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CT and IVU in the Diagnosis of Wilms' Tumour

A Comparative Study

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Abstract. CT whole-body scanning has been performed in 20 children in the evaluation of a suspected Wilms' tumour. All the patients had abnormal urographic findings including a "non-functioning" kidney in 6 cases, severe urographic changes in ten cases and minor alterations suggesting a small space-occupying lesion in four patients. – A solid tumour was found in 13 of the patients, eight were renal tumours and five neuroblastomas. The rest of the children had benign lesions as the underlying cause of the abnormal clinical and radiological findings. – CT was superior to IVU in the differentiation between a solid tumour and benign lesions such as cysts and hydronephrosis; the examination gave important supplementary information of the size and extent of the solid nature of tumours and tended to be helpful in the preoperative differentiation between Wilms' tumour and neuroblastoma.

Key words: Computerized tomography – CT scanning – CT whole-body scanning – Intravenous urography – Wilms' tumour – Nephroblastoma

Intravenous urography (IVU) is, in itself, the most commonly used diagnostic study upon which the diagnosis of Wilms' tumour is usually made [1, 5, 10]. When IVU has been inconclusive other more invasive procedures such as retrograde pyelography or angiography have been advocated [6, 11].

The introduction of whole-body computerized tomography (CT) has offered a new non-invasive technique, which had already proved valuable in the evaluation of suspected abdominal masses in children [3, 4, 7, 12]. Comparison between CT and IVU has been made in a single study which concerned abdominal masses in general [9], and in particular between CT and ultrasonography in patients with neuroblastomas [2].

The present paper deals with a comparison of CT and IVU in a series of pediatric patients with an abdominal mass, a clinical suspicion of Wilms' tumour and an abnormal urogram.

Material and Methods

During a two years period starting December 1976, 20 children were scanned. The patient age ranged from 2 days to 10 years, the median age being 4 years. There were 14 girls and 6 boys.

Nineteen patients had a mass palpable in the abdomen and all 20 patients had abnormal urographic findings.

All the urograms had been performed prior to CT scanning; in 15 cases the IVU had been carried out at other hospitals before admission – dose of contrast medium and its volume were often unknown. Five patients were examined at our department, using sodium and methylglucamine diatrizoate (60% Urografin®) 3 ml/kg bodyweight. Tomography and late films were taken when there was delay in excretion or no excretion of contrast medium on the affected side.

The scanner being used is an EMI CT 5005 General Purpose Scanner, scantime 18 s with a slice thickness of 13 mm and a mutual distance between slices of 15 mm.

Finally, the original descriptions of the IVU and CT were compared and correlated to the final diagnoses obtained at operation in 17 patients, biopsy in one case and other clinical investigations in 2 cases.

Results

The findings in the 20 children are listed in 3 tables on the basis of the urographic findings.

Table 1 summarizes the CT findings in 6 patients with a non-functioning kidney.

CT revealed a tumour as underlying cause of the impaired function in 4 patients. In one case (No. 3) CT was unable to elucidate the type of the

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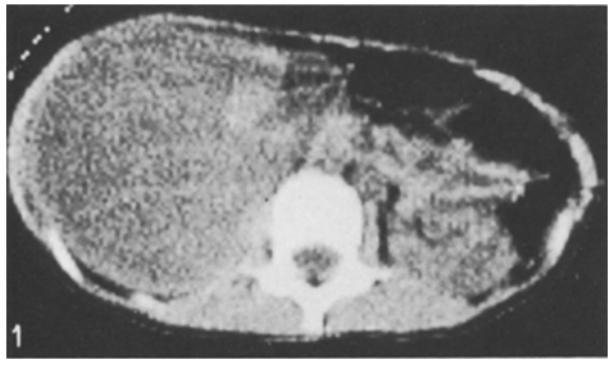


Fig. 1. A large retroperitoneal tumour in a five-year-old girl. IVU showing a non-functioning kidney. The tumour is low-absorptive, slightly inhomogeneous and well delineated. Operation revealed a Wilms' tumour

Table 1. CT findings and clinical correlations in patients with a "non-functioning kidney" on IVU

No.	Pt.	Age (years)	Sex	CT	Final diagnosis
1	R.W.	2	M	Wilms' tumour	Wilms' tumour
2	C.E.A.	4	F	Wilms' tumour	Wilms' tumour
3	L.L.H.	5	F	Retroperitoneal tumour	Wilms' tumour
4	N.A.	3	F	Neuroblastoma	Neuroblastoma
5	H.H.	9	F	Hydronephrosis	Hydronephrosis
6	I.P.	1	M	Hydronephrosis	Dysplastic kidney

retroperitoneal tumour (Fig. 1). Two benign renal lesions were found by CT; one was a hydronephrosis and the other a cystic dysplastic kidney which, however, at the time of scanning had been interpreted as being hydronephrosis. The final diagnoses have been obtained by operation in all six cases.

