The accuracy of ultra-sonographic findings in detection of abdominal tumor size in children (our experience in Children Medical Center)

Bahar Ashjaei[1] Saeedeh Azary[1] Amin Khalifeh-Soltani[1]

[1]Children Medical Center, Tehran University of Medical Sciences, Tehran, Iran

*Address for Corresponder: Dr. Bahar Aahjaei, Children Medical Center, Tehran University of Medical Sciences, Tehran, Iran
(email:ashjaei@tums.ac.ir B_ashjaei@yahoo.com)

How to cite this article:
Ashjaei B, Azary S, Khalifeh-Soltani A. The accuracy of ultra-sonographic findings in detection of abdominal tumor size in children (our experience in Children Medical Center). Iranian Journal of Pediatric Surgery 2017; 3(2): 78-86.
DOI: htt://dx.doi.org/10.22037/irjps.v3i2.19159

Abstract

Introduction: Since abdominal tumors are one of the common causes of childhood death, studying the clinico-pathologic features of them is important for early diagnosis. Our aim in this study was to determine these features in Iranian children and to evaluate the accuracy of ultrasonography in diagnosing abdominal masses in children.

Materials and Methods: In this retrospective case series study, data about sex, age, primary chief complaint, physical examination, imaging report and pathology finding of 156 children with abdominal tumor, who were admitted to the Children Medical Center in the last 6 years were gathered.

Results: Male to female ratio was 0.69. The most common type of tumor in this study was Willm's (37.5%) and Neuroblastoma (35.7%). Mean age of children with Willm's tumor and Neuroblastoma was 38.95 and 26.65 months respectively. Ultrasonography has a lower accuracy in patients with tenderness, children with Willm's tumor, female patients and children under 5 years old.

Conclusion: Our different findings regarding tumor type and distribution as opposed to previous studies may be due to genetic and geographic variations. In addition, this study shows that the accuracy of Ultrasonography in children with abdominal tumors depends on children's sex, age, pain and the type of tumor.

Keywords

- Pediatric abdominal tumor
- Ultrasonography
- Willm's tumor
- Neuroblastoma

received: 16 September 2017
accepted: 21 September 2017
ISSN 2423-5067

Introduction

Any mass palpable in the region that is anterior to the paraspinous muscle, inferior to the costal margins and superior to the iliac crests and the pubic symphysis; is referred to as an abdominal mass. Abdominal tumors are known to be common causes of death in children[1] and they include a large series of benign and malignant tumors.

Studying the clinico-pathologic features of tumors including sex, age and location distribution, type and tumor size are important for early diagnosis, treatment and prognosis. [2&3]

The most common malignancies of childhood are leukemia, lymphoma and central nervous system tumors which account for 63 percent of cases followed by Neuroblastoma and Willm's' tumor which account for 14.5 percent of childhood malignancies.[4] Neuroblastoma and Willm's' tumor most often produce an abdominal mass.[4]

Many factors such as histopathologic features, patient age, stage of disease at the time of diagnosis and tumor size affect the prognosis in Willm's tumo. Also, early diagnosis of Neuroblastoma is an important factor for good prognosis.[5-8]

Since using ultrasonography does not entail using ionizing radiation it is the standard method in the initial work up and also follow- up of abdominal masses in children. In other words, ultra sound can safely be used inittialy; and help initiate therapy as soon as possible.[9]

Abdominal tumors can occur at any age and may have various clinical presentations. Also, most of the children are asymptomatic, and physician or parents may note painless abdominal distension because the tumors are most commonly in the retro peritoneum and kidneys, so they become large, and create mass with no pain or any other symptoms.[2]

Symptoms of abdominal tumors' in children include palpable abdominal mass, abdominal pain, constipation, hematuria, decreased urination, fever, pallor and weakness.[2] To our knowledge data on the clinicopathologic features of abdominal tumors in children have not yet been published in Iran.

