Comparison of ^{99m}Tc Technetium hexamethylpropylene-amine oxime labelled leucocyte with ^{111}In tropolonate labelled granulocyte scanning and ultrasound in the diagnosis of intra-abdominal abscess

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Abstract

Fifty patients with suspected intra-abdominal abscess were investigated prospectively with ultrasound and with ^{99m}Tc -hexamethylpropylene-amine oxime (HMPAO) isotope labelled mixed leucocytes, using ^{111}In tropolonate granulocyte scanning as the reference standard. Twenty five patients had inflammatory bowel disease (three were postoperative): 21 of these had Crohn's disease and four had ulcerative colitis. The remainder comprised nine with postoperative fever and 16 with fever and abdominal pain. An abscess was diagnosed when focal activity on serial ^{111}In tropolonate and ^{99m}Tc -HMPAO images at one, three, and 24 hours resulted in activity at least equal to liver activity at 24 hours. Thirteen abscesses were diagnosed using each type of white cell scanning, resulting in 100% sensitivity for ^{99m}Tc -HMPAO compared with ^{111}In tropolonate. Bowel inflammation was easily distinguished from abscess on serial images. Eight of these 13 abscesses were detected by ultrasound. Altogether 17 abscesses were found. Ultrasound detected 12, including four liver abscesses which were not purulent and had not been detected by white cell scanning. Ultrasound had a sensitivity of 71% (12 of 17) and a specificity of 87% (33 of 38) using all confirmed abscesses as the reference standard. White cell scanning showed a sensitivity of 76% (13 of 17: as a result of the four non-purulent liver abscesses) and a specificity of 100%. ^{99m}Tc -HMPAO scanning is as accurate as ^{111}In tropolonate scanning, and has several advantages including simplicity, availability, superior image quality, and reduced radiation dose. Both methods are more sensitive and specific than ultrasound for intra-abdominal abscess detection but ultrasound is advisable if a neutrophil infiltrate is not suspected.

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Keywords: intra-abdominal abscess, ^{99m}Tc -Technetium, ^{111}In -Indium, ultrasound, inflammatory bowel disease, Crohn's disease.

Abdominal abscesses are an important cause of postoperative morbidity and mortality.¹ They can present as localised tenderness and a fever, or more insidiously without any localising signs, which results in delayed diagnosis. Abscesses can also complicate inflammatory bowel disease (IBD).² In Crohn's disease, an inflammatory mass may be the result of matted, thickened bowel or, more seriously, a complicating fistula and abscess. It is important therefore to diagnose abscesses as reliably and quickly as possible, and ultrasound is usually the first line investigation in most patients because it is rapid and non-invasive.³ Ultrasound has limitations, however, in the postoperative patient as a result of impaired access because of surgical drains and dressings. Moreover, collections cannot always be identified as an abscess rather than serous fluid or haematoma.⁴

If the patient has no localising signs, ultrasound has a limited role. In this situation, white cell scanning has been advocated as the investigation of choice.⁵⁻⁷ Thakur and Segal first described the use of ^{111}In labelled autologous leucocytes to localise abscesses in dogs,⁸ and then in febrile patients.⁹ Their studies using ^{111}In showed that intense, focal increasing activity on serial images up to 24 hours was diagnostic of an abscess due to continued recruitment of labelled cells into a confined space; whereas bowel inflammation resulted in decreasing activity with time due to shedding of labelled cells into the bowel lumen and distal transit. Since then, several other authors have confirmed their findings.^{10,11} In one report,¹² 100 consecutive patients were studied using ^{111}In labelled leucocytes - 34 after surgery, 36 with inflammatory bowel disease, 13 with fever of unknown origin, and 17 with miscellaneous abdominal and pelvic sepsis. The method was found to have a sensitivity of 93% and a specificity of 100%. In another study of 257 cases over five years with suspected intra-abdominal infection the sensitivity and specificity of ^{111}In scanning were 97% and 91% respectively.¹³

In difficult cases, ultrasound, ^{111}In leucocyte scans, and computerised tomography (CT) have been found to have a useful complementary role.^{6,14}

