Personal practice

How useful is ultrasound in the management of abdominal malignancy?

J A KOHLER, C METREWELI, AND J PRITCHARD

Departments of Haematology and Oncology and Paediatric Radiology, Hospital for Sick Children, Great Ormond Street, London

Suspicion of abdominal malignancy in a child should lead to urgent radiological assessment. While standard radiological techniques are still important, the advent of ultrasound, computed tomography, and isotopic studies has broadened the spectrum of imaging investigations available to the clinician and diagnostic radiologist. A number of authors have reviewed the value of one or more of these investigations in the management of children with a particular type of tumour. Thus, it has been shown that both computed tomography and ultrasound can provide valuable information for the management of children with Wilms' tumour¹ and neuroblastoma.²⁻⁴ Although computed tomography may be more accurate than ultrasound^{3 5} in the diagnosis and staging of malignant tumours, it is also expensive, involves ionising radiation, and often demands sedation or anaesthesia. Because whole body computed tomography is not available in many centres including our own, and because there is no published information specifically indicating the value of abdominal ultrasound in the diagnosis and management of children presenting with newly diagnosed abdominal masses we decided to review our own experience in a consecutive series of 103 patients.

Patients

The case records of all children referred to this hospital over a four year period with a diagnosis of primary intra-abdominal malignancy were reviewed. In addition, any patients referred as having benign conditions and who were subsequently found to have a malignancy were included in the study. Wilms' tumours (41) and neuroblastomas (45) comprised the majority of tumours. The final diagnoses are listed in Table 1.

Each of the 103 children had an ultrasound examination within a few hours of admission. Some

Table 1 *Number of patients in each diagnostic category*

Final histopathological diagnosis		
Wilms' tumour		41
Unilateral	37	
Bilateral	4	
Neuroblastoma		45
Other malignant tumours		12
Non-Hodgkin's lymphoma	5	
Rhabdomyosarcoma	4	
Hepatoblastoma	2	
Ovarian teratoma	1	
Benign lesions		5
Choledochal cyst	1	
Parapelvic cyst	1	
Hamartoma liver	1	
Renal abscess	1	
Xanthogranulomatous pyelonephritis	1	

children with advanced disease at diagnosis received chemotherapy for several months before tumour excision, and in these ultrasound scans were repeated at 6 to 12 weekly intervals until laparotomy. A Philips Sonodiagnost B scanner with 5 MHz transducers was used, with vegetable oil as a coupling agent. Ninety four children (91%) underwent intravenous urography either here or at the referring hospital and these films were reviewed independently of the ultrasound findings as part of our study.

How helpful was ultrasound in predicting the diagnosis?

Table 2 shows the preoperative diagnosis made (a) on clinical examination at the time of referral, (b) after abdominal ultrasound, and (c) after intravenous urogram, where performed.

Ultrasound yielded a diagnosis of Wilms' tumour in 42 patients, later confirmed in 36 (86%): four others were found to have neuroblastomas, one a renal abscess, and one xanthogranulomatous pyelonephritis. Forty four patients were thought by

Table 2 Preoperative diagnostic accuracy

	No of patients	% (in each group) confirmed histopathologically
<i>(a) Clinical diagnosis</i>		
Wilms' tumour	47	77
Neuroblastoma	38	85
Other diagnosis	18	33
Total	103	72
<i>(b) Ultrasound diagnosis</i>		
Wilms' tumour	42	86
Neuroblastoma	44	86
Other diagnosis	17	71
Total	103	83
<i>(c) Intravenous urogram diagnosis</i>		
Wilms' tumour	39	90
Neuroblastoma	40	90
Other diagnosis	2	0
No diagnosis	13	—
Total	94	75

the ultrasonographer to have neuroblastoma and the diagnosis was confirmed in 38 (86%): five were found to have Wilms' tumours and one a renal non-Hodgkin's lymphoma. Thus, ultrasound was no more efficient than intravenous urography in the diagnosis of Wilms' tumour and neuroblastoma. Seventeen patients were diagnosed by ultrasound as having a lesion other than Wilms' tumour or neuroblastoma: in 12 the specific diagnosis was correct while in five patients, three of whom actually had neuroblastoma, the diagnosis was wrong. The higher overall diagnostic accuracy of ultrasound (83%) compared with intravenous urography (75%) was attributable to its superiority in the diagnosis of tumours remote from the renal bed.

We carefully analysed the 17 cases in which the ultrasound diagnosis was wrong. In 10 patients specific ultrasonographic features were not characteristic of the tumour eventually diagnosed and misinterpretation was felt to be inevitable; this group included two patients with intrarenal neuroblastoma. In each of the remaining seven patients misinterpretation was felt to be avoidable and due to inexperience. In skilled hands, therefore, we feel that the diagnostic accuracy of ultrasound should be around 90%, a figure comparable with the conclusions of a study in which Stark *et al*³ found ultrasound to have 91% diagnostic sensitivity for neuroblastoma.

