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VOL 17

Emergency Abdominal Surgery

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Preface

For fifty years or more emergency laparotomy has been the testing ground for the young surgeon. It is not always appropriate for out-of-hours emergencies to be delegated to juniors, since some of the conditions encountered will tax the stamina and skill of even the most experienced surgeons. Nevertheless, the discipline of reaching a diagnosis and then testing it by immediate operation will quickly refine a surgeon's powers of clinical assessment. Thus worldwide the acute abdomen offers unrivalled opportunities for surgical education, whether appendicitis, stab wounds or strangulated bowel are the commonest indication for opening the peritoneum.

In editing this book on emergency abdominal surgery we have set out to be selective rather than comprehensive, concentrating on new developments and conditions of topical interest. Thus hepatic trauma is covered but renal trauma is not; likewise peptic ulcers bleed but do not perforate. Most of the contributors are from the UK and the USA, with others from Australia and South Africa, reflecting perhaps the editors' own travel rather than any preconceived plan. We do think that we are lucky to have gathered such a strong international cast.

While it remains true that the decision to operate can be more important than the exact diagnosis, this is not always the case (for example in acute pancreatitis). In any event accurate diagnosis is not just an academic exercise: it will govern the preoperative preparation and the choice of incision, besides alerting the surgeon to the likely scope and complexity of the operation. It seems appropriate that the first chapter of this book should therefore be devoted to new methods of diagnosis applicable to the acute abdomen, including computer programmes, modern scanning techniques, laparoscopy, peritoneal lavage and fine catheter aspiration cytology.

In some parts of the world, abdominal trauma is still the commonest indication for urgent laparotomy, whether civil or military violence is to blame. Our book deals with injuries to the liver, bile ducts, pancreas, spleen, pelvis and lower urinary tract. Sepsis is the bugbear of any acute abdominal condition, and the complexities of septic shock are discussed in detail. The next ten chapters deal with most of the common gastrointestinal emergencies and some of the rarer fascinations like acute acalculous cholecystitis, colonic pseudo-obstruction and enteroliths (Chapter 13). Gynaecological emergencies are so much a part of the differential diagnosis of appendicitis that they deserve their own chapter. The book ends by considering two vascular causes of an acute abdomen, mesenteric ischaemia and ruptured aortic aneurysm.

Our goal has been to whet the appetite rather than to satiate. We have tried to include enough to stimulate abdominal surgeons at all levels of seniority, not forgetting those with impending examinations. The acute abdomen is a rigorous taskmaster, its successful management all the more satisfying.

London and Exeter, 1990 Robin Williamson
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Contents

1 New diagnostic techniques in the acute abdomen

This three-part Chapter reviews the use of four diagnostic techniques in the management of the acute abdomen, assessing their current value and extent of use. Two of the techniques are non-invasive, namely computer-aided diagnosis and new imaging methods (ultrasound, computerized tomography and radionuclide scanning), whereas laparoscopy and peritoneal lavage are more invasive, involving penetration of the abdominal wall and entry into the peritoneal cavity.

PART I

Computer-aided diagnosis

D. J. LEAPER

Computer-aided diagnosis (CAD) is an exciting prospect for improving our clinical skills. Many studies have shown its value and accuracy in the field of acute abdominal pain over the last 10–15 years, yet it has become neither universally accepted nor established. Some centres, however, have found a place for CAD in patient management with an effective record, often involving junior medical staff or specially trained non-medical staff. Associated with this development has been the identification of several aspects of the clinical diagnostic process, notably why clinicians, particularly those in training, often fail to arrive at a diagnosis on which to hang a management decision. In addition, several authors have realized that by carefully documenting signs and symptoms and following the discipline of giving a specific diagnosis to compare with a computer diagnosis, their own diagnostic record and decision making is improved.

Failure of accurate clinical diagnosis in the acute abdomen

Several studies have shown that there is a high degree of inaccuracy in the clinical diagnosis of acute abdominal pain. To some extent failure is related to the doctor's grade and experience, but several other factors are involved. It is clearly in the best interests of our patients to make the correct diagnosis and institute the correct treatment at an early stage. There is therefore the need to recognize failure and act to minimize this. An accurate diagnosis is rarely made of an acute abdomen by referring or receiving staff, often merely the diagnosis of 'acute abdomen' sufficing to admit the patient or refer them to a surgical team. There is little doubt that diagnosis at this level can be significantly improved, and this could prevent unnecessary admissions or allow referral to the most appropriate team, rather than all patients with abdominal pain being referred to the on-call surgical team. Thus pelvic inflammatory disease could be referred directly to the gynaecologists and the abdominal pain of diabetes to paediatricians or physicians. By expediting this process there is an obvious benefit to the patient plus a financial saving. In addition there is, surely, a pride in achieving a high diagnostic rate quickly without the need for prolonged or expensive investigations.

