



## Computed Tomographic Evaluation of Paediatric Abdominal Mass Lesions

Pravakar Bahinipati<sup>1</sup>, Ranjan Kumar Sahoo<sup>1\*</sup>, Biswa Bhusan Mohanty<sup>2</sup>, Saurjya Ranjan Das<sup>2</sup>, Sitansu Kumar Panda<sup>2</sup>

<sup>1</sup>Asst. Prof. Department of Radiology, IMS & SUM Hospital, SOA University, Bhubaneswar, Odisha, India.

<sup>1</sup>Asso. Prof. Department of Radiology, IMS & SUM Hospital, SOA University, Bhubaneswar, Odisha, India.

<sup>2</sup>Asst. Prof. Department of Anatomy, IMS & SUM Hospital, SOA University, Bhubaneswar, Odisha, India.

<sup>3</sup>Asst. Prof. Department of Anatomy, IMS & SUM Hospital, SOA University, Bhubaneswar, Odisha, India.

<sup>4</sup>Asso. Prof. Department of Anatomy, IMS & SUM Hospital, SOA University, Bhubaneswar, Odisha, India.

\*Corresponding author's E-mail: [darierdarier2000@gmail.com](mailto:darierdarier2000@gmail.com)

Accepted on: 04-02-2016; Finalized on: 29-02-2016.

### ABSTRACT

Incidence of abdominal masses is common in paediatric patients. Usually more than one imaging modality is used to identify and diagnose a given abdominal mass. Hence, diagnostic evaluation of an abdominal mass in an infant or child is a challenging problem. Ultrasonographic examination can quickly provide important information regarding the organs of origin as well as some degree of tissue characterization. But for larger, ill defined or poorly visualized mass sectional imaging in the form of computed tomography or magnetic resonance imaging can be helpful. CT and MRI are better in providing anatomical detail and physiologic information of organs. Vascular involvement is best demonstrated in MRI and Ultrasound Doppler examinations. Angiography is currently indicated for abdominal masses only if a precise knowledge of segmental vascular anatomy is required. Though there are hazardous effects of radiation in paediatric patients, still computed tomography is an ideal imaging modality due to its easy availability, lesser financial constraints and less time consuming.

**Keywords:** Abdominal mass, Ultrasonography, computed tomography, Doppler study.

### INTRODUCTION

Paediatric abdominal masses comprise a varied group of conditions, attributable to different parent organs and manifesting themselves at different stages of prenatal life. Abdominal masses are common in paediatric patients and frequently more than one imaging modality will be used to identify and diagnose a given abdominal mass. Hence, diagnostic evaluation of an abdominal mass in an infant or child is a challenging problem. Plain radiographs of the abdomen remains an important component of the early investigation of an abdominal mass primarily for the purpose of detecting calcification and the effect of mass on surrounding structures such as bones or gastrointestinal tract. Ultrasonological examination can quickly provide important information regarding the organs of origin and some degree of tissue characterization. Therefore, it is usually the screening procedure of choice for abdominal masses in children. The main drawbacks of ultrasound are that, it is operator dependent and the abdominal gas can interface with the quality of images. Never the less in many cases ultrasound will establish the diagnosis. Further imaging may not be necessary. For larger ill defined or poorly visualized mass, sectional imaging in the form of computed tomography or magnetic resonance imaging can be helpful. Both modalities provide superior delineation of the margins and extent of abdominal masses. Computed tomography (CT) and magnetic resonance imaging (MRI) are superior in providing anatomical detail and pathological information of organs

and vascular structures in the retro peritoneum despite over lying gas and bone.

Vascular involvement is best demonstrated in MRI and Ultrasound Doppler examinations. Angiography is currently indicated for abdominal masses only if a precise knowledge of segmental vascular anatomy is required before operation.

Though the hazardous effects of radiation in paediatric patients in whom there are more number of cells in a dividing state, are well known, computed tomography is still an ideal imaging modality due to its easy availability, lesser financial constraints and less time consuming.