An alternative method of labelling leucocytes, using ^{99m}Tc instead of ^{111}In ,¹⁵ has been shown to have great potential for the

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Figure 1: Initial ^{99m}Tc -HMPAO scan showing total Crohn's colitis and terminal ileitis at one hour. Prominent bladder activity is shown.

imaging of inflammatory conditions including IBD. Its advantages over ^{111}In are: a low radiation dose, easy availability, simple cell labelling, and higher quality images. Disadvantages include renal excretion resulting in a bladder image (Fig 1) and non-specific intestinal activity which is particularly prominent after three hours,¹⁶ the cause of which is unclear but probably biliary excretion. Since this always results in low grade bowel activity at 24 hours, the diagnosis of abscesses using ^{99m}Tc could be potentially difficult. As there have been no direct comparisons of these labelling techniques at one, three, and 24 hour time points with same day ultrasound scanning, we decided to undertake this. The established technique of ^{111}In labelled granulocyte scanning was taken to be the reference standard for abscess diagnosis except in the liver due to normal liver physiological uptake, while aspiration was also used when available. This prospective study aimed therefore to compare ^{99m}Tc -HMPAO and ultrasound with ^{111}In tropolonate scanning. We included patients with IBD since it is particularly important to be able to distinguish between bowel wall inflammation and a complicating abscess.

Patients and methods

PATIENTS

A total of 50 adult patients (mean age 47 years,

range 17–90) with suspected intra-abdominal abscess were investigated: 33 were women. Twenty five patients had had IBD diagnosed using standard endoscopic, radiological, and histological criteria – 21 had Crohn's disease, and four ulcerative colitis. Sixteen of the 21 patients who were all known to have small bowel Crohn's disease presented with a Crohn's mass. They were included in the study as the mass could have been due to an abscess. The remainder of the Crohn's disease patients had a suspected abscess according to other clinical criteria such as rigors and localised tenderness. Two of these Crohn's disease patients were postoperative – the first had had drainage of an ischiorectal abscess and repair of a caecal perforation leaving a caecostomy and the second a right hemicolectomy complicated by perforation with a faecal fistula. One ulcerative colitis patient was recovering from total colectomy for fulminant colitis. Those patients who did not have IBD presented with clinical suspicion of an intra-abdominal abscess: nine patients had a suspected post-operative abscess and 16 with unexplained fever associated with abdominal pain (Table I).

Inclusion criteria

Inclusion criteria for the study were:

- Abdominal abscess suspected clinically.
- Aged 16 years or older.

Exclusion criteria

Patients who might have been pregnant (of child bearing age, not taking contraceptive precautions) and lactating patients were excluded.

METHODS

All patients were initially investigated with an ultrasound scan. Clinical data are summarised in Table I. To maximise the consistency of assessment, all individuals underwent ultrasound scanning under the supervision of a single experienced radiologist. A 3.5 or 5 MHz frequency transducer mechanical sector probe and the same ultrasound unit (Aloka SSD-650, Keymed House, Stock Road, Southend on Sea, Essex SS2 5QH) were used. The diagnostic criteria for ultrasound detection of an abscess were a cystic or fluid containing lesion.¹⁷ The patients then went on to have white cell scanning on the same day using simultaneous ^{99m}Tc -HMPAO labelled mixed white cells and ^{111}In tropolonate labelled purified granulocytes. Local research ethical committee and ARSAC (Administration of Radioactive Substances Advisory Committee) committee approval were granted.

Cell labelling

A standard method was used to label purified granulocytes with ^{111}In tropolonate as described¹⁸: 10 MBq of ^{111}In labelled cells were injected giving an average labelling efficiency of 88%. A standard method was also used to label mixed white cells with ^{99m}Tc -HMPAO as

TABLE I Pertinent clinical features of the patient groups entered into the study

Patient group	No	Fever ($>38^\circ\text{C}$)	Mass	Rigors	Neutrophilia ($>10 \times 10^6$)	Localised tenderness	Postoperative fever
Inflammatory bowel disease	25						
Crohn's disease*	21	6	16	2	9	21	2
Ulcerative colitis†	4	3	0	0	1	4	1
Fever-abdo pain	16	16	1	4	11	13	
Postoperative	9	9	0	1	2	8	9

*Two were also postoperative. †One was also postoperative.