Table 2 shows the CT findings in 10 patients with severe urographic changes.

IVU indicated a Wilms' tumour in 7 patients and a retroperitoneal neuroblastoma in 3 patients. The radiological diagnosis of Wilms' tumour was based on the findings of an enlarged kidney or solid mass on the plain film and excretion in a distorted more or less displaced renal pelvis (Fig. 2). IVU findings, indicating a neuroblastoma, were a soft tissue mass with or without calcification, displacement of the kidney and only slight or no distortion of the renal pelvis. This interpretation was in accordance with the operative findings in 6 of the 10 patients. One case of bilateral Wilms' tumour (No. 2) was preoperatively considered to be unilateral, and one nephroblastoma turned out to be a benign infantile renal tumour (No. 1). In three patients (No. 10, 12, 15) distinction between Wilms' tumour and neuroblastoma was uncertain. Finally, one intrarenal abscess (No. 16) mimicked a Wilms' tumour.

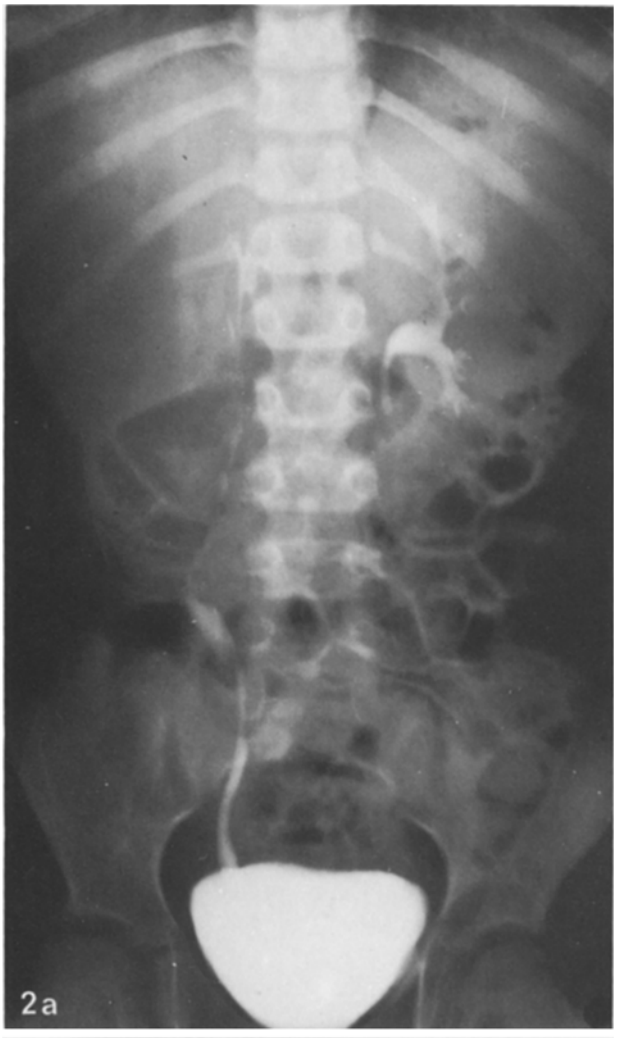
In this group of patients CT showed a tumour in all 10 patients. The type of tumour was in accordance with the final diagnosis in 8 of the patients, but the same reservations as mentioned in the results of IVU were made about the benign renal tumour (No. 1)

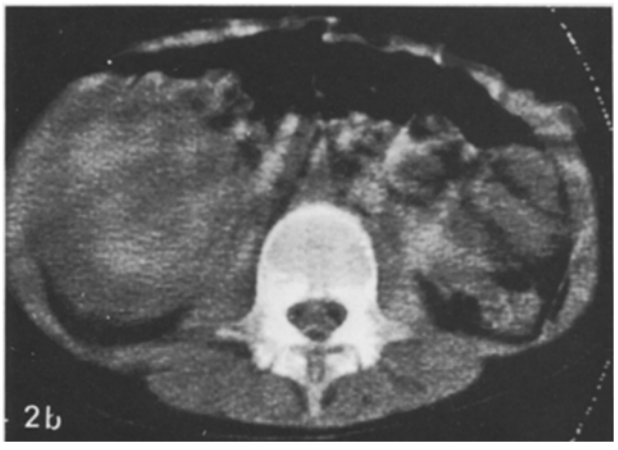
Table 2. CT findings and clinical correlations in patients with severe urographic changes

