Med. J. Cairo Univ., Vol. 62, No. 2, June (Suppl.) : 85-96, 1994.

Recent Concepts of Imaging of Renal Swellings in Pediatric Age Group

AYAT MOTAWIE, M.D.; MOSTAFA MOTAWIE,M.D.;
IBRAHIM EL-RATL, M.D. and MAGED ESMAEL, M.D.

The National Research Centre, Radiology and Pediatric Surgery Departments, Faculty of Medicine, Al-Azhar University.

Abstract

This study included 20 children, with renal swellings, aged from 1 month to 13 years, 12 males and 8 females. They were studied at Al-Azhar University Hospitals, in he period from April 1990 to August 1993. All cases were subjected to ultrasonic examination. Sonographic findings were compared with results of other diagnostic modalities, including CT., conventional radiology, operative and histopathological diagnosis. Basing on the results of this study, the authors believe that ultrasound must be the first choice in neonates and children with palpable flank or abdominal swelling. It had a specific diagnosis, so that no further evaluaiton was necessary in most cases. It is an excellent screening examination for suspected urinary tract obstruction with sensitivity of 93%. In cases of hydronephrosis, excretory urography should be done to confirm the diagnosis, reveals the nature of obstruction and to assess the function of involved kidney.

Introduction

DIFFERENT imaging modalities may be used for the diagnosis of renal swellings. Ultrasonic examination is simple, fast, non invasive and does not expose the child to ionizing radiation. It can be repeated, and even done at the bedside for high risk patients. It has largely replaced IVU as an initial renal imaging, with no need for intraveneous contrast medium.

The aim of this work is to assess the role of ultrasonography in the diagnosis of renal swellings in pediatric age group.

Material and Methods

20 patients were studied at Al-Azhar University Hospitals in the period from April 1990 to August 1993. Their ages ranged from 1 month to 13 years. They were 12 males and 8 females. All patients complained of abdominal mass, with or without loin pain and with or without hematuria. They were subjected to :

— Clinical examination.

— Laboratory investigations : urine analysis, blood picture and renal function tests.

Table (1) : Clinical Picture and Laboratory Investigations of Patients Presenting with Lion Masses.

Case No	Age	Sex	Clinical Presentation	Laboratory investigaitons		
				Urine	serum creatinine * mg/dl	Blood urea** mg/dl
1	8 years	F	Lt. flank mass	Free	0.8	22
2	2 years	F	Lt. flank mass	Free	0.5	25
3	7 years	M	Lt. lion mass & pain	R.B.C.S	0.9	30
4	10 years	M	Rt. flank mass	R.B.C.S	1	30
5	1 month	F	Lt. flank mass	Free	0.9	25
6	5 years	M	Bilateral flank masses	Free	1.5	50
7	3 years	M	Bilateral flank masses	Free	1.9	55
8	3 months	M	Bilateral flank masses	Free	1.2	35
9	8 months	F	Abdominal mass & low grade fever	+ve urine culture	1.5	50
10	4 years	M	Anuria +ve urine culture Bilateral flank masses	5	180	
11	8 years	M	Right loin mass, pain, fever & dysuria	R.B.C.S +ve urine culture	0.5	25
12	4 years	M	Hematuria, left loin mass	R.B.C.S	0.7	25
13	7 years	F	Rt. loin mass	R.B.C.S	0.5	32
14	8 years	M	Dysuria, hematuria	+ve urine culture	0.8	35
15	7 years	M	Hematuria + Rt. loin mass	R.B.C.S	0.8	40
16	8 years	M	Rt. loin mass, pain	+ve urine culture	1.1	30
17	8 months	F	Hematuria, dysuria Rt. loin mass	+ve urine culture	1	35
18	13 years	M	Lt. loin mass, pain	+ve urine culture	0.8	25
19	8 years	F	Lt. loin mass, pain,	R.B.C.S	1.2	35
20	7 years	F	Lt. loin mass, pain, hematuria	R.B.C.S	0.7	30

* Normal serum creatinine : Infant 0.2-0.4 mg/dl
Child 0.3-0.7
Adolescent 0.5-1.0

** Normal blood urea nitrogen: Infant/Child 5-18 mg/dl
Thereafter 7-18 mg/dl

Table (2) : Accuracy of U.S. Examination Versus other Diagnostic Modalities of Studied Cases.