Figure 2: Repeat serial ^{99m}Tc -HMPAO and ^{111}In -In scans performed 19 days later in the patient illustrated in figure 1 due to the development of a right iliac fossa mass and tenderness showing the appearances of an abscess. (A) and (B) show the ^{99m}Tc -HMPAO and ^{111}In -In scans respectively at 1 hour; (C) and (D) show the ^{99m}Tc -HMPAO and ^{111}In -In scans respectively at 3 hours; and (E) and (F) show the ^{99m}Tc -HMPAO and ^{111}In -In scans respectively at 24 hours.

described.¹⁹ One hundred ml of blood were used and 200 MBq of ^{99m}Tc were injected to achieve an average labelling efficiency of 50%. Both types of labelled cells were injected at the same time into a peripheral vein.

Imaging

'Cross-talk' from ^{111}In γ rays detected in the ^{99m}Tc energy window was less than 10%, and no 'cross-talk' correction was applied to the images. Dual isotope imaging was performed with photopeaks set at 140 KeV for ^{99m}Tc and 171 KeV and 245 KeV for ^{111}In , all with windows of $\pm 10\%$.

After the labelled cells had been injected, anterior, posterior, and pelvic gammacamera images were obtained at one, three, and 24 hours (Fig 2) using a medium energy collimator (Elsint SP6 LFOV gammacamera, Elscint Advanced Technology Centre, PO Box 550, Haifa, 31004, Israel). The anterior field of view was large and included lung images in most cases. No persistent lung activity was seen, suggesting that the labelled neutrophils were functionally intact as damaged cells are retained by the lungs.¹¹

Images on day 1 were acquired for five minutes, and on day 2 for 10 minutes. Since this study was designed to use white cell scanning in as simple a way as possible, mean

counts were not used. Using the radiation doses and times stated, the quality of images was sufficient to grade uptake in all physiological and pathological regions.

Image interpretation

Images were graded according to a simple visual grading system²⁰ which involves comparison of pathological uptake with that in the bone marrow, liver, and spleen as follows:

- Grade 0 – no abnormal activity;
- Grade 1 – abnormal activity with an intensity less than or equal to bone marrow activity;
- Grade 2 – abnormal activity greater than bone marrow activity and equal to liver activity;
- Grade 3 – abnormal activity with an intensity greater than liver activity but less than or equal to spleen activity.

We used the lumbar spine to assess bone marrow activity since preliminary experiments showed that this was uniform in distribution and less likely to have overlying bowel uptake than the pelvis.

Abscess diagnosis

Previous work using ^{111}In labelled cells has shown that abscesses have a characteristic time scale of uptake. Focal, fixed uptake is more

Figure 3: Serial ^{99m}Tc -HMPAO and ^{111}In scans showing intense left iliac fossa activity on early images but loss of activity at 24 hours because of diverticulitis. Note the unspecific colonic activity in the right iliac fossa at 24 hours on the ^{99m}Tc -HMPAO image which does not cause diagnostic problems. (A) and (B) show the ^{99m}Tc -HMPAO and ^{111}In scans respectively at 1 hour; (C) and (D) show the ^{99m}Tc -HMPAO and ^{111}In scans respectively at 3 hours; and (E) and (F) show the ^{99m}Tc -HMPAO and ^{111}In scans respectively at 24 hours. ANT=anterior view, TC= ^{99m}Tc -HMPAO, IND= ^{111}In .

intense (at least grade 2, see above) on later images (>20 hours) than on early images (<3 hours after re-injection) because of the continued recruitment of labelled white cells into the abscess site (Figs 1 and 2).^{5 11} We used the same criteria for abscess diagnosis with ^{99m}Tc -HMPAO.

