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(Accepted 22 October 1990)

Diagnosis of abdominal masses with percutaneous biopsy guided by ultrasound

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Abstract

Objective—To assess the accuracy and safety of percutaneous biopsy of abdominal masses guided by ultrasound.

Design—Prospective study.

Setting—Combined gastroenterology service, Scarborough Hospital.

Patients—108 Consecutive patients identified as having a discrete mass on diagnostic ultrasound examination of the abdomen.

Intervention—A sample of tissue was obtained with an aseptic technique under local anaesthesia: an 18 steel wire gauge needle (Tru-Cut) was mounted in a spring loaded firing device (Biopty gun) that was advanced under simultaneous ultrasound scanning, permitting precise localisation of the target organ.

Main outcome measure—Results of histological examination of tissue specimens.

Results—Biopsy failed in four patients. Adequate histological specimens were obtained in 104 patients with masses in the liver (31), pancreas (37), kidney (10), and adrenal glands (six) and in 20 undiagnosed abdominal and retroperitoneal masses. Follow up was until death or confirmation of the diagnosis. Three complications but no deaths occurred. Malignancy was suspected in 84 patients before biopsy. This was confirmed in 70 patients, in 26 of whom confirmation of dissemination obviated the need for further investigation. In 10 patients biopsy indicated a previously unsuspected primary tumour, and in 12 it showed only a benign lesion. Among 24 patients considered to have benign disease biopsy showed an unsuspected neoplasm in seven. Use of biopsy thus had a major effect on clinical management in 55 patients. Four false negative but no false positive diagnoses resulted from the procedure.

Conclusion—Percutaneous biopsy of abdominal and retroperitoneal masses under ultrasound guidance is a safe and accurate method of obtaining a histological diagnosis. The results obtained have a considerable effect on clinical management.

Introduction

An important obstacle in managing patients with intra-abdominal and retroperitoneal masses is the difficulty in safely obtaining an accurate diagnosis based on the results of histological examination without doing a laparotomy. This is particularly important in elderly patients with suspected malignancy, in whom surgery is often hazardous. Attempts to overcome this problem with percutaneous biopsies with large gauge needles have had only limited success

because of considerable associated morbidity.^{1,2} Many authors recommend using fine needle aspiration cytology, but this requires specialist skills, which are not always available.³⁻⁷

More recently a system has been developed that enables biopsy of the targeted organ to be performed percutaneously with ultrasound guidance.⁸ The tissue specimens obtained are suitable for routine histological examination. After successfully applying this technique to biopsy of the pancreas⁹ we applied it more generally in investigating patients with abdominal masses. We report our initial experience with particular reference to the accuracy and safety of the technique.

Patients and methods

We analysed prospectively 108 consecutive patients who presented to our combined gastroenterology service over three years in whom abdominal ultrasound scanning confirmed the presence of a clinically or radiologically suspected mass or identified a previously undetected discrete mass. In many cases malignancy was suspected and it was important to confirm or exclude the presence of disseminated disease. Thirty two patients underwent percutaneous biopsy, guided by ultrasound, of lesions of the liver. In 13 patients with hepatomegaly ultrasound scanning showed single (seven) or multiple (six) lesions. Eleven patients with proved malignant disease were scanned to exclude liver metastases. In eight patients ultrasound scanning was performed to investigate non-specific abdominal symptoms.

Twenty patients underwent biopsy of abdominal or retroperitoneal lesions. Six had a palpable abdominal mass, and two presented with abdominal pain but had no abnormalities on examination or on contrast radiological examination. Six patients underwent biopsy of para-aortic or retroperitoneal lymph nodes, of whom two had received treatment for lymphoma. Three patients with abnormal results of liver function tests had portal lymphadenopathy on ultrasound examination. Two patients underwent biopsy of the pylorus after equivocal findings on endoscopy and radiological examination. One patient in whom the result of endoscopic retrograde cholangiopancreatography was equivocal had a lesion identified in the choledochojunal anastomosis from a previous Whipple's operation. All but six of this group had other extensive investigations before ultrasound scanning identified a mass.

