support & Financial Disclosures: None

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