Bowel inflammation – colitis, diverticulitis

Bowel inflammation differs in that initial activity at the site of bowel uptake on early images (one and three hours) is greater than at 24 hours at the same site. This is because of exudation and transit of labelled cells along the bowel lumen (Fig 3).²⁰

Using these strict criteria, scans were interpreted by two independent observers, who were unaware of the clinical and ultrasound findings. ^{111}In scans were scored independently from ^{99m}Tc scans and ultrasound.²⁰ When available, surgical, microbiological, and histological corroboration of the ^{111}In scan diagnosis were provided.

Results

OBSERVER AGREEMENT

There was complete agreement between the two observers in the detection of abnormal

scans and identification of inflamed bowel and intra-abdominal abscesses using the two radio-labelled white cell techniques.

INTRA-ABDOMINAL ABSCESS DETECTION

Thirteen intra-abdominal abscesses were detected using ^{111}In tropolonate scanning (Table II). All patients who met the criteria for an abscess on the ^{111}In scan also met the same criteria on the ^{99m}Tc scan. This resulted in a 100% sensitivity and specificity for intra-abdominal abscess detection with ^{99m}Tc where ^{111}In tropolonate was used as the reference standard (Tables III and IV).

POSTOPERATIVE PATIENTS

All of the three postoperative patients with IBD were found to have an abscess on white cell scanning but only one lesion was detected by ultrasound (Table III). In the nine postoperative patients without IBD, an abscess was found on white cell scanning in three, while on ultrasound only two were found due to technical difficulties (Table V).

Among the patients without localised tenderness (four in the non-IBD group) white cell scanning detected one abscess which was missed by ultrasound. All of the IBD patients had localised tenderness.

TABLE II *Diagnosis of purulent abscesses using the three modalities*

Diagnosis	^{99m} -Tc	¹¹¹ -In	Ultrasound
Abscess	13	13	8
No abscess	37	37	32

Analysis of the activity grade for each isotope at each of the three time points showed that ^{99m}-Tc behaved very similarly to ¹¹¹-In in both patients with abscess and those without abscess (Fig. 4). Mild colonic activity seen on 24 hour ^{99m}-Tc images did not interfere with image interpretation at all (Fig 3). Subsequent corroboration of the ¹¹¹-In scan findings was obtained by removal of pus in eight patients, by response to antibiotic therapy in four, and the subsequent finding of liquefied, necrotic small bowel constituting an abscess at laparotomy in one.

Ultrasound detected eight of the 13 abdominal abscesses shown by ¹¹¹-In scanning. The sensitivity of ultrasound in the detection of intra-abdominal abscess was therefore 62%. No patient with a negative white cell scan was subsequently shown to have a purulent abscess (that is, 100% specificity), while the specificity of ultrasound was 87%. Consideration should, however, be given to the four patients in whom a non-purulent abscess was demonstrated in the liver by ultrasound but not with either of the white cell scanning methods. This is not surprising since, almost by definition, radio-labelled neutrophils show the distribution of these cells only. This finding underlines the importance of ultrasound as it will detect these non-purulent causes of fever – which are numerous. With regard to both purulent and non-purulent abscess detection, white cell scanning had a sensitivity of 76% and ultrasound 71% (Tables III and IV).

White cell scanning was useful in three patients with fever in whom ultrasound was unable to distinguish haematoma from abscess: negative white cell scans supported the diagnosis of haematoma. These three patients were either haemophilic (n=1) or had uncontrolled warfarin therapy (n=2). Their fevers resolved spontaneously and, given the clinical context and scan results, haematoma seemed very likely.

TABLE III *Statistical analysis of all abscesses found using ¹¹¹In tropolonate as the reference standard*

Test	Sensitivity (%)	Specificity (%)	Accuracy (%)	Positive predictive value	Negative predictive value
Ultrasound	62	87	73	0.73	0.88
^{99m} -Tc-HMPAO	100	100	100	1.0	1.0

^{99m}-Tc compares very favourably with US. Non-purulent abscesses were excluded as ¹¹¹-In tropolonate cannot act as a reference standard for these cases.

