Original Article

Ultrasonography in the Diagnosis of Wilms' Tumor in Children

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ABSTRACT

Background: *Ultrasound is a noninvasive imaging modality aids in diagnosis of abdominal complicacy without any potentially damage of paediatric patients. Wilms' tumor is the second most common abdominal tumor in childhood and the most common primary pediatric renal malignancy.*

Objective: *The present study aims to evaluate the effectiveness of abdominal ultrasonography (USG) in the diagnosis of Wilms' tumor and compare the results of USG with those of other methods.*

Materials and methods: *This descriptive, cross-sectional study was carried out in the Department of Paediatric Surgery of Mymensingh Medical College Hospital, Mymensingh, Bangladesh, from June 2015 to September 2016. A total of thirty patients with palpable abdominal masses in children were selected in this study. Among them, eighteen were male and twelve were female. Age ranged between 6 months and 12 years. Among thirty patients, twenty-five were operated and remaining five were inoperable and underwent enhanced abdominal CT scan.*

Results: *The results suggested that the predominance of male over female in the ratio of 3:2. This study confirms that Wilms' tumor accounted for 30%. The sensitivity of ultrasonogram is 96.30% and the specificity is 60%. The positive predictive value is 92.86% and negative predictive value is 75% and the overall diagnostic accuracy of this series is 90.62%. In this study false positive rate of ultrasonogram diagnosis is 6.66% and false negative rate of ultrasonogram diagnosis is 3.33%.*

Conclusion: *Ultrasonography is a non-invasive, safe, inexpensive, and rapid diagnostic tool for determination of Wilms' tumor. It may be the first line of investigation in the evaluation of Wilms' tumor in paediatric surgical practice.*

Keywords: *Ultrasonography, Wilms' tumor, abdominal mass*

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INTRODUCTION

Diagnostic ultrasound is an imaging modality to locate and measure interfaces between different organs and tissues and to cut cross-sectional through different structures. In contrast to image casuistic in different places give direct information, ultrasound enables us to outline the lesion directly and to investigate its relationship with neighboring structures. There is no need for administration of any radiologic contrast possibly harmful to the function of the impaired organ. Ultrasound, both as a screening and diagnostic tool, is a non-invasive and atraumatic procedure, and may be substituted for angiography in many cases. The major feature that is unique to ultrasound is the ability to recognize and verify deep body organs and lesions having similar density on conventional x-ray studies.

Ultrasound is a noninvasive imaging modality that aids in diagnosis without the potentially damaging effects of ionizing radiation, a particularly important consideration in the evaluation of pediatric patients. Ultrasound is widely available, easy to use, and reliable; it is therefore the imaging method of choice in evaluating most known or suspected abdominal masses in neonates or older children. This article focuses on the clinical and sonographic features of selected common abdominal masses in infants and children. The authors highlight the important clinical characteristic of these abdominal masses and specific sonographic imaging features that allow clinicians to differentiate among the common abdominal masses in paediatric patients[1].

Wilms' tumor is the second most common abdominal tumor in childhood and the most common primary pediatric renal malignancy. It is an embryonal renal neoplasm, with 450 new cases reported annually in the United States. Presentations include a flank or abdominal mass, left-sided varicocele, hematuria, and hypertension. Such masses can be quite large at diagnosis because they can go unnoticed due to their retroperitoneal location and are usually painless unless hemorrhage or rupture occurs. Wilms' tumor may occur in association with other congenital anomalies or syndromes including sporadic aniridia, isolated hemihypertrophy, cryptorchidism, Beckwith-Wiedemann syndrome, Denys-Drash syndrome, and WAGR complex (Wilms' tumor, Aniridia, Genitourinary malformations, Mental retardation).[2] In such associations, Wilms' tumor is more likely to be bilateral and may present at a younger age. Approximately 15% of patients will have metastatic disease at diagnosis, most commonly affecting the lungs followed by the liver and regional lymph nodes. Sonography is the best initial imaging technique to confirm the kidney as the organ of origin and to estimate the tumor size. Major blood vessels should be assessed to determine the extent of intravascular tumor thrombi if present. A CT scan with contrast is helpful to determine the degree of kidney invasion and evaluate for metastasis. The contralateral kidney should be assessed carefully for possible involvement. Treatment includes surgery, if possible, radiation, and chemotherapy. Four-year survival rates range from 95% for patients with low stage and favorable histology to less than 25% for advanced initial disease and unfavorable histology. Similar to neuroblastoma, such patients should be cared for in a specialized pediatric center.