More experienced surgeons are more accurate in their diagnosis of abdominal pain. This is probably because they are able to reason heuristically and use relatively few items of information, whereas the junior surgeons in the accident and emergency department, or receiving patients on the ward, reason algorithmically. They glean all the information they can but become bogged down because they cannot utilize it effectively. This synthesis of course is what a computer can achieve easily if appropriately programmed. Nevertheless all of us are capable of poor diagnostic accuracy based on clinical assessment, presumably because we base our opinion on a wrong anecdote, cannot think in a truly probabilistic pattern or cannot handle large amounts of information.

So why has CAD not become established in the diagnosis of acute abdominal pain, with a computer terminal or access to a program available for this purpose, on surgical wards as it is for haematological and pathological results? Inevitably there must be 'physician suspicion' of computers taking over their time-honoured role. Ignorance of statistical analysis and probabilistic theory may prejudice interest, although this fear is likely to recede in the general surgical field with the continuously increasing numbers of surgeons who have written a thesis or engaged themselves in original scientific research. Another difficulty lies in the need to write down clinical information in a computer-codable form. Many would be unwilling to give their time for this, despite their acceptance of the computer in medicine. Coding can be very difficult: for example, how does one accurately and reproducibly distinguish between periodic, episodic, intermittent or colicky abdominal pain?

The realism of using a computer for diagnosis of abdominal pain is more likely to be seen by junior staff who are then able to be as effective as their seniors, particularly in out-of-hours admissions. Another way around the time factor is to use a physician's assistant, who may perhaps be resented as much as a computer presence. Although such assistants are a rarity in the UK, they can be as effective as fully trained medical staff (Lawrence et al 1987) and may allow a system to be usable in the clinic or at the bedside just like any other diagnostic aid. These assistants would be trained to translate clinical signs and symptoms into data that is acceptable to a computer, more quickly than the physician they assist. If effective, they would pay for themselves by avoiding expensive and time-wasting investigations. Clearly CAD could offer a great advantage to inexperienced staff in compromised areas: its use on submarines for diagnosing acute abdominal pain has been explored, for example (Osborne 1984).

The diagnostic process

Diagnosis, i.e. methods to achieve a management decision, is as old as medicine itself, but problems remain: we are still unable to qualify its logical steps and to facilitate the decision-making process. Many attempts have been made to dissect diagnostic pathways based on theory and on practical studies (Jaquez 1964, Lusted 1968, Gill et al 1973, Leaper et al 1973, De Dombal 1980, Wulff 1981, McCartney 1987). It is clear that senior clinicians are better diagnosticians and use few data to be effective, but how their intuition exists or works is enigmatic. It is more than just a simple pattern-matching process (De Dombal et al 1972b). There is little doubt that a computer can help to analyse much larger quantities of data, but the programming of a computer with an artificial intelligence based on experience is still a long way away. Nevertheless diagnostic dilemmas can be defined, particularly in a field such as acute abdominal pain, and signs and symptoms can be identified and recognised by computer programs. Interestingly, transcription of data to computer format and the complete filling in of proformas can improve performance. Thus the diagnostic accuracy can be improved for appendicitis (with fewer normal organs being removed) without risking an increased proportion of perforated or gangrenous appendices (De Dombal et al 1974, Adams et al 1986). The definition of terms for computer recognition is open to observer variation, but this variation lessens with practice (Gill et al 1973, Leaper et al 1973, Bjerregaard et al 1983). The importance of this definition is obvious, but it is probably changeable as disease toxonomy, let alone signs and symptoms, is arbitrary (Wulff 1981, McCartney 1987).

Methods of computer-aided diagnosis

The blunderbuss approach to CAD is to try to diagnose all diseases by simple comparison to an enormous data base (Okada et al 1977, Winter et al 1984). This approach would be impossible in practice, but a system that contained some appropriate data (rather than everything possible) or allowed some sort of dialogue, might permit diagnosis of rare disease (Pople et al 1975, Duda & Shortliffe 1983). Simple pattern matching using probabilities has been shown to be effective in abdominal pain (Graham 1977, Nixon & Rundle 1980), but more logical systems have expanded this to use simple algorithms to ask the next best question (Williams 1982), an interactive programme which guides the operator, or to employ a decision-tree pattern recognition to help with diagnosis (Kurzynski 1987).

Multiple logistic regression analysis works well with clearly defined data to help in diagnosis of pulmonary and cardiac function (Croft & Machol 1974, McCartney et al 1979, Habbema & Gelpke 1981), but it may not be so effective in the relatively imprecise field of abdominal pain (Van Way et al 1982). Cluster and connectivity analysis may allow further specificity (Atkin 1974), as they permit weighting techniques to give discrimination.