It is worth noting that the 24 hour urinary vanillylmandelic acid excretion was significantly raised in 42 of 45 (95%) children with neuroblastoma in one series,⁶ thus helping to establish a preoperative diagnosis independently of the radiological findings.

Did ultrasound lead to precise abdominal staging of tumours?

There was good correlation between the spread of tumour predicted by ultrasound and the histological findings after surgery in 30 of 41 patients with Wilms' tumour (73%), in 19 of the 30 children with neuroblastoma who have so far undergone laparotomy (63%), and in 10 of 12 other malignant tumours (83%). Precise staging of abdominal disease which depends on evidence of microscopic spread as well as macroscopic features is not always possible with ultrasound.

Since capsular invasion, found in six patients, was never identified (Wilms' tumours) and local spread (Wilms' and neuroblastomas) was predicted by ultrasound in only 25% of patients, we were unable, for instance, to discriminate between stage I and II tumours.^{7,8} A similar conclusion was reached by Levine *et al*⁹ in a study of adults with renal tumours. It was also very difficult to identify nodes abutting upon a large tumour and impossible to decide if enlarged nodes were invaded by tumour or were reactive. This is hardly surprising since even macroscopically normal nodes were frequently found to contain tumour when resected at laparotomy.

Four patients with Wilms' tumour had renal vein invasion, only one of these being correctly predicted by ultrasound before operation. Renal vein invasion should be easier to see on the left side than the right but our numbers were clearly too small for specific comment.

When the inferior vena cava is compressed and displaced by a large tumour ultrasound identification is difficult. Occasionally, altering the posture of the child may show blood flow and, therefore, patency of the inferior vena cava. Secondary deposits in the liver parenchyma should be readily detected by ultrasound, but it is much more difficult to visualise subcapsular metastases or direct invasion from a right sided tumour. Similarly subcapsular nodules in the kidney are easily missed. The contralateral subcapsular Wilms' tumour included in this series was unsuspected until the posterior aspect of the 'healthy' kidney was examined at laparotomy.

Did ultrasound correctly predict the surgical resectability of the mass?

Because the ultrasonographer cannot identify the lower limit of pelvic tumours and is, therefore, unable to predict their resectability, and because the small group of 'other' malignant tumours is so heterogeneous, we limited this aspect of our analysis to the 71 patients with Wilms' tumour and neuroblastoma who underwent laparotomy (Tables 3 and

Table 3 *Resectability of Wilms' tumour*

Surgical resectability of tumour	Timing of surgery	
	At diagnosis	After chemotherapy
Complete	29 (29)	6 (6)
Incomplete	4 (3)	2 (1)
Totals	33 (32)	8 (7)

Figures in brackets indicate numbers of tumours for which ultrasound prediction was correct.

Table 4 *Resectability of neuroblastomas*

Surgical resectability of tumour	Timing of surgery	
	At diagnosis	After chemotherapy
Complete	9 (9)	9 (9)
Incomplete	7 (3)	5 (3)
Totals	16 (12)	14 (12)

Figures in brackets indicate number of instances in which ultrasound prediction was correct.

4). These tables also indicate the number of patients who had chemotherapy before operation.

The ultrasonographer always identified correctly those tumours which could be completely resected surgically, whether at diagnosis or after chemotherapy. Of 18 tumours which proved to be incompletely resectable, however, only 10 were correctly identified as such by ultrasound, the other eight being thought by the ultrasonographer to be resectable. Resectability, which overall was accurately predicted in 63 (89%) of these 71 tumours, depends primarily on involvement of major blood vessels and other vital organs close to the tumour. The tendency of ultrasound to overestimate the likelihood of complete excision presumably results from its inaccuracy in definition of local spread.

Conclusions

Ultrasound is a safe, non-invasive, and inexpensive investigation which we have found to be acceptable to children for both isolated and repeated examination. All 103 children were examined without preparation or sedation, and wherever possible in the presence of their parents. In a few instances the child could not be calmed sufficiently at the first attempt but each examination was successfully completed later in the day. The ready acceptance of

ultrasound means that response to treatment can be monitored frequently.

Clearly, ultrasound contributes more information than intravenous urography about tumours or metastases remote from the renal bed. Its main limitation—poor recognition of local tumour spread—can lead to inaccurate preoperative staging and a misleading prediction of surgical resectability.

Recommendations

In a district general hospital we should expect that most Wilms' tumours and neuroblastomas could be accurately identified by intravenous urography and 24 hour urinary vanillylmandelic acid estimations. Since children with abdominal tumours are likely to be referred to specialist units for further investigation and treatment planning it seems appropriate for the definitive ultrasound examination to be carried out at the paediatric oncology centre, where experience is likely to lead to greater diagnostic accuracy.

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Correspondence to Dr J Pritchard, Department of Haematology and Oncology, The Hospital for Sick Children, Great Ormond Street, London WC1 3JH.