Imaging finding	Image used			Final Diagnosis	Accuracy
	U.S	Exc. Urography	Other		
Large kidney with mass	**4 cases**	**4 cases**	**C.T. 4 cases**	**Wilm's T**	**100%**
Large kidney with mass	1 cases	1 case	histopathology 1 case	Chronic inflam. mass	100%
Large kidney with cysts	2 cases	2 cases	-	Polycystic kidney disease	100%
Large kidney with ectopic malrotation	1 case	1 case	C.T. 1 case	Retroperitoneal	100%
Large kidney with mass occupying pelvis & abdomen and displacing bowel loops	**1 case**	**1 case**	**C.T. 1 case** operation	**Retroperitoneal** abscess	**100%**
Large both kidneys with communicating cysts	**1 case**		• **Ascending cystourethrography, no reflux** • descanding pyelography Rt. pelviureterio obst	Bilateral pelviureteric obstruction	
Large kidney with calouli and pelviureterio obstruction	1 cases	1 cases	• **Ascending and descending pyelography show** Rt. pelviureterio obst	Rt.pelviuretrio obst. + stone Lt.kidney	
Large kidney with calouli	**7 cases**	**7 cases**	-	Hydronephrosis	**100%**
Large kidney with fluid level	1 case	1 case	• Percutaneous nephrostomy pyonephrosis	Rt. hydropyomephosis	100%
Normal size kidney with perinephric collection and splenic tear	**1 case**		• **No dye excretion of Lt** kidney • Deviation of U.bladder by Lt. pelvic space occupying lesion	**lt. renal and splenic** tear with collection	**100%**

— Ultrasonography.

— Plain & Excretory urography, computed tomography, exploration and histopathology of any surgically removed masses.

Fig. 1. Wilms tumour of Lt. kidney.

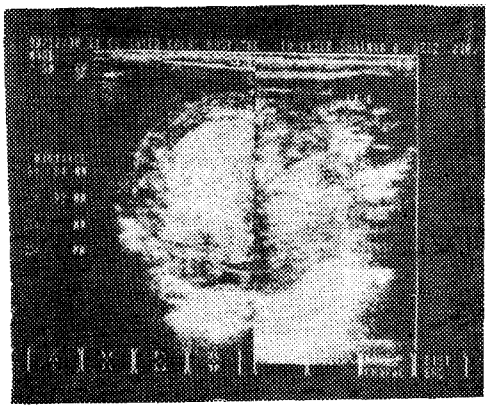

Fig. 1. a) Nephrosonography of the left kidney showed : echogenic mass arising from its lower pole with echolucent areas and ipsilateral hydronephrosis.

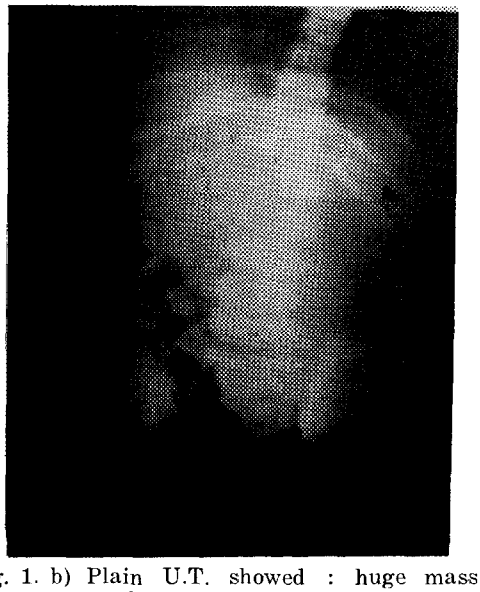

Fig. 1. b) Plain U.T. showed : huge mass displacing the air filled bowel.

Fig. 1. c) IVU showed : distortion of the left pelvicalyceal system, displacement and kinking of the left ureter.

Fig. 1. d) Pre contrast CT showed : huge mass blending imperceptibly with the left kidney.