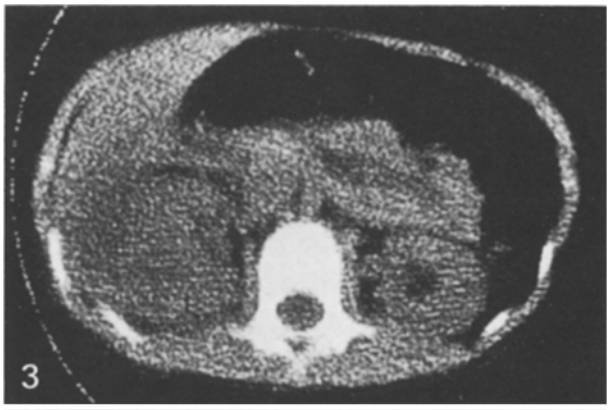
No.	Pt.	Age (years)	Sex	IVU	CT	Final diagnosis
7	P.H.	1 day	F	Wilms' tumour	Wilms' tumour	Mesoblastic nephroma
8	S.M.Ø.	4	F	Wilms' tumour	Wilms' tumour	Bilat. Wilms' tumour
9	H.D.N.	4	M	Wilms' tumour	Wilms' tumour	Wilms' tumour
10	J.W.	4	M	Neuroblastoma	Wilms' tumour	Wilms' tumour
11	M.K.N.	6	F	Wilms' tumour	Wilms' tumour	Wilms' tumour
12	S.Z.	3 months	M	Wilms' tumour	Wilms' tumour	Neuroblastoma
13	L.C.	1	F	Neuroblastoma	Neuroblastoma	Neuroblastoma
14	D.L.N.	2	M	Neuroblastoma	Neuroblastoma	Neuroblastoma
15	L.N.	9	F	Wilms' tumour	Neuroblastoma	Neuroblastoma
16	T.T.L.	6	F	Wilms' tumour	Renal tumour	Renal abscess

Table 3. CT findings and clinical correlations in patients with minor urographic changes indicating a small space-occupying lesion

No.	Pt.	Age (years)	Sex	IVU	CT	Final diagnosis
17	S.V.L.	4 months	F	Tumour?	Bilat. cysts	Polycystic kidneys
18	M.K.	1	F	Tumour?	Intraabd. abscess	Periappendicular abscess
19	L.T.	5	F	Tumour?	Normal kidneys	Intussusception
20	H.H.	10	F	Tumour?	Tumour?	Chronic pyelonephritis







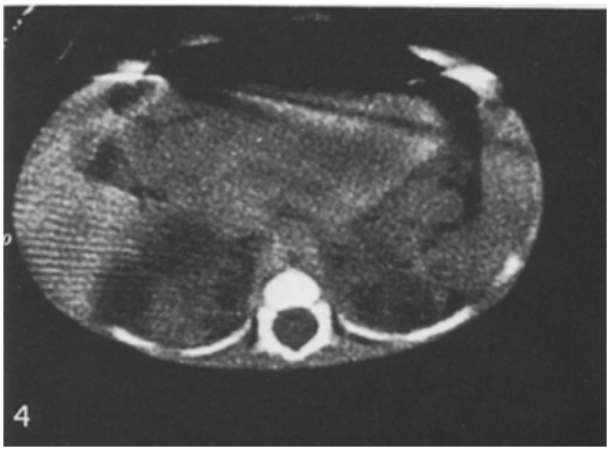


Fig. 2. a IVU in a six-year-old girl with a Wilms' tumour. The right renal pelvis is displaced and distorted. **b** Correspondent CT appearance of the tumour

Fig. 3. Upper abdominal scan of a six-year-old girl with an intrarenal abscess. The right kidney is enlarged with areas of decreased attentuation values and obliteration of the pericapsular fatplane laterally. Cysts were found in more caudal scans

Fig. 4. A four-month-old girl with polycystic kidneys. CT at the level of the upper parts of the kidneys shows bilateral renal enlargement and at least three cysts on the right side and 2 cysts on the left

and when missing a contralateral Wilms' tumour (No. 2). The intrarenal abscess was considered to represent an adult tumour, as the appearance of the lesion was almost similar to that of a hypernephroma (Fig. 3).

Furthermore, CT, we believe, provided important additional information concerning the extent and the size of the lesion in all ten patients, of whom nine were operated and one biopsied (No. 14).

Table 3 shows details of 4 patients with minor urographic changes, indicating a small space-occupying lesion.