### AIM AND OBJECTIVE

The main objective of this study is:

- A) To assess the role of the computed tomography in
  1. Detection
  2. Localization
  3. Characterization of pediatric abdominal masses.
- B) To identify true nature of underlying lesion by application of different CT techniques and to reach a conclusive diagnosis.
- C) To confirm the CT findings with
  1. Fine needle aspiration cytology (FNAC)
  2. Surgical Findings
  3. Post surgical histopathological findings



## MATERIALS AND METHODS

A prospective study of 25 paediatric cases of clinically suspected abdominal masses was conducted in the department of Radio diagnosis at IMS and SUM Hospital, Bhubaneswar, Odisha during the period from August 2012-2015. The study included 13 male children and 12 female. Age of the patients ranged from neonates 10 days of age to adolescents of 15 years.

A complete evaluation of these patients was done in following format.

- Detailed birth history
- Detailed clinical history
- Clinical examination of abdomen
- Routine investigations like haemogram, blood smear, serum urea, serum creatinine, stool routine and microscopy, urine routine and microscopy.
- Abdomen radiographs
- Ultrasound examinations of abdomen.
- CT scan of abdomen (Plain & Contrast)

Cases were followed upto reach of the confirmatory histopathological diagnosis wherever it was possible.

### CT scan Technique

CT scan of pediatric abdomen was done with GE high speed dual slice CT with Kodak laser camera and Kodak dry view printer. All the 25 cases were subjected to both non-contrast and contrast (both oral and intravascular) enhanced CT in axial planes with multiplanar image reconstructions in sagittal and coronal planes wherever necessary.

Contiguous thin sections of 5mm in the infant and older children with thinner slices through small areas of interest were done in conventional CT. Spiral CT with its rapid sub second data acquisition and appropriate optimization of contrast obviated the need for sedation in some older cooperative children. 3D reconstruction of spiral volumetric data acquisition and dual phase contrast imaging enhanced accurate anatomic evaluation of the specific organs of interest. The contrast was given in the concentration of 1-2 ml/Kg body weight. Non ionic contrast media was used invariably in all patients.

All the sections were studied in two window settings one for soft tissue and another in bone window to rule out any bony involvement or calcifications. The specific Hounsfield unit (HU) values of the region of interest were thoroughly studied. The results obtained from clinical examination, routine investigation, disease specific biochemical markers for imaging and pathology correction. CT scan study, surgical and post surgery histopathological findings were analyzed and were correlated with observations of similar studies by other workers. Summary and conclusions were drawn as regard to the accuracy and utility of CT scan in evaluating

pediatric abdominal masses in the neonates, infants and children by analyzing the above findings and on basis of comparison with report from other literatures.

### Observations

**Table 1:** Age distribution of the cases presenting with abdominal mass in neonates and younger infants

Age	Male	Female	Total
0-2 months	4	1	5
2-6 months	1	2	3
6 months-1 year	1	1	2
<b>Total</b>	<b>6</b>	<b>4</b>	<b>10</b>

**Table 2:** Age distribution of the cases presenting with abdominal mass in older infants and children

Age	Male	Female	Total
2-5 years	4	2	6
5-10 years	3	3	6
10-15years	1	2	3
<b>Total</b>	<b>8</b>	<b>7</b>	<b>15</b>

From the above two tables it is observed, 10 cases were neonates and young infants and 15 cases were older infants and children.

**Table 3:** Distribution pediatric abdominal masses according to anatomical organ of origin in neonates and younger infants found on ct.

Organ of origin	Male	Female	Total	Percentage
Renal	3	3	6	60%
Non-renal (RP)	1	1	2	20%
GI	1	0	1	10%
Hepato-spleno-biliary	1	0	1	10%
Genital	0	0	0	0%
<b>Total</b>	<b>6</b>	<b>4</b>	<b>10</b>	<b>100%</b>

RP-Retroperitoneum, GI-Gastrointestinal.