TABLE IV *Statistical analysis of all abscesses found using ¹¹¹-In tropolonate as the reference standard but also including four non-purulent liver abscesses*

Test	Sensitivity (%)	Specificity (%)	Accuracy (%)	Positive predictive value	Negative predictive value
Ultrasound	71	87	71	0.88	0.89
^{99m} -Tc-HMPAO	76	100	92	1.0	0.9

^{99m}-Tc-HMPAO still compares favourably with US. Non-purulent abscesses were not excluded: these have aspiration as the reference standard in three cases and positive toxoplasma serology in the fourth. ¹¹¹-In tropolonate was the reference standard for the remaining cases.

Discussion

To the best of our knowledge this is the first report of a prospective study that compares ultrasound imaging and two different radio-labelled white cell scanning techniques in the diagnosis of intra-abdominal abscesses. Because of its relatively long half-life (67 hours), ¹¹¹-In had been described as the ideal isotope for studying the kinetics of neutrophils, which have a circulating half-life of approximately seven hours.²¹ This technique has been shown to have a high sensitivity and specificity in the diagnosis of abscesses.¹² On theoretical grounds, the much shorter half-life of ^{99m}-Tc-HMPAO suggests that it would be less useful in abscess detection. In this study, however, we have shown that it performs as well as ¹¹¹-In, provided late scans (20–24 hours) are taken. Early (<three hours) ^{99m}-Tc images are insufficient to diagnose an abscess with certainty, since we demonstrated several examples of early intense activity with much reduced activity at 24 hours suggesting inflamed bowel wall rather than abscess (Fig 3). However, early images (one hour) were still essential to exclude non-specific bowel activity on ^{99m}-Tc imaging, which only appears after two to three hours.²² Most importantly, a normal one hour ^{99m}-Tc scan excludes an abscess and provides a rapid diagnosis since all these scans were intensely positive in the 13 abscess patients detected (liver abscesses excluded), while a one hour ¹¹¹-In scan is not diagnostic and not normally performed. On the other hand, 24 hour imaging is essential with ¹¹¹-In tropolonate since the sensitivity for abscess detection is 67% at four hours compared with 100% at 24 hours.²² The exclusion of bowel inflammation rather than an abscess at one hour is less definite. In our experience, the one hour scan has an 87% sensitivity for detecting bowel inflammation. Underestimation of bowel inflammation was also noted by Almer *et al.*²³ However, we noted that when inflammation was missed it was universally mild and often overlapped with normality. Surprisingly, this was not in agreement with the findings of Almer *et al.*,²⁴ who sometimes did not detect severe inflammation in colonic segments on early images using an early ^{99m}-Tc-HMPAO scan. We have no explanation for this anomaly apart from differences in imaging time (45 minutes instead of one hour) and a smaller dose of isotope used (median 170 MBq rather than 200 MBq). Furthermore, it was also rather a small study.

Transmural inflammation could be difficult to distinguish from an abscess on a 24 hour scan. We have noted, however, that there is always some intraluminal transit in cases of Crohn's disease, which is not seen in abscesses. The intensity at the possible abscess site is therefore less at 24 hours in uncomplicated Crohn's disease.

It is of interest that the detection rate of abscesses was much lower with ultrasound than white cell scanning (Table V). Out of a total of 12 postoperative patients, six were detected by white cell scanning and only three by ultrasound. This was due to the fact that the

TABLE V Comparison of abscess detection in patients with and without inflammatory bowel disease (IBD) in relation to their operative status

Group	White cell scan		Ultrasound*	
	IBD	Non-IBD	IBD	Non-IBD
Postoperative	3/3	3/9	1/3	2/9
Non postoperative	3/22	4/16	2/22	2/16

*Finding confirmed by ^{111}In scan as reference standard.

abdomen is difficult to examine postoperatively because of dressings and drains. This was also the experience of Uno *et al*⁶ who showed that ultrasound had reduced sensitivity for abscess detection in postoperative patients because of bowel gas. Lantto *et al*²⁴ found no difference in sensitivity using these methods in postoperative patients. They did, however, show an overall reduced sensitivity of 74% using ultrasound compared with 90% using $^{99\text{m}}\text{Tc}$ -HMPAO in the detection of abdominal abscesses but this was mainly in the non-post-operative group.