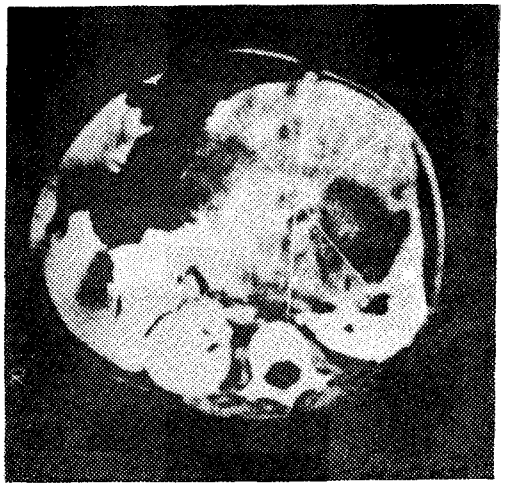

Fig. 1. e) Post contrast CT showed : heterogenous enhancement of the mass.

Ultrasonography was done by gray scale, real time ultrasound using trasducer 3.5 or 5 M.H. according to the patient's age and size. Upper-tract imaging is routinely started with the patient in supine position.

The right kidney is best examined subcostally or intercostally from the anterior approach, using the liver as an acoustic window. Normally, angling the transducer under the costal margin enables adequate visualization of both upper and lower poles of the kidney in a longitudinal plane. Otherwise, the transducer can be moved to an intercostal position. In some cases, the right kidney cannot be adequately visualized through the anterior approach. In these cases, the transducer is moved more laterally towards the mid-axillary line until an adequate longitudinal image has been obtained. Once the kidney has been identified longitudinally and at least three longitudinal scans have been obtained, the transducer is rotated 90° and three or four scans are acquired.

Fig. 2. Polycystic kidney disease.

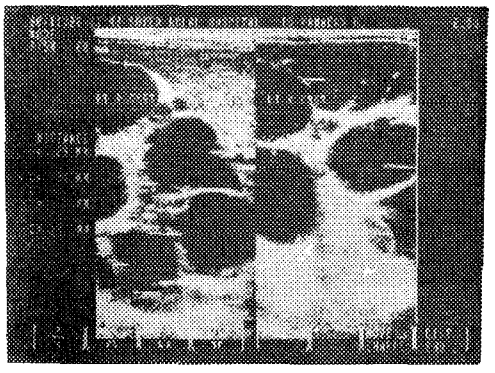

Fig. 2. a) Nephrosonography showed both renal parenchyma completely replaced by multiple non communicating transonic cysts.

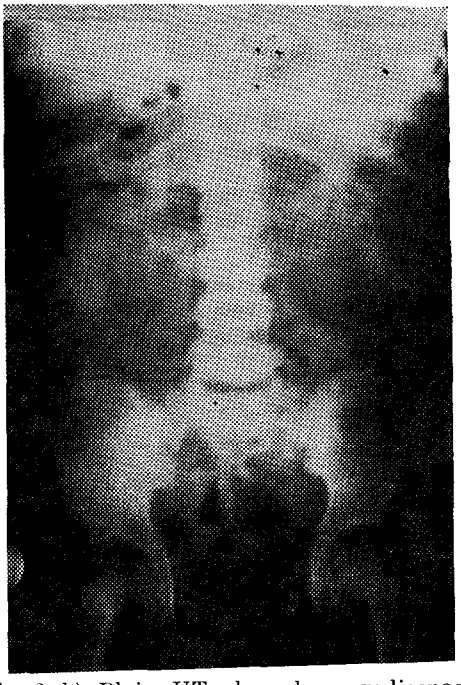

Fig. 2. b) Plain UT showed no radioopaque shadows.

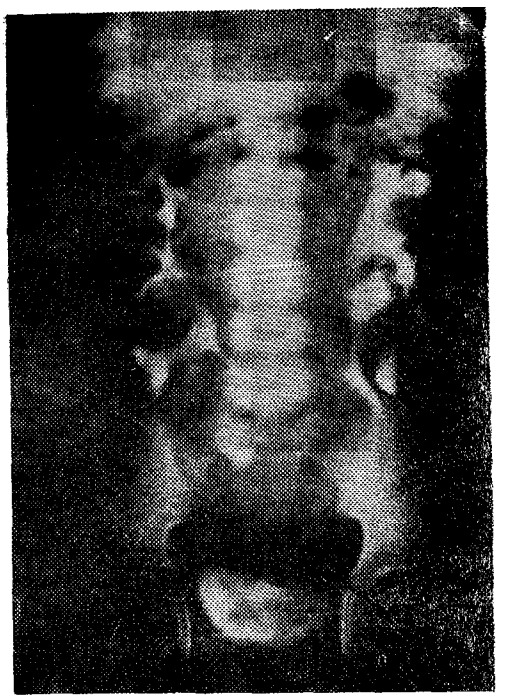

Fig. 2. c) IVU showed : elongated spalulated minor and major calyces.