## DISCUSSION

Paediatric abdominal masses include a spectrum of lesions of diverse origin and significance. The incidence and prevalence of such lesions are different in different age groups such as neonates (0-1 month), infants (1-12 months) early childhood (1-3 years) and the late



childhood (> 3 yrs). So, paediatric abdominal masses are broadly divided into two groups, one in neonates and young infants and the other in early and late childhood.

### Abdominal Masses in Neonates & Young Infants

#### Renal masses (55%)

- Congenital hydronephrosis
- PUJ Obstruction
- Posterior urethral valve
- Prune belly syndrome
- Multicystic dysplastic kidney
- Infantile polycystic kidney

#### Hepato-spleno-biliary Masses (5%)

- Hemangioma
- Endothelioma
- Hepatic cysts
- Hepatoblastoma

#### Genital Masses (15%)

- Hydrometrocolpos
- Ovarian cysts
- Ovarian tumors

#### Gastrointestinal Masses (15%)

- Duplication cysts
- Mesenteric cyst
- Omental cyst
- Complicated meconium ileus
- Bowel atresia

### Neonatal Abdominal Masses

Abdominal masses in the newborn period from birth to one month of age are predominantly benign lesions usually representing defects in embryonic development.

About 65% of neonatal masses are retro peritoneal mass of which 55% are renal in origin.

#### Renal Masses

1. Hydronephrosis
2. Cystic disease of the Kidney: Multicystic dysplastic Kidney (MCDK), Autosomal Recessive Polycystic Kidney Disease
3. Nephroblastoma (Wilms' tumor)
4. Renal Abscess
5. Mesoblastic Nephroma
6. Renal Vein Thrombosis

### Non Renal Masses

1. Adrenal hemorrhage
2. Neuroblastoma
3. Hepato-spleno-biliary mass lesions
4. Hepatoblastoma: Hemangioendothelioma, Choledochal Cyst
5. Hepatic Abscess: Pyogenic liver abscesses, Amoebic liver Abscess, Hydatid cyst of liver
6. Lymphoma

In the national Wilm's tumour study group 5 (NWT5) the tumour stage is determined operatively. The grade is established on pathologic examination. The preoperative imaging protocol in NWT5 includes abdominal and pelvic sonography, abdominal and pelvic CT, Chest CT and conventional chest radiography. Ultimately the data will be analyzed to determine what modalities of treatment are most beneficial to patient.

Griscam NT<sup>1</sup>, showed that 55% of paediatric abdominal masses were of renal masses both in the early and late age group. In this study, it was found that 14 cases (56%) were of renal origin. So it is in conformity with the study of Kirks<sup>2</sup> in which renal masses was the most common cause of abdominal mass in paediatric age group.

Again by the same study group Griscam NT<sup>1</sup> and Kirks<sup>2</sup> around 25% cases of paediatric (neonates and young infants) abdominal masses was due to hydronephrosis and in 20% cases in older infants and children. In this study it was found that 3 cases of abdominal masses due to hydronephrosis in neonates and young infants and one case in older age group which is in conformity that hydronephrosis presenting as abdominal mass was more common in the neonates and young infants age group than the older children.

Nimkin K. Teeger S.<sup>3</sup> study shows that adrenal haemorrhage is the most common cause of an adrenal mass in the neonate occurring as a result of perinatal stress and less common in older infants and children and usually is the result of trauma. Smith EL<sup>4</sup> study shows that neuroblastoma is the most common malignant abdominal tumour in children usually affecting children under age of 4 years and more than half of all neuroblastoma originate in the abdomen and two thirds of these arise in the adrenal gland. In this study it was found that 2 cases of adrenal haemorrhage were found in which the patients were in the age group of 6 months and 4 cases of neuroblastoma presenting as abdominal masses were found in which the patients were in the age group of 1-4 years. So it is conformity with above two studies.

Abdominal masses in the paediatric population are predominantly retroperitoneal in location as seen from table 3 and 4. In the above table it is seen that total percentage of renal masses and non-renal retroperitoneal masses were 73.5% in older infants and children. The



total percentage of renal and non-renal retroperitoneal masses was 80% in neonates and younger infants. It is also seen that in neonates most abdominal masses are benign and beyond the neonatal period the percentage of malignant tumours increases. So CT scanning has an important role in older infants and children in determining the site of origin. From the above observation it can be concluded that renal and non renal retroperitoneal mass are the most common aetiology presenting as paediatric abdominal masses in all age group.