The aim of current study is to evaluate the clinicopathologic features of abdominal tumors in children regarding age, sex, signs and symptoms, tumor location, physical examination, imaging and pathologic findings and to assay the accuracy of ultrasonography in diagnosing abdominal mass in children. Also no study has been done before for evaluating the accuracy of ultrasonography in different sexes, ages, site and type of tumors.

Materials and Methods

Subject: In this retrospective case series study we gathered the data of 156 children with abdominal tumor who were admitted to the Children Medical Center in the last 6 years.

Tumor was resected if it had no adhesions to vital organs or the resection of tumor did not need to sacrifice vital organs like vena cava and aorta. Of all our patients 145 cases underwent surgery however the tumor was not resectable in eleven patients therefore biopsy was done. In these eleven patients neoadjuvant chemotherapy or radiotherapy if necessary according to pathologic findings was carried out.

Patients' sex (male or female), age (month) and their chief complaint (mass, pain, mass together

with pain, nausea vomiting, Icter and fever) have been recorded on admission. Also, physical examination has been done, and the results were recorded (existence of tenderness, rebound and/or guarding).History taking and physical examination was done by a pediatric surgeon .History was taken from patient's parents if the patient was under 5 years. If the patient was over 5 years we took the history from the child and her or his parents. Abdominal ultrasonography has been performed for all cases, and we recorded the size and location of mass. Ultasonografic evaluation was performed by one radiologist who was expert in the field of pediatric abdominal ultrasonography.

Tumor size measurement

In operating room, after tumor resection, the largest length of each dimension of tumors was measured in centimeters and recorded. Then the specimens was sent to the pathology department for microscopic evaluation. In Ultrasonographic study, the largest length of each dimension of tumor was measured and recorded. Using the three lengths for three sides of each tumor, we calculated tumor volume by multiplication of these three lengths. In other words, we calculated the volume of a cube in which the tumor is encompassed by. We choose the same dimensions for the actual tumor and its ultrasonographic study in order to make their comparisons possible.

Statistical analysis

Data analyses were performed using SPSS software. Descriptive statistics were used to summarize the demographic characteristics. Also, we used R analysis program for analyzing the data. In order to analyze the accuracy of ultrasonography in determining tumor size, we evaluated normalized error between volume of tumor in the operation chart and in the ultrasonographic report (error= (volume of tumor in ultrasonographic finding - volume of actual tumor after resection)/volume of actual tumor after resection). We defined the null hypothesis such that an error has zero mean, and test the hypothesis using a two sided t-test for patients with tenderness and without tenderness, female children and male children, patients with Willm's and Neuroblastoma, children above and under 5 years old. In this test, lower p-value indicates that error is significantly nonzero.

Results

Data set included 156 cases of abdominal tumors, 92 cases were female (59%), and 64 cases were male (41%). Male to female ratio was 0.69. Mean age was 37.35 months old. Our youngest patient was 2 months old, and our oldest one was 178 months old (14.83 years old). Eighty percent of all patients were under 5 years old, and 25% of them were under 12 months old. The mean age of females was 40.9 months old (median =36), however, mean age in the male group was 32.26 (median=24)

The most common symptoms at admission, was abdominal mass along with abdominal pain (67 cases, 43% of all patients), followed by abdominal pain (47 cases, which30% of all patients). Abdominal mass without any pain existed in 28 cases (17.8%) as shown in **Figure 1**.

We evaluated abdominal tenderness, rebound and guarding in abdominal physical examination. Tenderness was seen in 138 patients (89 %). Guarding was seen in 60 cases (39 %), and the rebound was seen in 8 patients (5.3 %). Only