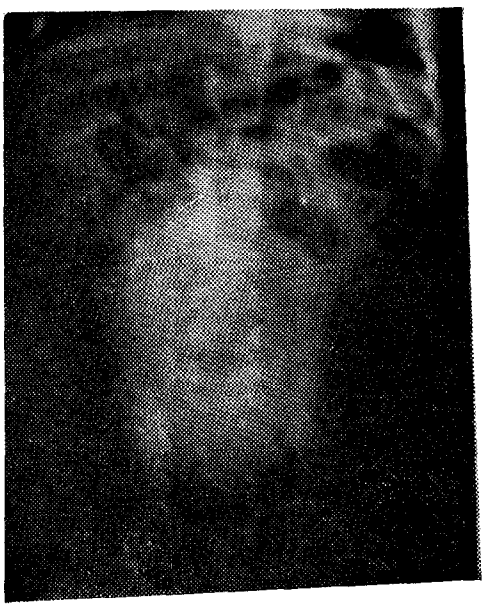

Fig. 3. b) Plain UT showed Soft tissue pelviabdominal mass causing displacement of the air filled bowel loops.

Fig. 3. Pelviabdominal abscess with hydronephrotic kidneys.

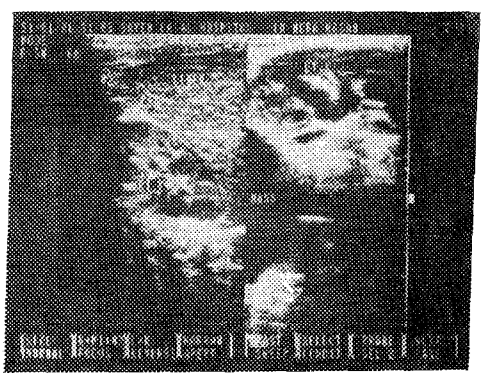

Fig. 3. a) Nephrosonography showed : Bilateral hydronephrosis.

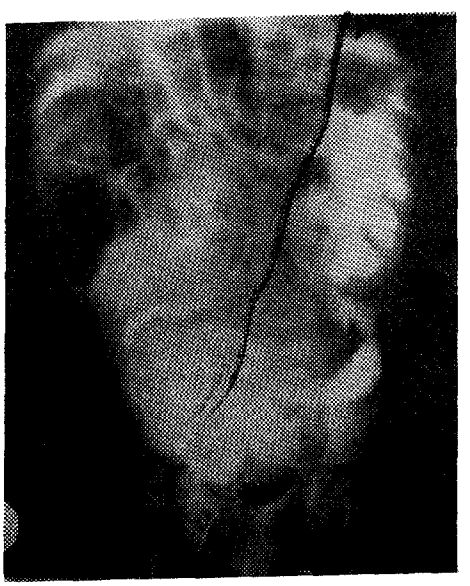

Fig. 3. c) IVU showed : Bilateral hydronephrosis with lateral displacement of the both ureters.

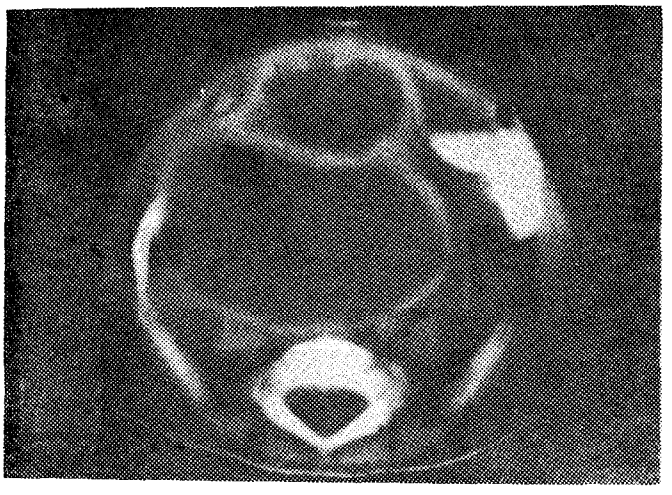

Fig. 3. d) C.T. showed : The abdominal extent of the multilocular pelviabdominal abscess with associated regular marginal enhancement and thickening of the adjacent tissue planes.