The present study aims to evaluate the effectiveness of abdominal USG in the diagnosis of Wilms' tumor in pediatric surgical practice and compare the results of USG with those of other methods.

MATERIALS AND METHODS

This descriptive, cross-sectional study was carried out in the Department of Paediatric Surgery of Mymensingh Medical College Hospital, Mymensingh, Bangladesh, from June 2015 to September 2016.

Inclusion criteria:

(i) Patients presenting with palpable abdominal mass otherwise healthy child
(ii) All patients aged 0 to 12 years

Exclusion criteria:

(i) Patients having congenital abnormalities.
(ii) Patients having life threatening co-morbidity.
(iii) Patient above the age of 12 years

Considering all inclusion and exclusion criteria, finally a total of 30 patients having palpable abdominal mass were selected for this study. Among them, 25 children underwent both abdominal ultrasound and laparotomy with tissue diagnosis, while remaining 5 children were inoperable and undergone abdominal ultrasound with enhanced abdominal CT and CT guided FNAC and tissue diagnosis. A purposive sampling technique was adopted.

In each case, data about the patients were obtained by using a questionnaire after obtaining the consent from the parents or guardians of patients verbally. The clinical history was taken in every case with special attention to the duration, sites, and consistency of the palpable abdominal masses and any change since it was noticed. A complete general examination, local examination and relevant systemic examinations were performed in every case and thus clinical diagnosis was made. Abdominal ultrasound was performed in each case. A routine investigation including complete blood count, Bleeding profile, LFT, RFT, Chest x-ray P/A view, imaging studies, especially abdominal ultrasound, enhanced Abdominal CT and CT guided FNAC (where necessary), IVU, Isotope Renogram.

Data were processed and analyses using SPSS (Statistical Package for Social Sciences) software version 20.0 for windows. Analyses were done using

Chi-square test and student's t-test. P value <0.05 was considered as significant. Continuous scale data were presented as mean standard deviation and Categorical data were presented as number percentage. Ethical clearance was obtained from the Ethical Review Committee of Mymensingh Medical College, Mymensingh, Bangladesh.

RESULTS

The highest incidence is 2 to 5 years in age (76.67 %) and 0 to 2 years in age (13.33%) with the second highest incidence (Table-I). Mean age was 3.80 (±1.36) years and minimum age was 1 year and maximum age was found 10 years. The predominance of male over female was in the ratio of 3:2. Among the 30 case the highest incidence in male is 60% and female is 40% (Table-II). Occurrence of palpable abdominal lump is higher in male child than female.

Table I: Age distribution of the patients

Age in years	Frequency	Percentage
0 to 2	4	13.33
2 to 5	23	76.67
5 to 12	3	10.00
Total	30	100.00

Table II: Sex distribution of the patients

Sex	Frequency	Percentage
Male	18	60
Female	12	40
Total	30	100

The maximum number of patients examined in the present study was Wilms' tumor, as this accounted for 26.66 %. Hydronephrosis was the second highest incidence and was 16.66%, and Lymphoma accounted for 13.32% as the third highest incidence (Table-III). Out of 30 cases, by ultrasound 9 cases were found Wilms' tumor which was 30.00%, where 7 cases of Wilm's tumor clearly delineated by ultrasound and diagnosed both clinically and ultrasonographically another two (2*) 6.66% was not well delineated and inconclusive (Table-V). Among 3 (10.00%) cases of sonographically diagnosed lymphoma 2 (6.66%) cases were well delineated but another 1* (3.33%) was not well delineated and inconclusive. Among 4 (13.32%) cases of sonographically diagnosed ovarian mass 3 (10%) cases were well delineated but another 1* (3.33%) was not well delineated sonographically and was inconclusive. The result suggested that eight (8) cases were clinically suspected Wilm's tumors whereas 9 cases were diagnosed as Wilms' tumour by sonography, among 5 cases of clinically diagnosed hydronephrosis 4 cases were sonographically diagnosed as hydronephrosis, among 4 cases of sonographically diagnosed ovarian mass where 2 cases were clinically diagnosed, among 4 cases of clinically suspected lymphoma 3 were sonographically diagnosed.