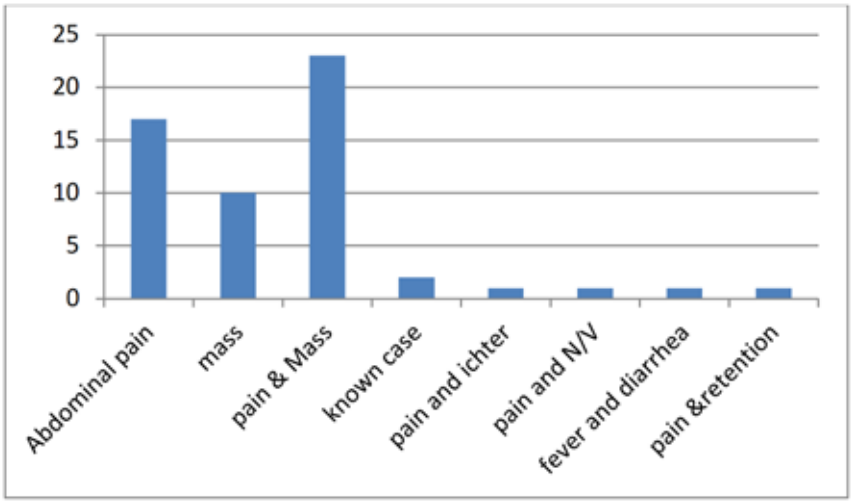

Figure 1: Frequency of patient's chief compliant in children who underwent abdominal mass surgery at Children Medical Center in the last 6 years.

five patients had tenderness, and rebound and guarding all together. Eighty six percent of males had abdominal tenderness, however, 90.9 percent of female had the same symptom. Also, 42.4 of females and 34.4% of males had guarding during physical examination.

Willm's tumor was seen in 58 patients (37.5% of all patients) and Neuroblastoma was seen in 52 patients (35.7% of all patients), and small round cell tumor was seen in 7 patients, lipoma in 8 patients and lipoblastoma in 7 patients. **Figure 2** .

The mean age in children with Willm's tumor was 38.95 months and in children with Neuroblastoma was 26.65 months old. In children with Neuroblastoma (52) 28 cases were female, and 24 cases were male (male to female ratio was 0.85)

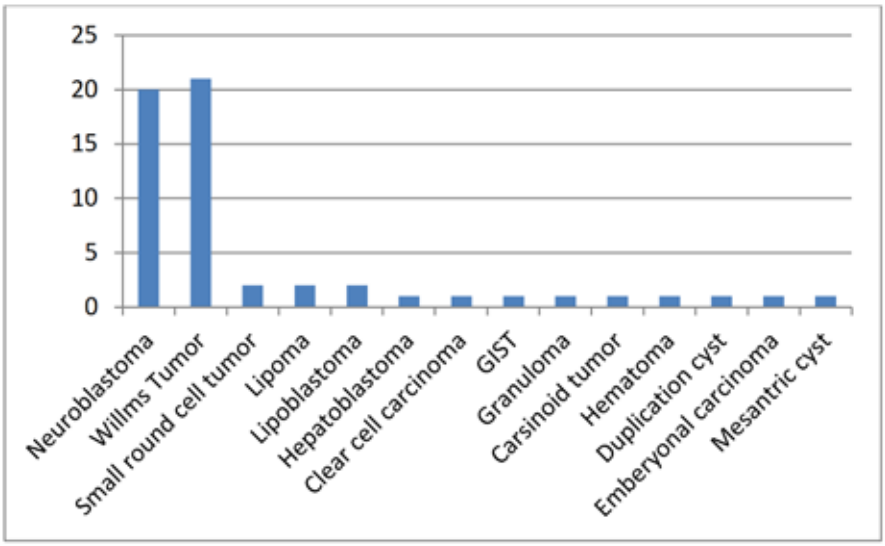

Figure 2: Pathologic finding in patients who underwent abdominal mass surgery in Children Medical Center in the last 6 years