Ten patients underwent biopsy of renal masses; in six these were an incidental finding at intravenous urography. Two patients had had a nephrectomy for

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Br Med J 1990;301:1188-91

carcinoma, and recurrence was suspected. A renal mass was found on computed tomography in one patient with acute pancreatitis. The remaining patient had myelomatosis. Six patients underwent biopsy of adrenal masses; in four of these metastatic deposits were suspected, and two were being investigated for general malaise.

Biopsy of the pancreas was performed in 40 patients with a mass detected by ultrasound scanning. Most of these patients (28) were considered to have pancreatic carcinoma and 16 were jaundiced. Chronic pancreatitis had been diagnosed clinically in six patients. Six patients had pancreatic cysts, of whom two had chronic pancreatitis and four acute pancreatitis. Thirty of these patients were included in a previous report⁹ but are included in this series for completeness.

All patients fasted for six hours before biopsy. A coagulation screen was performed and serum grouped and saved. No antibiotic prophylaxis was given. All patients were observed for a minimum of 24 hours after the procedure, but no restrictions on eating or drinking were imposed unless clinically indicated. Patients were followed up until death or confirmation of the diagnosis.

The biopsy technique was originally described by Lindgren for hepatic and renal biopsy.⁸ All biopsies were performed with a real time ultrasound machine. Initially, detailed scanning was performed to plan the route of the biopsy. The entry point was marked on the skin and, using an aseptic technique, the biopsy track was infiltrated with 2% lignocaine to the peritoneum. An 18 steel wire gauge biopsy needle (Tru-Cut) was mounted in an automatic firing device with a spring loaded mechanism (Biopsy, Radiplast AB, Uppsala) that was operated with one hand, permitting simultaneous scanning. The needle tip and its track during biopsy were shown ultrasonically, ensuring precise sampling of the target lesion. The biopsy needle was advanced under continuous ultrasound guidance to the edge of the mass. The trigger mechanism was then activated and the needle withdrawn.

Biopsy specimens were fixed in 10% formalin and embedded in paraffin wax. In most patients a firm diagnosis was made with standard stains. Additional microbiological and immunological stains were used when necessary.

Results

Complications occurred in three patients. These were minor in two, one of whom developed transient abdominal pain and the other a haematoma that resolved without treatment. The only severe complication was septicaemia in a jaundiced patient in whom biopsy confirmed carcinoma of the head of the pancreas; this resolved after treatment with antibiotics, and she subsequently had a successful Whipple's operation. No deaths related to the biopsy occurred. In four patients biopsy yielded insufficient tissue for histological examination, but adequate specimens were obtained in the remaining 104 patients.

SUSPECTED MALIGNANT LESIONS

Malignancy was suspected in 84 patients after clinical assessment and investigation (table I). Biopsy failed in two patients. Twelve of these patients proved to have benign disease, and follow up did not result in a change in the diagnosis ("unsuspected benign disease," table I). In 10 patients the clinical diagnosis of malignancy was confirmed but histological examination showed that the primary tissue of origin was different from that suspected ("altered primary"). This group included four patients considered to have primary or metastatic liver cancer who proved to have carcinoid; four patients considered to have pancreatic carcinoma in whom histological examination showed ampullary, gastric, and metastatic carcinoma and lymphoma; and two patients in whom suspected primary liver cell cancer or hypernephroma proved to be metastatic adenocarcinoma.

Metastatic disease was diagnosed in 26 patients with suspected malignancy (13 with liver, five with adrenal, and eight with abdominal masses), which obviated the need for further investigation. In 31 patients, including 20 with pancreatic carcinoma, the biopsy confirmed the clinical and ultrasound diagnosis of a primary carcinoma.

Follow up showed that biopsy yielded false negative diagnoses in three patients suspected of having malignant lesions. Biopsy in one patient showed cirrhosis, although she was suspected to have a hepatoma and this proved to be the case at later necropsy; in two other patients considered to have metastatic liver disease the results of biopsy were normal or showed necrotic tissue, but both patients died within three months and were proved to have carcinomatosis.