Fig. 4. Hydronephrotic kidneys with poor renal function.

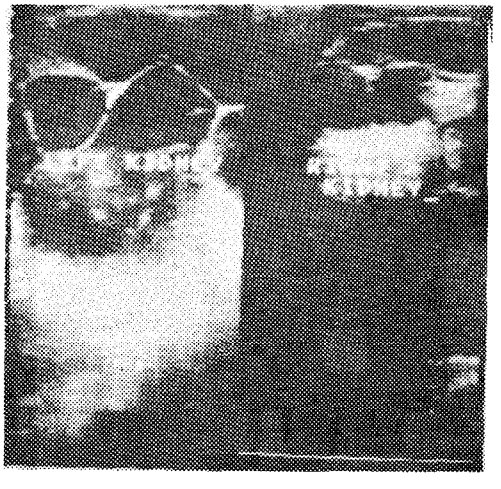

Fig. 4. a) Nephrosonography showed bilateral multiple communicating cysts (dilated calyces).

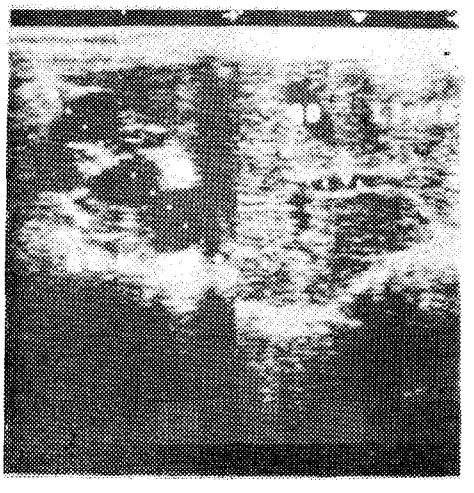

Fig. 4. b) Nephrosonography of the right kidney showed : mild enlargement. Its parenchymal echogenicity is equal to the liver echogenicity.

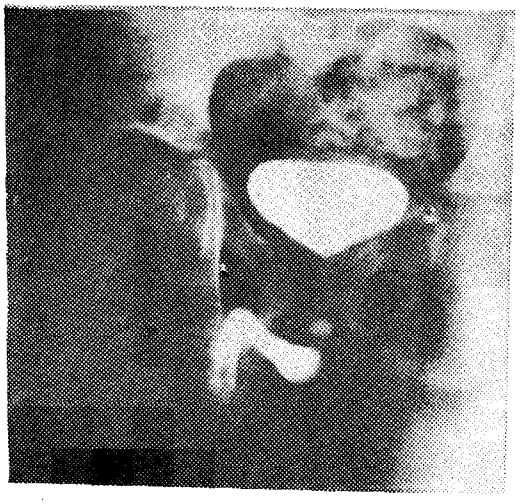

Fig. 4. c) Ascending cysto-urethrography showed no reflux.

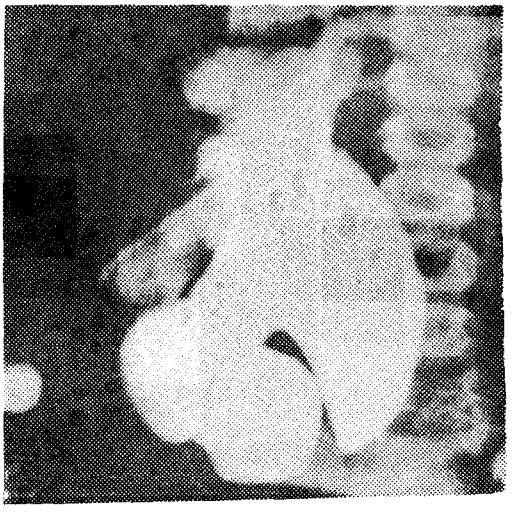

Fig. 4. d) Descending pyelography of the Rt.K. showed : huge pelvicalyceal dilatation with arrest of the dye at the pelvic ureteric junction.