In this study it was found that renal cysts in children usually are bilateral and found in association with hereditary polycystic kidneys disease. Non-hereditary simple cortical cysts are distinctly uncommon in children. The clinical features of autosomal recessive polycystic kidney disease are dependent on the age of presentation. Infants present with large kidneys, poor renal function and minimal hepatic disease. In older children portal hypertension and oesophageal varices secondary to hepatic fibrosis predominate. CT or MRI is done to search for collateral vessels. The kidneys enlarge with smooth margins. The cysts which represent dilated tubules are usually centrally located and exhibit near water attenuation on CT. Some cysts are hyper dense in CT because the contents are mucoid or hemorrhagic. Dilated bile ducts due to hepatic fibrosis also seen in CT.

Silverman PM, Korobkin M<sup>5</sup> showed that CT demonstration of adrenal haemorrhage was a common cause of paediatric abdominal mass and is usually unilateral and more commonly on the right side (70%) and in only 10% instances it is bilateral. In this study, it was found that both the cases of adrenal haemorrhage were unilateral and were found on right side. So there is need for further study for the right side predominance of adrenal haemorrhage in neonates.

According to Crittenden and Mc Kinely<sup>6</sup>, the most common variety of choledochal cyst found in 80%-90% of cases is Todani's type I. In this study it was found that the choledochal cysts are usually of type I which is in conformity to the above studies.

Isaacs H. Jr.<sup>7</sup> stated that hepatic hemangioendotheliomas are the most common benign hepatic lesion of the neonates and young infants and are diagnosed before six months of age and almost 50% appear within the 1<sup>st</sup> week of life. The female incidence is twice that of males. They appear as single or multiple nodules often extensive and occupying a substantial part of even most of the liver causing hepatomegaly. They are often responsible for significant AV shunting which may lead to high output heart failure. Consumptive coagulopathy resulting in disseminated intravascular coagulation may occur (Kasabach-Merritt Syndrome). In this study a case of infantile hepatic hemangioendothelioma presenting as abdominal mass without heart failure was present and the case was a female young infant. This finding is in confirmation with study of Isaacs H. Jr.

Davidson AJ. Hartman DS<sup>8</sup> studied the nature of retroperitoneum teratoma and their radiologic, pathologic and clinical correlation in 50 cases and stated that, these tumours account for 3% of malignant tumours of children and adolescents. Germ cell tumours are benign or malignant tumours arising from the primordial germinal epithelial layer cells in extragonadal or gonadal sites. Two thirds of these tumours are extragonadal in origin. Forty one percent of germ cell tumours occur in the sacro-coccygeal region and most are benign. Thoracic germ cell tumours are located in the anterior superior mediastinum. Abdominal germ cell tumours are usually located in the retroperitoneal space though occasional involvement of the stomach, omentum and liver is described. A teratoma arises from pluripotent cells and is composed of variety of tissues foreign to the organ of its anatomic site of origin. Neonatal teratomas occurs 80% of the time in the sacrococcygeal region. In this study a retroperitoneal teratoma was found in an adolescent, which was within 4% of the total study population. So this finding is partially in confirmation of the study by Davidson AJ<sup>8</sup>.

In this study, 7 cases of Wilm's tumours were detected which show large spherical heterogenous soft tissue density intrarenal mass lesions which enhances after intravenous administration of contrast media but usually to a lesser degree than the adjacent normal renal parenchyma. A single case out of 7 cases shows minimal calcification which is within 15% of cases. Extension through capsule to perinephric space is seen in one case (15%), which are in conformity, with the study of Griscom<sup>1</sup> and Kirks<sup>2</sup>.