TABLE I—Clinical diagnosis and histological diagnosis after biopsy in 84 patients with suspected malignancy

Clinical diagnosis	Histological diagnosis	No	Comments
Adrenal tumour (n=6)	Metastatic adenocarcinoma	5	
	Hyperplasia	1	Unsuspected benign disease
Pancreatic carcinoma (n=28)	Diagnosis confirmed	20	
	Chronic pancreatitis	2	Unsuspected benign disease
	Extrapancreatic neoplasm	4	Altered primary*
	Failed biopsy	2	
Clear cell carcinoma (n=6)	Diagnosis confirmed	3	
	Normal	2	Unsuspected benign disease
	Metastatic adenocarcinoma	1	Altered primary
Primary liver cell carcinoma (n=9)	Diagnosis confirmed	2	
	Carcinoid	1	Altered primary
	Metastatic adenocarcinoma	1	Altered primary
	Cirrhosis	3	Unsuspected benign disease (2), false negative finding (1)
Adenocarcinoma liver metastatic (n=15)	Diagnosis confirmed	13	
	Carcinoid	3	Altered primary
	No malignancy	2	False negative findings
	Subacute necrosis	1	Unsuspected benign disease
Lymphoma (n=4)	Diagnosis confirmed	3	
	<i>Mycobacterium avium</i> infection	1	Unsuspected benign disease (HIV positive)
Lymphatic metastasis (porta hepatis) (n=3)	Diagnosis confirmed (cholangiocarcinoma)	1	
	Reactive change	2	Unsuspected benign disease
Myeloma (n=1)	Pyelonephritis	1	Unsuspected benign disease
Retroperitoneal sarcoma (n=1)	Liposarcoma	1	
Pyloric carcinoma (n=1)	Diagnosis confirmed	1	
Anastomotic recurrence (after Whipple's operation) (n=1)	Diagnosis confirmed	1	
Intra-abdominal metastasis (n=7)	Diagnosis confirmed	7	

*Ampullary (1), gastric (1), metastatic (1), lymphoma (1).

TABLE II—Clinical diagnosis and histological diagnosis after biopsy in 24 patients with suspected benign disease

Clinical diagnosis	Histological diagnosis	No	Comments
Chronic pancreatitis (n=6)	Diagnosis confirmed	4	False negative result (1)
	Insulinoma	1	Unsuspected malignancy
	Failed biopsy	1	
Pancreatic pseudocyst (n=6)	Pancreatitis	5	
	Cystadenocarcinoma	1	Unsuspected malignancy
Mesenteric cyst (n=2)	Dermoid cyst	1	
	Lymphoma	1	Unsuspected malignancy
Renal cyst (n=2)	Clear cell carcinoma	1	Unsuspected malignancy
	Diagnosis confirmed	1	
Haemangioma (kidney) (n=1)	Clear cell carcinoma	1	Unsuspected malignancy
Psoas haematoma (n=1)	Plasmacytoma	1	Unsuspected malignancy
Liver cyst (n=3)	Diagnosis confirmed	2	
	Equivocal	1	Carcinoma excluded at laparotomy
Hepatic steatosis (n=2)	Metastatic adenocarcinoma	1	Unsuspected malignancy
	Failed biopsy	1	
Hepatic abscess (n=1)	Hepatitis	1	

TABLE III—Details of follow up until death or confirmation of diagnosis at laparotomy of patients with malignancy or benign disease, excluding those in whom biopsy failed or yielded false negative results

Diagnosis	No of patients	Laparotomy	Necropsy	Followed up for >1 year (duration years)	Comment
<i>Patients with malignancy (n=74)</i>					
Primary neoplasm	36	17	5	*	13 Died within one year
Metastatic carcinoma	30†	8	1	*	20 Died within one year
Carcinoid	4		1		3 Had progressive disease
Lymphoma	4	1	1		2 Were in remission after treatment
<i>Patients with benign disease (n=26)</i>					
Chronic pancreatitis	10	3		7 (2.0 to 3.6)	
Parenchymal liver disease	6		3	3 (1.4 to 2.5)	2 With cirrhosis died
Benign cyst	5	4		1 (1.0)	
No abnormality on biopsy	3			2* (1.0 to 1.6)	
Positive for HIV	1			1	
Pyelonephritis	1			1 (3.0)	

*One patient lost to follow up.