All of the IBD patients had localised tenderness. For patients without IBD and no localised tenderness (four in the non-IBD group) white cell scanning detected one abscess which was missed by ultrasound. This was also the experience of Lantto *et al*²⁴ who showed 88% sensitivity using ultrasound in these patients compared with 90% using white cell scanning. This has also been shown in older studies using ^{111}In tropolonate,^{25 26} and an algorithm has been suggested whereby the patient who is not critically ill and has no

localising signs should first be examined by white cell scanning because ultrasound is less sensitive in this clinical setting. Since ultrasound is more easily accessed this is often performed first, but a negative scan does not exclude an abscess.

It cannot be stated with absolute certainty that an abscess was present in the four patients with an abscess indicated on white cell scanning as this was confirmed only by a clinical response to antibiotics. All patients, however, made a full recovery and there was no subsequent evidence of IBD to explain the abnormal isotope uptake.

Imaging beyond three hours is not normally recommended with $^{99\text{m}}\text{Tc}$ -HMPAO¹⁶ because of non-specific, mild colonic activity. If an abscess is present, however, the 24 hour view shows intense localised uptake, as is the case with ^{111}In tropolonate. Furthermore $^{99\text{m}}\text{Tc}$ -HMPAO has other well known advantages such as ease of cell labelling, availability on site, superior quality images, and reduced radiation dose.²⁷

What are the relative roles of the three methods discussed in this paper and where does CT fit in?

ULTRASOUND

Ultrasound had a lower specificity (87%) and sensitivity (71%) than $^{99\text{m}}\text{Tc}$ -HMPAO and ^{111}In tropolonate for abscess diagnosis in our study (Tables II, III, IV). Ultrasound over diagnosed bowel inflammation. This reflects

Figure 4: This demonstrates the number of patients with a given visual scan grade at 1, 3, and 24 hours in four patient groups: (A) Thirteen patients with an abscess demonstrated by $^{99\text{m}}\text{Tc}$ scan. (B) Thirteen patients with an abscess demonstrated by ^{111}In scan. (C) Thirty seven patients with no abscess demonstrated by $^{99\text{m}}\text{Tc}$ scan. (D) Thirty seven patients with no abscess demonstrated by ^{111}In scan. Note that at 24 hours there was no significant rise in activity using $^{99\text{m}}\text{Tc}$ -HMPAO or ^{111}In in the non-abscess group, while in the abscess group there was an increase in activity using both $^{99\text{m}}\text{Tc}$ -HMPAO and ^{111}In , with maximum activity at 24 hours.

the fact that ultrasound detects structural rather than functional changes, and in some cases the bowel may have been thickened but not inflamed. Ultrasound detected the four liver abscesses missed by white cell scanning. None was a typical purulent liver abscess, however – that is, one was a massive necrotic cholangiocarcinoma represented by a large cold area on white cell scanning, two abscesses followed amoebic dysentery, and the fourth was associated with positive toxoplasma serology which responded to antibiotics (but liver aspiration under ultrasound control was negative). The sensitivity for detection of liver abscesses using ^{111}In has been high in some studies.¹¹ This may well be due to the longer half life of ^{111}In and the fact that background liver activity is relatively low at 24 hours. Other studies, however, have supported the difficulty in detecting liver and spleen abscesses using scintigraphy.²⁴ Because of this, colloid subtraction to remove background liver and spleen activity is usually recommended.^{28 29}

Our study also showed that ultrasound scanning alone was often inadequate to make a diagnosis of intra-abdominal abscess because of difficulties in postoperative patients of surgical drains limiting access or problems distinguishing an uninfected collection or haematoma from an abscess. These findings are in keeping with some other studies,¹³ although the reported results are very variable,^{6 25} and reflect the fact that this technique is highly dependent on the operator. Previous retrospective studies have shown low sensitivity using ultrasound particularly in the absence of localising signs.^{6 26} Thus, if clinical suspicion remains high after an initial negative ultrasound scan, patients should have further investigations such as white cell scanning or CT.