Fig. 5. Blunt renal trauma.

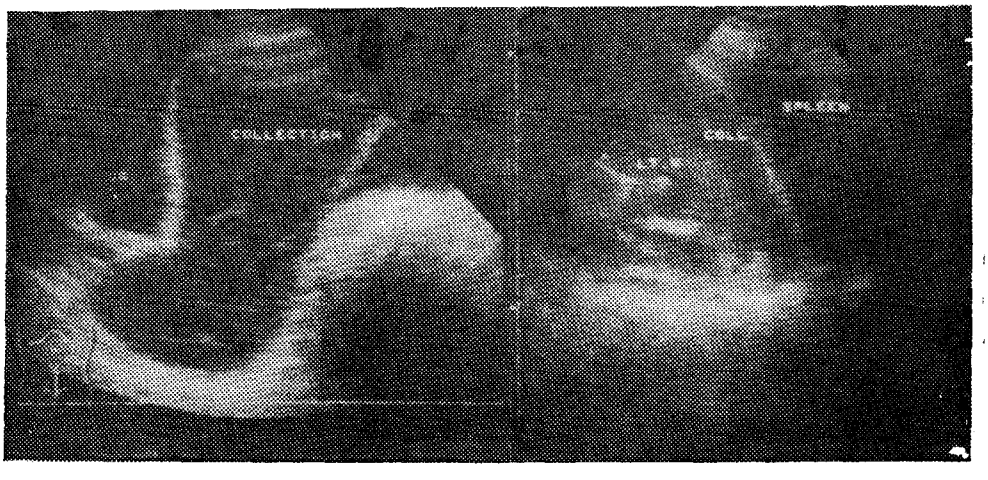

Fig. 5. a) A child with blunt abdominal trauma. Ultrasonography showed distortion of the left renal outline with heterogeneous echo pattern, suggestive of parenchymal lesion. Large amount of perirenal haematoma is seen extending to the left pelvic region. Splenic tear is also seen at the upper pole. The patient was operated upon and left nephrectomy and partial splenectomy were done.

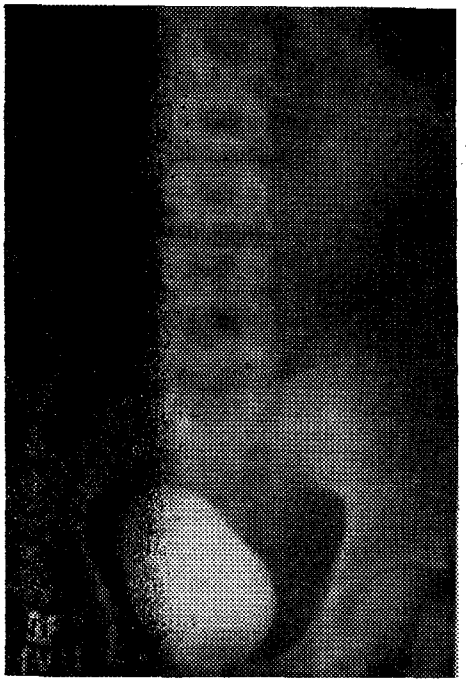

Fig. 5. b) Excretory urography of the same case revealed non functioning left kideny, the urinary bladder was deviated to the right side, by left pelvic collection.

Visualization of the left kidney is generally more difficult. On occasion, the spleen tip provides suitable acoustic window to enhance the quality of renal image. In most cases however, the left kikney must be viewed from the posterior approach. Generally, the examination is begun with the patient in the right lateral decubitus position, with the transudcer being placed at the left mid-axillary line either subcostally or intercostally until the renal oultine has been identified. The examiner should take advantage of normal caudal movement of the kidney on inspiration to obtain optimal imaging of the upper pole. Anterior imaging of the left kidney is seldom possible because of gas within the gastrointestinal tract.

Fig. 6. Hydro-pyonephrosis.