In this study, 2 neuroblastoma cases were found which appear on CT as heterogenous paraspinal suprarenal soft tissue density masses with lobulated margins and enhancing less than the surrounding normal tissue. Calcifications were found in both the cases (Stippled calcification in one case and mottled calcification in the other). These findings correlate well with the findings of Boechat MI<sup>9</sup>.

In all cases of paediatric abdominal masses included in this study, the lesions were accurately localized, involvement of adjacent anatomical structures were clearly demonstrated and the presence of lymphadenopathy, adjacent visceral metastasis and midline crossing of mass could be established. The overall accuracy in characterizing the lesions causing paediatric abdominal masses was 90%. In only one case, the diagnosis was missed as small Wilm's tumour near the upper pole of left kidney which was later confirmed with other multiplanar imaging and surgery as neuroblastoma. Similar observations have been made by Donaldson JS<sup>10</sup>, Feshman EK<sup>11</sup> and Luker GD<sup>12</sup>.



## CONCLUSION

In this study it was found that the etiological detection of the pediatric mass lesions by CT was up to 90% when the protocol and patient preparations are standardized. Hence CT scanning should be the ideal investigation of choice in evaluation of lesions presenting as paediatric abdominal masses. It is most useful in detecting, characterizing and determining the extent of disease process. In this study, as the new spiral mode CT machine was used it was found that due to capability of the spiral mode to collect extensive contiguous volume data the detection of small lesions is possible than the older conventional CT scanner. Though there is always a risk of radiation hazard for the pediatric patient, utility of the CT scanning to evaluate a pediatric abdominal mass is bound to increase. But we have to do more research work in relation of radiation hazards with diagnostic specificity of CT scanning. Finally with technical advancement and improvement of CT scanners like invent of multi row detector CT scanners like 64 & 256 slice, they should be compared for a specific lesion and should be optimized keeping three things in mind i.e. Technology, radiation hazard and diagnostic specificity.

## REFERENCES

1. Griscom NT. The roentgenology of neonatal abdominal masses. *The American journal of roentgenology, radium therapy, and nuclear medicine.* 93, 1965, 447-63.
2. Kirks DR, Merten DF, Grossman H, Bowie JD. Diagnostic imaging of pediatric abdominal masses: an overview. *Radiologic Clinics of North America.* 19(3), 1981, 527-45.
3. Nimkin K, Teeger S, Wallach MT, DuVally JC, Spevak MR, Kleinman PK. Adrenal hemorrhage in abused children: imaging and postmortem findings. *AJR. American journal of roentgenology.* 162(3), 1994, 661-3.
4. Smith WL, Franken EA, Mitors FA. Liver tumors in children. *Semin Roentgenol.* 18, 1983, 136-148.
5. Silverman PM, Kelvin FM, Korobkin M, Dunnick NR. Computed tomography of the normal mesentery. *American journal of roentgenology.* 1, 143(5), 1984, 953-7.
6. Crittenden SL, McKinley MJ. Choledochal cyst—clinical features and classification. *The American journal of gastroenterology.* 80(8), 1985, 643-7.
7. Isaacs H. Fetal and neonatal hepatic tumors. *Journal of pediatric surgery.* 42(11), 2007, 1797-803.
8. Davidson AJ, Hartman DS, Goldman SM. Mature teratoma of the retroperitoneum: radiologic, pathologic, and clinical correlation. *Radiology;* 172(2), 421-5.
9. Boechat MT. Adrenal glands pancreas and retroperitoneal structures in Siegal MT. ed. *Paediatric body CT*, New York. Churchill living stone, 1988, 177-217.
10. Donaldson JS, Shkolnik A. Pediatric renal masses. *SeminRoengenol.* 23, 1988, 194-204.
11. Fishman EK, Hartman DS, Goldman SM, Siegelman SS. The CT appearance of Wilms tumor. *Journal of computer assisted tomography.* 7(4), 1983, 659-65.
12. Luker GD, Siegel MJ, Bradley DA, Baty JD. Hepatic spiral CT in children: scan delay time-enhancement analysis. *Pediatric radiology.* 26(5), 1996, 337-40.

Source of Support: Nil, Conflict of Interest: None.