Table III: *Clinical diagnosis of Wilms' tumor in patient age ranging from 6 months to 12 years*

Clinical Diagnosis	Frequency	Percentage
Wilm's tumor	8	26.66
Choledochal cyst	1	3.33
Pancreatic pseudocyst	1	3.33
Neuroblastoma	2	6.66
Dysgerminoma	2	6.66
Retroperitoneal mass	2	6.66
Ovarian mass	2	6.66
Mesenteric cyst	3	10
Lymphoma	4	13.32
Hydronephrosis	5	16.66
Total	30	100.00

Among the Inoperable 2 (40.00%) cases of Wilms' tumor 1 (20.00%) was well delineated by enhanced CT and also proven by tissue diagnosis but another 1 (20.00%) was not well delineated by enhanced CT but proven by tissue dia gnosis. Among the inoperable 2 (40.00%) cases of ovarian teratoma (Immature) 1 (20.00%) was well delineated by enhanced CT and also proven by tissue diagnosis but another 1 (20.00%) was not well delineated by enhanced CT but proven by tissue diagnosis. 1 (20.00%) inoperable case of Non-Hodgkin's lymphoma (suggestive in Ultra sonogram) was not well delineated by enhanced CT but proven by tissue diagnosis.

8 (26.64%) cases were clinically suspected Wilms' tumour whereas 9 (30%) cases were diagnosed as Wilm's tumors by sonography but 7 (23.33%) cases of Wilm's tumor were clearly delineated by

Table IV: *Pattern of Wilm's tumor in respect of their age (n=30)*

Age in years	Pattern of tumor	Percentage
0 to 2	Neuroblastoma (1)	3.33
	Dysgerminoma(1)	3.33
	Hydronephrosis(1)	3.33
	Rhabdomyosarcoma(1)	3.33
2 to 5	Wilm's tumor (9)	30.00
	Ovarian teratoma(4)	13.32
	Hydronephrosis(3)	10.00
	Mesenteric cyst(2)	6.66
	Non Hodgkin's lymphoma(3)	10.00
	Neuroblastoma(1)	3.33
	Retroperitoneal teratoma(1)	3.33
5 to12	Choledochal cyst(1)	3.33
	Pancreatic Pseudocyst(1)	3.33
	Non-Hodgkin's lymphoma(1)	3.33
Total		100.00

ultrasound and another 2 (6.66) cases were not well delineated by ultrasound (Table-IV). Among 3 (12%) cases of sonographically diagnosed Mesenteric cyst, of them 2 (8%) cases were found peroperatively mesenteric cyst but 1 (4%) case was diagnosed as Non-Hodgkin's Lymphoma by peroperative findings with tissue diagnosis. Among 2 (8%) cases of sonographically diagnosed Retroperitoneal mass, of them 1 (4%) was diagnosed as Retroperitoneal teratoma and another 1 (4%) was diagnosed as Rhabdomyosarcoma by peroperative findings with tissue diagnosis (Table-V). All of the cases of Wilms' tumor, hydronephosis, neuroblastoma, dysgerminoma, ovarian mass, choledochal cyst and pancreatic pseudocyst were same in peroperative findings and tissue diagnosis (where necessary) with sonographic diagnosis. The highest incidence in 2 to 5 years in age was 23 cases (76.67%) and 0 to 2 years in age was 4 cases which was 13.33% with the second highest incidence. Mean age was 3.80 (±1.36) with a range between 1 and 10 years.

Table V: *Enhanced CT scan of abdominal masses with CT guided FNAC with tissue diagnosis of inoperable cases*

Diagnosis	Clinical diagnosis Frequency	Ultrasonographic diagnosis Frequency	Operative findings with tissue diagnosis Frequency
Rhabdomyosarcoma	00	00	1(3.33)
Choledochal cyst	1 (3.33)	1(3.33)	1 (3.33)
Pancreatic pseudocyst	1(3.33)	1(3.33)	1(3.33)
Dysgerminoma	2 (6.66)	1(3.33)	1(3.33)
Retroperitoneal mass	2 (6.66)	2 (6.66)	1 (3.33)
Neuroblastoma	2 (6.66)	2 (6.66)	2(6.66)
Ovarian mass	2 (6.66)	4* (13.32)	4(13.32)
Lymphoma	3 (13.32)	3 (10.00%)	4(13.32)
Mesenteric cyst	4 (13.32)	3* (10.00)	2(6.66)
Hydronephrosis	5(16.65)	4 (13.32)	4(13.32)
Wilm's tumor	8 (26.64)	9* (30.00)	9(30.00)
Total	30 (100.00)	30 (100.00)	30(100.00)

*Figure with parenthesis indicate percentage.