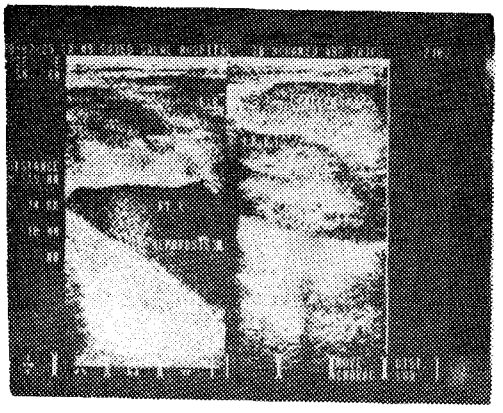

Fig. 6. a) Nephrosonography of the right kidney showed urine-debris level, moderately dilated calyces.

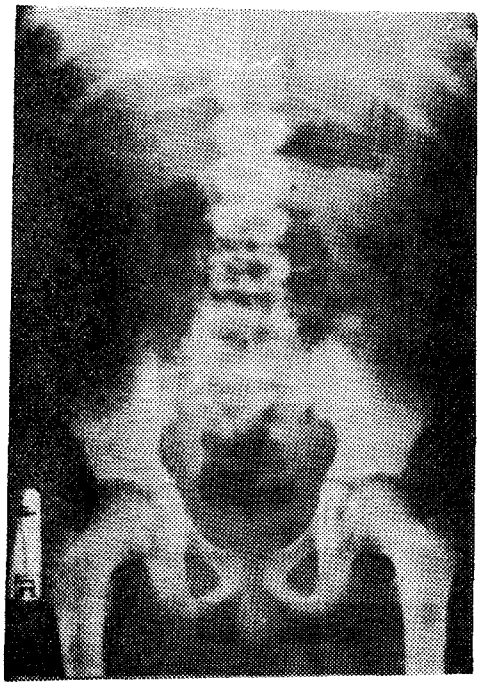

Fig. 6. b) Plain U.T. showed : two medium sized radio cpaque calcular shadows, one in the region of the right kidney and the other along the course of the right ureter.

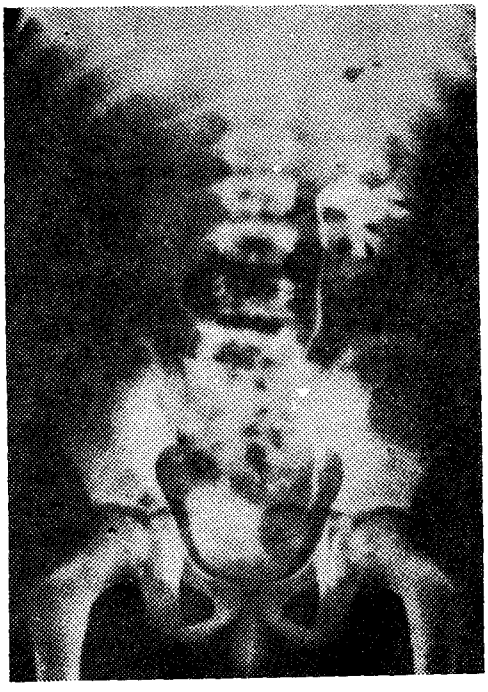

Fig. 6. c) The right kidney showed no evidence of contrast excretion.

Exploration of the renal masses was done in all cases where nephrectomy was done for renal tumours. Partial nephrectomy was done for some cases of avulsed renal pole causing urinoma. Pyeloplasty was done for cases of congenital hydronephrosis or some cases of traumatic injuries to the pelvicalyceal system of the kidney. The transabdominal and translumber ways were used depending on the type of the renal pathology.

Discussion

Ultrasonography is the initial evaluation of neonates and children with palpable flank or abdominal mass distinguishing between cystic, complex and solid lesions and finally characterizing soild lesions and the extent of any neoplastic disease. It has largely replaced execretory urography for initial renal imaging in nconate because of its independence from renal function, safety, flexibility and its rapid diagnostic yield [1].

It provides anatomic & morphologic information difficult to determine by conventional radiographic technique. This agreed with this study where sonographic findings prooved to be as accurate as other modalities (Plain U.T., execretory urography, C.T. scan, histopathology) in the diagnosis of pediatric renal masses. Glass et al [2] indicated that abdominal sonography is the first line imaging modality for children with abdominal masses as it characterizes the tumour fully. The radiologic features either from sonograpy or C.T. were the same in their studies and in this study (Fig. 1).