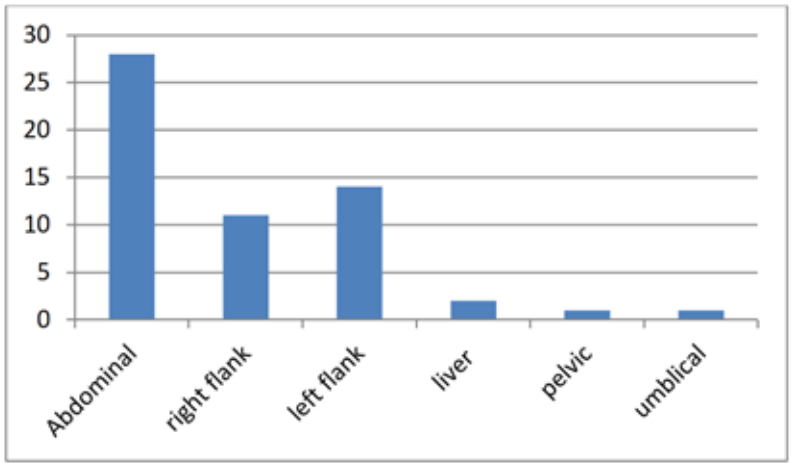

Figure 3: Tumor location in patients who underwent abdominal mass surgery in Children Medical Center in last 6 years.

and in children with Willm's tumor (58 cases) 36 cases were female, and 22 cases were male (male to female ratio was 0.61).

Abdominal Ultrasonography was performed for all cases, and tumor size was determined before surgery, also actual size of the tumor was measured after tumor resection. Analysis shows that in operation reports the minimum volume of tumors was 20 (mm^3), the maximum was 84000 (mm^3), with the mean of 7094 (mm^3) and the median was 2995 (mm^3). However, in ultarasonographic findings smallest tumor was 24 (mm^3) and the largest was 189000 (mm^3) with a mean of 9184 (mm^3) and the median was 3000 (mm^3). The mean of tumor volume was 8202 (mm^3); however, it was 5905(mm^3) in females. T-test was done and the p-value with 95% confidence interval was not significant (p-value=0.20).

In order to analysis the accuracy of ultrasonography in determining tumor size, T-test results showed that in cases that tenderness existed p-value of the test was 0.04226 which rejects the null hypothesis. Hence, for patients with tenderness, error is higher than zero. However, in patients who didn't have tenderness, the test failed to reject the hypothesis (p-value=0.6) which means that the error had a true mean zero.

The same test was done in cases which patients were male and female while we controlled for tenderness effect. T-test results revealed that an error had a mean zero for males (p-value=0.89) while the error was significantly far from zero in females (p-value=0.02).

Also, the same test has been done for patients with age less than or more than 5 years old and in both groups (age >5 and age<5 years) the test failed to reject the hypothesis and the error means were not significantly higher than zero for both cases (p-value is .07 and .24, which is not smaller than .05). In patients aged less than 5 years old, p-value of the test for error was 0.07226 which is much lower than the p-value in the patients with age higher than 5 years old. Considering the fact that the lower p-value indicates more significant

error presence, hence, for younger patient's error is more.

In addition, the same test has been done for the patients with different pathological findings. T-test results revealed that an error had mean zero for all kind of tumors (p-value is bigger than .05 for all of them). Again using the above mentioned fact, we can conclude that error in tumor size between Ultrasonographic finding and tumor actual size is more in Willm's tumor (p-value=.49) than in Neuroblastoma (p-value=.16) Compression of Neuroblastoma and Willm's tumor in patients who underwent abdominal mass surgery in Children Medical Center in last 6 years is presented in **Table 1**.

Discussion

Clinico-pathologic features including sex, age,

Table 1- Compression of Neuroblastoma and Willm's tumor in patients who underwent abdominal mass surgery in Children Medical Center in the last 6 years.