DISCUSSION

In present study, the highest incidence in 2 to 5 years in age (76.67%) and 0 to 2 yrs in age (13.33 %) with the second highest incidence. Similar results were found by Athameeneh et al.[3] as their study showed age ranged from 0 to 14 years with a median age of 5 years. In current study, the predominance of male over female with the ratio of 3:2 was observed. Similar observation was reported by Athameeneh et al.[3] with 42 male (66.00%) and 22 female (34.00%).

This study showed maximum number of patients examined is Wilms' tumor which accounted for 30% cases. Sonographically 9 cases were found with Wilms' tumor. Hydronephrosis is most common with other etiologies including polycystic kidney disease, mesoblastic nephroma, nephroblastomatosis – Wilms' tumor spectrum, renal vein thrombosis, and ectopic kidney. GI tract masses account for about 15% of abnormalities. Common causes include duplication cysts and mesenteric or omental cysts, as well as meconium pseudocysts. Pelvic masses extending into the abdomen make up another 15% and include ovarian cyst, hematocolpos, and sacrococcygeal teratoma. Non-renal flank masses make up 10% of cases and include adrenal hemorrhage, neuroblastoma, and teratoma. Annuar et al.[4] showed the majority (71%) were retroperitoneal masses where two-thirds were of renal origin Eighty-six percent of Wilms' tumours, 80% of neuroblastomas, 50% of hepatoblastomas, 50% of choledochal cysts and 50% of ovarian cysts were correctly diagnosed. Wilms' tumours are echogenic renal masses whereas neuroblastomas appear as echogenic extra renal masses. The presence of calcific foci was observed in one-third of neuroblastomas.

In this study that sensitivity was found 96.30%, specificity was 60%, PPV 92.86%, NPV, 75% and efficiency of the test was found 90.63%. Athameeneh et al.[3] described the ability of ultrasound to determine the presence of absence of a lesion responsible for the mass in the whole group. In the 44 patients with a definitely palpable mass, a lesion was present in 36, and there was one false negative. In the 20 patients with possible mass, a lesion was present in 6 and there was one false positive ultrasound diagnosis. The high positive predictive value was (97%) and negative predictive value was (95%) for the presence or absence of a lesion in study indicates that ultrasound is a credible test of exclusion for palpable abdominal mass. The use of gray-scale ultrasound morphology to characterize a pelvic mass may also be called pattern recognition[5]. Subjective evaluation of ovarian masses based on pattern recognition can achieve sensitivity of 88.00 to 100.00% and specifically of 62 to 96%.

Research revealed that both ultrasound and CT scans are excellent modalities for affirming or excluding a palpable abdominal mass[6-10], with sensitivity and specificity values >95%.[7,10] Both US and CT usually demonstrate the organ from which a mass arises. The accuracy of US in determining the organ of origin has been 88%–91%,[6,7] whereas CT has fared slightly better at 93%[9]. US is limited by bowel gas in cases of dilated bowel or by body habitus. US is also partly operator-dependent, however likely to a lesser extent with directly palpable abnormalities. As expected, attempts to predict the pathologic diagnosis of masses based on imaging findings are less successful. In several studies US findings correctly suggested the pathologic diagnosis in 77–81% of cases[4,11], whereas CT findings correctly suggested the diagnosis in 88% of cases[9]. US still remains more appropriate as the first-line imaging in the pediatric population because of its high sensitivity (90–99%), specificity (97–100%), and lack of ionizing radiation.

CONCLUSION

Abdominal masses are not uncommon surgical condition encountered in infant and children. A definitive diagnosis is very crucial for the management of patient. Many diagnostic modalities are now available for the evaluation of abdominal masses in infants and children. Ultrasound has which characteristic which makes it very suitable, safe and informative in infancy and children. The present study suggested that might be used for diagnosis of abdominal masses in infants and children and shows the potentially of ultrasonographic evaluation of diagnosis of abdominal masses in infants and children. Children with an abdominal mass demand for rapid clinical evaluation. Imaging studies particularly sonography, may provide a specific diagnosis. So, ultrasonographic evaluation of Wilm's tumor is justified as a preliminary tool. Ultrasonography immense help in planning radiotherapy and in following the growth or regression of a mass after treatment are suggested for further study.

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