Shkolnik [3] stated that sonography is non specific except in polycystic disease of the kidney. This disargrees with the results of this study where we found that sonography was accurate in the diagnosis of all renal masses and had specific diagnostic value in polysystic kidney so that no further evaluation is necessary (Fig. 2). Sonography is an excellent screening examination for suspected urinary tract obstruction with a sensitivity of 93%.

Ultrasound is excellent for initial evaluation of suspected hydronephrosis, except for certain limitations related to the operator as checking for bladder distension which may give false positive cases [4].

Partial obstruction was more apparent in execretory urography because contrast induces diuresis which clears hydronephrosis in cases of false negative sonography. Malave et al[5] found that false negative examinations have been infrequent and generally occur with minimal degree of collecting system dilatation.

In hydronephrosis sonography is superior to execretory urography because it is indepenedt on renal function and severely obstructed kidney which can not be imaged by execretory urography but can be imaged by sonography. Diament et al [4] found that most congenital renal obstructions in neonates present with gress hydronephrosis that can be easily detected by sonography while acquired obstruction commonly accompained with minimal dilatation can not easily be detected by sonography (Fig. 3).

In this study sonographic diagnosis of hydronephrosis in neonates and children proved to have 93% sensitvity and this agreed with Diament et al[4] who found sensitivity of 90%. This study & Diament et al[4] showed that in patients with poor renal function ultrasonography was more specific and provided image detail superior to that of execretory urography. The main role of ultrasound in cases of renal failure is to exclude hydronephrosis (Fig. 4).

In blunt renal parenchymal trauma according to the study of Leppaniemi et al[6] :

— Patients with microscopic haematuria without obvious reason in the lower urinary tract should undergo ultrasonic examination of the kidneys even at the bedside.

— Patients with perirenal/retroperitoneal haematoma or suspected renal parenchymal lesion on ultrasound should have contrast enhanced C.T. as soon as possible.

— Patients with non-enhancement of one or both kidneys on C.T. or abdominal radiograph taken after C.T. should undergo renal angiography to exclude renal pedicle injury.

In this study, there were two cases of urinoma following kidney trauma, the first case showed non-functioning left kidney in I.V.U. Picture with lateral displacement of the bladder by mass lesion. Ultrasound examination showed a urinary collection around the upper pole with also a splenic tear and collection extending down to the pelvis. This case was operated upon two times; one for urgent splenic bleeding where partial splenoectomy was done and nephrectomy of the left kidney six weeks later (Fig. 5).

The second case was a completely avulsed ureter with a big urine collection aroumd the lower pole of the kidney following horse bite 3 months ago. Pyeloplasty was done to correct the hydronephrotic kidney.

Radiologic evaluation of pediatric patients, with urinary tract infection is necessary to elucidate congenital genitourinary tract anomalies that predispose to infection including vesicoureteric reflux which occurs in nearly 50% of children with urinary tract infection. The evaluation should

commence with voiding cystourethrogram and renal ultrasound examination [7] (Fig. 6).

References

1. AMIS, E.S. and HARTMAN D.S. : Renal ultrasonography : a practical overview. Radiol. Clin. North Am., Vol. 22 : 315-332, 1984.
2. GLASS, R.B.; DAVIDSON, A.J. and FRENBACH, S.K. : Clear cell sarcoma of the kidney; C.T., sonographic and pathologic correlation. Radiology, 180 : 715-717, 1991.
3. SHKOLNIK, A. : Application of ultrasound in neonatal abdomen. Radiol. Clin. North. Am., Vol. 23 (1), 141-156, 1985.
4. DIAMENT, M.J.; TAKASUGI, J. and KANGARLOO, H. : Hydronephrosis in children : reliability of ultrasound screening. Pediat. Radiol., 14, 31-36, 1984.
5. MALAVE, S.R.; NEIMAN, H.L. and SPIES, S.M. : Diagnosis of hydronephrosis : comparison between radionuclide scanning and sonography. A.J.R., 135 : 1179-1185, 1980.
6. LEPPANIEMIA, A.K.; KIVISAARI, AO.; HAPIAINEN, R.K. and LEHTONEN, T.A. : Role of magnetic Resonance imaging in blunt renal parenchymal trauma. Br. J. Urol., 68 : 355-360, 1991.
7. BERNSLEY, C.N. and ELDER, J.S. : Urologic imaging in pediatric patient. World Journal of Urology, Vol. 10 (4) : 183-189, 1992.