	Willm's tumor	Neuroblastoma
	cases 58	cases 52
Symptoms on admission		
1.abdominal mass	22	10
2.abdominal pain	6	18
3.abdominal mass and pain	25	24
Location of tumor		
abdomen.1	3	44
2.right flank	22	3
3.left flank	33	5
Physical examination findings		
Tenderness	58	42
Rebound	3	0
Guarding	19	16
Tumor actual size		
1. The largest tumor	15000	45000
2. The smallest tumor	120	75
3.mean volume	4028	8334
4. median	2600	5000
Age distribution(month)		
1.youngest patient	3	2
2.oldest patient	108	94
3.mean age	38.95	6.65 2
4.median	36	16.5

symptoms, location, and tumor type in children with abdominal tumor could be very different among different populations. In addition, Imaging is the major step in evaluation of an abdominal mass in children and ultrasonography can affirm or exclude the diagnosis with a sensitivity value exceeding 95%. Also it is helpful in detecting the organ of origin in nearly 88% to 91% of the time and can determine the tumor component (cystic or solid) and has gained much attention as a first-line standard procedure. [9-13]

Cancer is a common cause of death in children. Willm's tumor is the most common renal malignancy in children .Neuroblastoma is most common solid extra cranial tumor in children and the most common cancer in children and infants.[2] As seen in **Figure 2** in this study the number of patients with Willm's and Neuroblastoma are approximately equal, however, in most studies Willm's' tumor was more common than Neuroblastoma. Also, in this study Neuroblastoma was the most common malignancy in infants same as the previous studies,[2] Male to female ratio in our study (0.69:1) is less than other similar studies (1.7:1).[2]

In a study which was conducted on 39 patients with abdominal tumors, abdominal mass without pain was the most common symptom on admission in Willm's' tumor and Neuroblastoma especially in Willm's' tumor.[2] Also, in the other studies abdominal mass, which was detected by a physician or parents, was the most common chief complaint on admission.[14] In our study, abdominal pain along with a palpable mass was the most common symptom. In Neuroblastoma, the second most common symptom was abdominal pain. However, in Willm's' tumor abdominal mass without any pain was the second most common symptom. We can conclude that, in our country diagnosis of abdominal mass in children occurs in higher stages than that of other countries that is why patients present when the mass has become large enough to produce pain.

After comparing age and sex distribution in the two most common masses, Neuroblastoma and Willm's tumor, we can conclude that the mean age in children with Willm's tumor is significantly higher than children with Neuroblastoma (PV=0.02).

We compared tumor size, which was reported in ultrasonography imaging, with the tumor actual size which was measured after surgical resection. The accuracy of ultrasonography was evaluated in different groups of children. This study has never been done before in the region revealing some interesting aspects. We can conclude that in patients with tenderness there is a difference between tumor size in ultrasonography and the actual tumor size, and this difference is not present in patients who did not have tenderness. We also found that difference in tumor size between tumor actual size and tumor size in ultrasonography was more in females than male. Thus ultrasonography should be done with more care and sensitivity in females.

Moreover, the error is sensitive has a relation with patient's age that is more difference is seen the between actual size and the size revealed in ultrasonography in patients with age under 5 years old than those above 5 years old. Also as our results suggest, type of the tumor might be related to the error of the volume. Patients with Willm's tumor

are more vulnerable to the error in ultrasonography; hence, their tumor size should be examined more carefully than those with Neuroblastoma.

In one study which was done in Shahid Beheshti Univercity of Medical Sciences in Iran the mean age of children with Wilm,s tumor was 38 months which was almost similar to our study with a mean age of 36 months.[15] In a nother study in our country the prevalence of germ cell tumor was reported to be 4 percent in children.[16] but our study cannot reveal this prevalence because of the limitation of the field of evaluation in abdominal cavity. Although germ cell tumors occur more commonly in the abdominal cavity, they also existed in the sacrococcygeal area, mediastinum, head and neck.

The size of a mass naturally will be smaller after operation, because in Ultrasonography the tissues is alive and bloody but after operation it starts to shrink. According to other studies on colorectal tumors, shrinkage is considerable and most of this shrinkage is due to formalin fixation, however in other solid tumors like kidney tumors and neural tumors the shrinkage after surgery can be ignored it is very little.[10]

The differences found in this study compared with others can be due to racial and geographic differences, and variations in the study design. Yet, knowing these can help the surgeons to perform a more accurate evaluation and come to an early diagnosis.