Connectivity analysis combined with 'fuzzy' logic has been used effectively in the diagnosis of acute abdominal pain. This analysis is based on a model of the vagueness of human reasoning and reflects the uncertainty of the clinical diagnostic process (Baldwin 1979, Norris et al 1985).

Knowledge-based systems, artificial intelligence or a combination of the two allow diagnosis to be modelled on human reasoning (Szolovits 1982, Spiegelhalter & Knill-Jones 1984, Reggia & Tuhrim 1985). Some workers have found this to have no great advantage over the time-honoured technique of Bayesian analysis (Fox et al 1980), which has been used extensively for CAD of acute abdominal pain and is probably the 'gold standard'.

CAD using Bayesian analysis

The 18th-century English cleric Thomas Bayes left us some of his mathematical thoughts, which were presumably formulated between his ecclesiastical chores. The principle of this type of analysis is first to set up a large data base of signs and symptoms, of preset and mutually exclusive disease processes, within a diagnostic field. This data base can be collected either retrospectively or prospectively. Acute abdominal pain is an ideal example of the sort of case to which this type of analysis can be applied and has, in fact, served as a template for research into the effectiveness of the different types of analysis. Once the probability of each sign or symptom has been determined for each disease, then new patient data can be prospectively compared with the data base and the cumulative probability of each disease can be calculated.

De Dombal's group in Leeds reported a high degree of success using Bayesian analysis of acute abdominal pain in the early 1970s (Horrocks et al 1972, De Dombal et al 1972a). In these studies they chose appendicitis, diverticulitis, perforated duodenal ulcer, non-specific abdominal pain, cholecystitis, small bowel obstruction and pancreatitis as the seven main disease categories. The overall diagnostic accuracy of the computing system (91.8%) was significantly higher than that of the most senior member of the surgical team — usually a registrar or senior registrar — who saw each case (76.9%). Many other groups have reported similar success in diagnosing abdominal pain in similar clinical circumstances (Gunn 1976) or in a different clinical environment (Wilson et al 1977, Graham & Wyllie 1979, Edwards 1986).

The difficulty with Bayesian analysis is that it gives simple probabilities only, which many clinicians may not understand when formulating a decision for management. It may be presumed to be 'right' or 'wrong', although the increased probability of a predicted disease tends to be related to increased accuracy of diagnosis. It is interesting to note that when clinicians are allowed to give their estimates of probabilities of signs or symptoms in the same categories of acute abdominal pain, they are often inaccurate. Surely, then, it is not just their inability to handle large amounts of data (which is so easily achieved by computer analysis) that makes them relatively inaccurate at prediction

of disease but also the fact that they are unaware of probabilities (Leaper et al 1972)?

The data base for Bayesian analysis should be large, but it does not usually reflect changes in signs or symptoms in reaching its diagnosis, nor can it incorporate any 'weighting' of signs or symptoms easily elicited by repeated examination by the surgeon in charge. These data cannot readily by interrelated by Bayesian analysis, which makes the system rather rigid, but this does not seem to matter in practice (Seroussi 1986).

An abdominal pain data base cannot take in rare diseases, which usually have to be coded as non-specific abdominal pain. Although Meckel's diverticulitis would be diagnosed fairly accurately as appendicitis, thereby not allowing a failure in a decision to operate, salpingitis would be more likely to be diagnosed as non-specific abdominal pain and operation avoided. This category of non-specific abdominal pain is clearly unsatisfactory, particularly as follow-up of such patients can reveal important disease (Gray & Collin 1987). A second data base that only considers these more specific diagnoses may allow for greater accuracy.

The data entered into a data base might be expected to vary from area to area, but there is evidence that this is not in fact the case. The Leeds system has been shown to work on a multicentre basis both in Finland (Ikonen et al 1983) and the UK, although it was not so accurate for diagnosis of small bowel obstruction (Adams et al 1986). It was reported as being unhelpful in a study from the United States (Van Way et al 1982), but the authors of this study used a slightly different method of analysis.

In conclusion, computer-aided diagnosis of acute abdominal pain has been proved to be effective. The use of Bayesian analysis, which is easy to operate despite certain drawbacks, is as accurate as more sophisticated, interactive, interrelated computer methods that employ artificial intelligence or 'fuzzy' logic. Why its use has not been more widespread is unclear.

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PART 2

Methods of imaging

C. KISSIN and J. VIRJEE

Despite the rapid expansion of new diagnostic techniques, plain radiography is still the most commonly used imaging procedure in the evaluation of patients with acute abdominal symptoms. The radiographs may be diagnostic in themselves or, more frequently, they may provide information to direct subsequent radiological evaluation. The choice of imaging techniques available is now very wide and includes contrast-medium examinations, ultrasound (US), computerized tomography (CT), nuclear medicine, angiography and magnetic resonance imaging (MRI).