†In seven patients a primary tumour was subsequently found.

Thus in 22 patients with suspected malignant lesions (12 with unsuspected benign masses and 10 with altered primary tissue) a different diagnosis was established, and in 26 disseminated malignancy was confirmed.

SUSPECTED BENIGN LESIONS

Among the 24 patients with a clinical diagnosis of benign disease biopsy was unsuccessful in two (table II). Biopsy in seven cases showed malignancy. One false negative result occurred: biopsy confirmed the clinical diagnosis of chronic pancreatitis, but on histological examination after excisional surgery adenocarcinoma in association with chronic pancreatitis was identified.

FOLLOW UP

Follow up of patients was by review in the outpatient department or until death or confirmation of the diagnosis after laparotomy (table III). At the time of writing the diagnosis reached by means of biopsy, in particular the presence or absence of malignancy, was incorrect in four patients as described above. Biopsy did not yield any false positive results.

Among the 74 patients in whom malignant disease was diagnosed by biopsy this was confirmed at laparotomy or necropsy in 34. A further 33 patients died within one year, and five were still alive (three with metastatic carcinoid and two with lymphoma in remission after treatment). Two patients were lost to follow up. Among the 26 patients in whom benign disease was diagnosed by biopsy this was confirmed in 11 at laparotomy or necropsy. Apart from one patient lost to follow up, the remainder were alive after at least one year and their disease was pursuing its expected clinical course; the patients with chronic pancreatitis were all followed up for at least two years so that a missed carcinoma was improbable.

Discussion

Use of abdominal ultrasound scanning to investigate patients with gastroenterological disorders is common. In patients with a palpable mass it may identify the tissue of origin but further investigations are often required to establish a firm diagnosis without laparotomy. In many other patients, as shown in this series, ultrasound scanning detects a previously unsuspected abdominal mass, the clinical importance of which may be unclear. Clearly, managing any patient with an abdominal mass is greatly helped by a knowledge of its histology.

In 1982 Lindgren described a percutaneous needle biopsy technique for the kidney and liver with several practical advantages.⁸ Ultrasound scanning can continue during biopsy to confirm that the correct target has been sampled. The biopsy specimen is large enough for histological assessment. Reported experience, however, is limited. In an initial series of 45 hepatic and renal biopsies the technique proved to be safe and accurate.⁸ Donald *et al* used the method successfully to obtain biopsy specimens of lymph nodes in six patients positive for HIV and referred to its safety in an unpublished study of 200 intra-abdominal biopsies.¹⁰ We have reported successfully applying the technique to pancreatic biopsy, and Parker *et al* have described their experience in a heterogeneous group of patients in whom computed tomography and fluoroscopic guidance were used in addition to ultrasound guidance.^{9 11}

Our results suggest that there are few disadvantages associated with the technique. Biopsy was impracticable or failed to provide an adequate specimen in only 4% of the series. Three complications (one of which was serious) but no deaths occurred. Tumour seeding is a theoretical problem but did not occur in this series. These results compare favourably with those reported for fine needle aspiration biopsy. Mortality associated with fine needle aspiration biopsy is negligible, and serious complications are rare; the technique's safety is a consequence not only of the fine needle used but also of the accurate localisation of the target organ with ultrasound scanning or computed tomography before biopsy. The low incidence of complications of percutaneous biopsy guided by ultrasound in this series must also reflect the accuracy of localisation before biopsy.

No false positive diagnoses and only four false negative diagnoses occurred in this series. The absence of false positive diagnoses means that the positive predictive value approaches 100%, which has enormous implications for managing patients.

The sensitivity of fine needle aspiration biopsy for abdominal malignancies is 65-95%,³⁻⁶ depending on selection criteria as well as the skill of the operators.¹² An experienced cytologist and good technique are necessary for success, but these constraints do not apply to percutaneous biopsy guided by ultrasound. Good ultrasound scanning is now widely available, as is the skill to interpret histological specimens. The results of this series suggest that the sensitivity of percutaneous biopsy guided by ultrasound will be comparable with or better than that of fine needle aspiration biopsy and the method will not be limited to specialist centres.