Conclusion

There are significant differences regarding the Male to female ratio and chief complaints in patients with Willm's tumor and Neuroblastoma in our patients as compared to preexisting studies. These differences may be due to genetic and geographic variations in the populations. We surprisingly find out that accuracy of ultrasonography in determining the size of abdominal mass in children is significantly related to patient's gender, age and tumor type (Willm's or Neuroblastoma). Also the accuracy of ultrasonography in determining size was significantly related to the presence of abdominal tenderness. Maybe usage of analgesic medications at the time of ultrasonographic evaluation could increase the accuracy of tumor size determination .

Acknowledgment

The ethics committee of Children Medical Center at Tehran University of Medical Sciences approved this study. Special thanks are due to Tehran University of Medical Sciences, department of pediatric surgery and radiology in Children Medical Center. All subjects who participated in the study are gratefully acknowledged.

References

1. Kim PK, Lee HS, Chin DS, et al:Clinical studies of abdominal tumors in infants and children--ten year review. Yonsei medical journal. 1970;11(2):182-93.
2. Jaafari-Ashkavandi Z, Ashraf MJ: A Clinico-Pathologic Study of 142 Orofacial Tumors in Children and Adolescents in Southern Iran:Iranian Journal of Pediatrics 2011, 21(3): 367-372.

3. V.Rastogi, P.K.Singal, A. Aserland S.B.Taneja.Pattern of abdominal masses: Indian J of Pediatr,1988;55:295-300.

4. Robison LL: General principles of the epidemiology of childhood cancer. In: Pizzo PA PD, eds. Principles and practice of pediatric oncology. 3d ed. Philadelphia: Lippincott-Raven, 1997:1-10.

5. Ehrlich PF: Wilms tumor: progress and considerations for the surgeon. Surg Oncol 2007;16 (3): 157-71.

6. Dome JS, Cotton CA, Perlman EJ, et al: Treatment of anaplastic histology Wilms' tumor: results from the fifth National Wilms' Tumor Study. J Clin Oncol 2006; 24 (15): 2352-8.

7. Shamberger RC, Anderson JR, Breslow NE, et al: Long-term outcomes for infants with very low risk Wilms tumor treated with surgery alone in National Wilms Tumor Study-5. Ann Surg 2010; 251 (3): 555-8.

8. Shahgili E, Bavarian B: Early diagnosis of Neuroblastoma by mass screening.Iranian journal of pediatrics 1997; 7:27-28.

9. Raab CP, Gartner JC: Diagnosis of childhood cancer. Primary care. 2009;36(4):671-84.

10. Goldstein NS, Soman A, Sacksner J: Disparate surgical margin lengths of colorectal resection specimens between in vivo and in vitro measurements. Am J Clin Pathol 1999; 111: 349–51.

11. Smith EH: The hazards of fine-needle aspiration biopsy. Ultrasound in medicine & biology. 1984;10(5):629-34.

12. Engzell U, Esposti PL, Rubio C, et al: Investigation on tumour spread in connection with aspiration biopsy. Acta radiologica: therapy, physics, biology 1971;10(4):385-98.

13. Colquhoun IR, Saywell WR, Dewbury KC: An analysis of referrals for primary diagnostic abdominal ultrasound to a general X-ray department. The British journal of radiology 1988;61(724):297-300.

14. Goodman M, Gurney, JG, Smith, MA, et al: Sympathetic nervous system tumors. In: Cancer Incidence and Survival among Children and Adolescents: United States SEER Program, 1975-1995, Ries, LA, Smith, MA, Gurney, JG, et al (Eds), National Cancer Institute, Bethesda, MD 1999. p.35.

15. Seyed-Ahadi MM, Khaleghnejad-Tabari A, Mirshemirani A: Wilm's Tumor: A 10 Year Retrospective Study. Archives of Iranian Medicine 2007; 10(1): 65– 69.

16. Khaleghnejad-Tabari A, Mirshemirani A, Rouzrokh M: Pediatric Germ cell Tumors; A 10 year experience. Iran J Pediatr 2014; 24 (4): 441 - 444