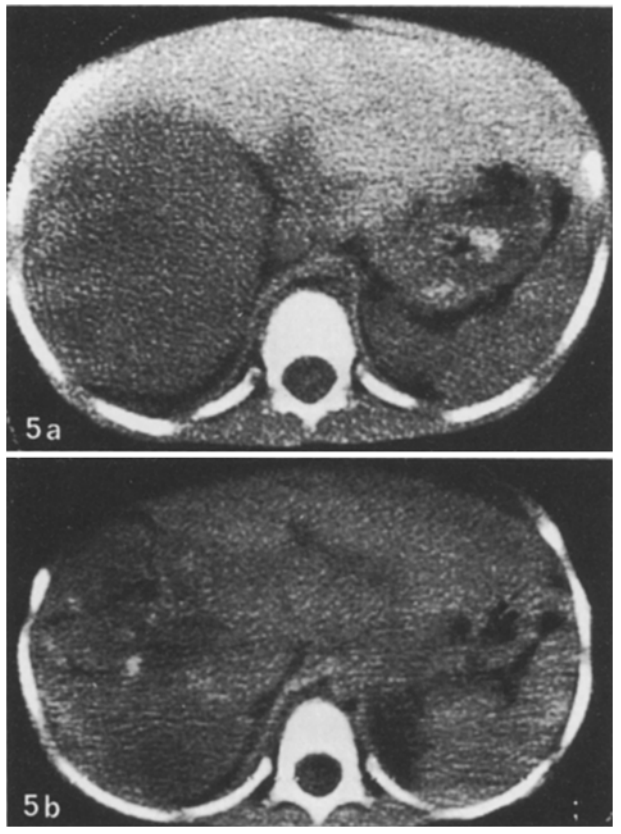


Fig. 5. a A large mixed Wilms' tumour of the right kidney. The tumour is well delineated with a smooth contour. Note the slightly displaced caval vein with preserved perivascular fatplane. **b** A large retroperitoneal neuroblastoma in the right side of the abdomen. The tumour is of irregular shape, containing small calcifications. It crosses the midline and there is blurring of the anterior border of the aorta – the vena cava cannot be identified

CT disclosed bilateral cysts in a 4 months old girl (No. 17, Fig. 4), in whom surgery was not performed. The scans showed normal kidneys in 2 patients (No. 18, 19), who both underwent surgery due to an intra-abdominal abscess in one case and recurrent intussusception of the colon due to a polyp in the other. In the last patient with a chronic pyelonephritis (No. 20) CT sustained the suspicion of a small space-occupying lesion. This suspicion was excluded on the basis of further clinical investigations and so no operation was performed, of course.

Discussion

IVU is the first investigation performed in a child with a mass palpable in the abdomen. In case of Wilms' tumour and neuroblastoma, this examination can be diagnostic in typical cases [5, 6, 10, 11]. However, it is important to realize that the "classic" case is not always the most common.

In this study of 20 patients, clinically suspected of Wilms' tumour, the IVU demanded supplementary radiological examinations to verify or exclude the diagnosis in 10 patients. Furthermore, in 8 patients with operatively verified renal tumours, the IVU was typical of an intracapsular tumour in only 4 cases; and 3 cases showed no excretion on the affected side and in one case appearances were indistinguishable from a retroperitoneal neuroblastoma.

CT whole-body scanning is a new radiologic modality and its potential applications in pediatric patients are just beginning to be realized [12]. There is no doubt that CT is an important aid in the evaluation of an abdominal mass and a valuable supplement to an IVU, as this study demonstrates.

In 20 examinations CT truely differentiated between a solid tumour and "benign" lesions in 18 cases. In evaluating the type of a tumour CT diagnosis was in accordance with the final diagnosis in 10 of 13 patients. Real mistakes were made in the case with an abscess. Small intrarenal lesions are difficult to visualize with CT as was demonstrated in the case of a bilateral Wilms' tumour and in a patient with chronic pyelonephritis.

The CT appearances of Wilms' tumour and neuroblastoma are much alike. A thorough reading of the scans of this material devoted to the shape, the relationship to the surrounding structures and the attenuation values of the two types of tumours gives the following impression:

(i) Wilms' tumour tends to be round and well-defined with a smooth contour. It is rather inhomogeneous, relatively low-absorptive with absorption values ranging from 16 to 30 EMI units (Fig. 5a). In most cases the tumour is limited to one side of the abdomen without crossing the mid-line or embedding the axial vessels.

(ii) The large neuroblastomas tend to be of irregular shape, crossing the midline and displacing or even totally obliterating the aorta and vena cava (Fig. 5b). The absorption values of the tumours varies from 0 in cystic areas to 30–35 EMI units in tumour tissue. Calcification was found in 2 of the patients. In four of the five patients it was possible to identify the displaced kidney separate from the tumour, an important sign in the differential diagnosis from Wilms' tumour.

In conclusion, CT is an important non-invasive tool in the evaluation of patients suspected of Wilms' tumour. It is superior to IVU in the diagnosis of a solid renal mass as against benign lesions such as cysts and hydronephrosis. Moreover, it may be important in the differential diagnosis between Wilms' tumour and neuroblastoma.

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