We accept that the diagnosis obtained from percutaneous biopsy guided by ultrasound was not confirmed independently by necropsy or surgical histological examination for all patients. All except five patients with malignant disease, however, did have confirmation by surgery or biopsy or died within one year. Of these five patients, two had lymphoma, which went into remission, and three had metastatic carcinoid, which progressed clinically and radiologically as expected. Follow up in the patients with benign

disease unconfirmed by laparotomy or necropsy was sufficiently long to make an erroneous diagnosis extremely unlikely. We conclude that our incidence of false negative and false positive diagnosis is unlikely to change, particularly as the four false negative diagnoses were all identified within six months of biopsy.

The potential clinical benefits of biopsy guided by ultrasound are well illustrated in this series. The addition of histological sampling to the ultrasound evaluation corrected the erroneous clinical diagnosis of malignancy in a tenth of patients as well as identifying the correct primary tissue in a further tenth. We thus considerably increased our diagnostic accuracy with major implications for treatment. In a further 26 patients, a quarter of this series, confirming metastatic malignancy removed the need for laparotomy. As the main objective in such patients is effective palliation, avoiding surgery with its morbidity and mortality is beneficial. The need or otherwise for surgery and other invasive investigations also has important implications for costs. Our study suggests that this technique will effect considerable savings because a firm diagnosis is obtained quickly. These financial benefits are enhanced because the technique does not require expensive equipment or additional staff.

The biopsy also allows pathologists to use additional microbiological or immunological stains. In one patient positive for HIV *Mycobacterium avium-intracellulare* was shown and the clinical diagnosis of lymphoma refuted. Few cytologists are confident in diagnosing lymphoma, and the sensitivity of fine needle aspiration biopsy in this condition has been reported to be as low as 40%.¹³ The availability of a tissue specimen

from biopsy guided by ultrasound should facilitate an accurate pathological diagnosis in this difficult group of patients.

We conclude that biopsy guided by ultrasound as described here is a safe and reliable method of establishing the histological diagnosis of abdominal and retroperitoneal masses and influences clinical management considerably.

We thank consultant colleagues at this hospital who allowed us to study their patients. In particular, we thank Dr A M Jackson, consultant pathologist.

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(Accepted 31 August 1990)

Junior doctors' on call activities: differences in workload and work patterns among grades

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Abstract

Objective—To examine the workload and work patterns of junior doctors of all grades while on call.

Design—Pilot study of activity data self recorded by junior doctors, with the help of students during busy periods.

Setting—A general surgical firm and a general medical firm based at University Hospital, Nottingham.

Subjects—Four registrars, three senior house officers, and five preregistration house officers.

Results—Senior house officers and preregistration house officers spent nearly half of all their on call duty time working, but less than half of that time was spent in direct contact with patients. Registrars were on call more often than the house officers but spent less than one fifth of their on call duty time working, and almost two thirds of that time was spent in direct contact with patients.

Conclusions—Workload while on duty is excessive for both senior and preregistration house officers. Changes in some administrative procedures and employment of more non-medical staff during on call periods might reduce the time spent on non-clinical activities, thereby reducing the overall workload and allowing more time for patient contact.

Introduction

Recent evidence indicates that some junior doctors

may be working in stressful conditions over long periods without sleep.¹⁻³ To identify when, where, and why junior doctors locally were working excessively the district general manager of the Nottingham Health Authority, supported by the then director of public health, commissioned this study.

Subjects and methods

The study was confined initially to two acute specialty firms, one general surgical and one general medical, which together comprised 12 junior doctors. Both firms were based at University Hospital, Nottingham, a large teaching hospital of roughly 1400 beds. Data were collected only during on call periods—that is, outside the normal 9 am to 5 pm working week. The surgical firm was studied for 34 days and the medical firm for 27 days, and the study was conducted mainly in December 1989.

There was full cooperation of the participating doctors, who helped design the study. The collection of data relied mainly on self recording on detailed, pocket book size (11×15 cm) forms. Participants recorded in detail all activities, including work, leisure, and sleep. In addition, they completed a separate form about each bleep call received. During periods when participants did not have time to record their own information because they were too busy students shadowed them, asking questions and recording answers.

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Br Med J 1990;301:1191-2