^{99m}Tc -HMPAO

This technique seems to have an important role in the assessment of abdominal sepsis.²⁴ Firstly, a negative one hour scan excludes an abscess and no further scanning is necessary. Secondly, it has equal sensitivity to ^{111}In in the detection of purulent abscesses (100%). Furthermore, it can be repeated since it involves a low radiation dose. A minor drawback is the 24 hour wait for a positive result. It is ideal in the postoperative patient since dressings and drains do not interfere with scanning. Mild uptake in the surgical wound is common (personal observations), and often helps in the localisation of an abscess. In the case of a negative ultrasound it is the investigation of choice.

^{111}In TROPOLONATE SCANNING

Again, a 24 hour wait is required but this is also a highly sensitive and specific test for abdominal sepsis which can be used in the postoperative patient. A negative one hour scan does not, however, exclude an abscess. It is a more complicated test to perform and involves a higher radiation dosage than ^{99m}Tc -

HMPAO.²⁷ It is not usually immediately available in most hospitals as the ^{99m}Tc needs to be ordered from a cyclotron unit and this may result in some delay. ^{111}In may be advantageous in chronic abscesses with a slow white cell turnover since it results in a higher abscess to background ratio than ^{99m}Tc -HMPAO,^{18 19} and it has also been shown to be capable of demonstrating communication of abscesses with the bowel lumen.²⁶ The present study only found one such case, however, and as the abscess was demonstrated using both isotopes the treatment was unaltered.

CT

Although CT was not studied, it has an important complementary role in abdominal sepsis.^{6 25} It has the advantage of providing more precise anatomical information and is particularly useful for the investigation of pancreatic sepsis. It can detect collections of fluid with high sensitivity but the distinction between serous fluid, haematoma, and abscess may be difficult. Aspiration, if possible, can solve this dilemma. The cost of CT is very variable. In our hospital when used with contrast it is roughly equivalent to ^{99m}Tc -HMPAO scanning. At most other centres, however, CT is cheaper and the price is determined by the frequency of usage. As stated,⁶ ultrasound is the initial investigation of choice. If this is unhelpful or equivocal then either CT or ^{99m}Tc -HMPAO scanning should be performed. If there is still doubt then the third modality should be used. If a chronic, low grade infection is suspected then ^{111}In is the investigation of choice.

CROHN'S MASS

Intra-abdominal abscesses are a common complication of Crohn's disease and have been reported in 12 to 30% of patients.³⁰ In this situation, the finding of an abdominal mass can represent inflamed loops of bowel rather than an abscess. The patient with a Crohn's mass is very suitable for investigation by white cell scanning as this method enables abscesses to be accurately detected and the degree of associated bowel inflammation to be ascertained. In addition, the typical appearance of small bowel loops at one hour with transit into large bowel at three hours and no focal uptake, leaves little doubt that the mass is due to matted inflamed loops of small bowel and in clinical practice no 24 hour scan is needed.³¹

SUMMARY

Our findings indicating the usefulness of ^{99m}Tc -HMPAO scanning in intra-abdominal abscess detection confirm a recent retrospective study of 69 patients with suspected abdominal abscesses which showed that this technique had a sensitivity of 90%, a specificity of 91%, and an accuracy of 91%. Ultrasound was less accurate, with a sensitivity of 74%,²⁵ similar to our own findings. These authors did not carry out a comparison with ^{111}In

scanning and also used different criteria for abscess detection which depended on the size, shape of uptake, and lack of shift in activity on serial images. We believe that our criteria are simpler and less observer dependent.

In conclusion, we recommend that ultrasound remains the initial investigation of choice in patients with suspected intra-abdominal abscess because of its rapid availability and simplicity and reported superiority in liver lesions. Our study also highlights its limitations, however, particularly in the post-operative patient; and if results are equivocal or inconsistent with clinical findings the patient should be further investigated with radiolabelled white cell scanning or CT scanning.^{6 25 32}

In our experience ^{99m}Tc-HMPAO imaging is as sensitive and specific as ¹¹¹In scanning in the diagnosis of intra-abdominal abscess and has improved availability, reduced radiation dosage, technical simplicity, and in cases of exclusion of an abscess, a rapid result. It is therefore the second line investigation of choice.

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