The modality that has been found to be the most useful is ultrasound. This technique has gained acceptance as a major diagnostic tool largely because of the technological development of real-time units and mechanical sector scanners. The resultant accurate, high-resolution visualization of intra-abdominal structures has led to its employment as the first imaging technique (after plain films) in most abdominal emergencies, excluding those with primary bowel pathology such as gastrointestinal bleeding, obstruction or perforation. Computerized, Doppler and endoscopic ultrasound are also in use in some centres. Although CT has become much more widely available over the last 10 years, it is still more expensive and time-consuming to perform than US examination. It therefore tends to be employed where US has failed because of bowel gas, obesity or poor access. In addition, however, CT has particular advantages over US when an overview of abdomen, pelvis and bony structures is required, in assessing the extraluminal extent of gastrointestinal and vascular disease, and in enabling limited tissue identification within a mass or collection.

The recent advances in nuclear medicine imaging involving the gastrointestinal tract have improved the evaluation of those patients with acute hepatobiliary pathology, acute lower gastrointestinal bleeding and intra-abdominal abscesses and inflammation. Contrast-media examinations of the bowel and urinary tract continue to play an important role in the assessment of the

acute abdomen. In particular, however, the increasing awareness of pseudo-obstruction has led to an increase in the number of emergency enemas performed to identify the existence or site of an obstructing lesion, and the technique of small bowel enema examination has enabled more accurate assessment of some small bowel pathology.

The need for diagnostic angiography in the acute abdomen declined when US and CT were first introduced. It has now regained its popularity because of a wide acceptance of the value of interventional procedures and because of the development of digital subtraction techniques, which may permit the use of lower doses of contrast medium and less invasive procedures than those required for conventional arteriography. MRI is a modality which is still in its infancy in the UK. Its application to acute abdominal procedures has not yet been fully explored therefore. Indeed it is unlikely to have any real place until it is readily available in most radiology departments.

These techniques, or combinations thereof, have had an impact on the diagnosis of many conditions presenting with an acute abdomen. In particular they have a major role in the diagnosis of acute cholecystitis and pancreatitis, acute gastrointestinal haemorrhage, major trauma, aortic disease, intra-abdominal abscesses, acute appendicitis and diverticulitis.

Acute cholecystitis

Accurate diagnosis of acute cholecystitis is imperative when early cholecystectomy is to be considered, and three imaging techniques are now available. Some authors still stress the reliability of infusion cholecystography and claim a true positive rate of 88% (Dykes et al, 1984), but US and radionuclide scanning are the most popular imaging modalities at present. Cholescintigraphy is performed using one of the ^{99m}TC-labelled acetanilide iminodiacetic acid (IDA) derivatives. Non-visualization of the gallbladder with an otherwise patent biliary system implies obstruction of the cystic duct and thus acute cholecystitis (in both calculous and acalculous disease; Mauro et al 1982) (Fig. 1.1). Several similar pharmacological agents are now available (all having in common the N-substituted iminodiacetic structure), which will enable biliary visualization even with raised serum bilirubin levels. They also have a relatively low renal excretion, thus minimizing superimposition of renal activity over the gallbladder region. In the appropriate clinical setting cholescintigraphy has been reported to have over 95% sensitivity and specificity (Johnson & Coleman 1982). Following improvements in equipment and greater experience with its use, ultrasound has now been shown to have a similar predictive value. Despite the recognition of the significance of features such as uniformly decreased gallbladder wall echogenicity, the 'halo' sign (Schneider et al 1982) and the 'double wall' sign (Joseph 1983), the ultrasonographic findings most suggestive of acute cholecystitis remain the presence of gallstones, tenderness over the gallbladder and mural thickening.

Fig. 1.1 Positive IDA scan. There is non-visualization of the gallbladder with an otherwise patent biliary system in a patient with symptoms and signs of acute cholecystitis.

Acute pancreatitis

In contrast to acute cholecystitis, the diagnosis of acute pancreatitis is essentially clinical and biochemical. Both US and CT can demonstrate the typical features of acute inflammation, but imaging techniques have a more important role in identifying complications. Contrast-enhanced CT, for

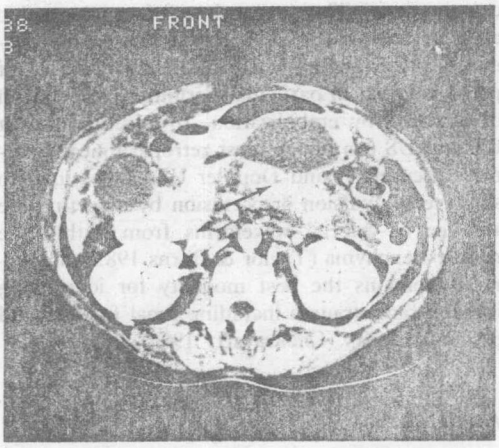

Fig. 1.2 Contrast-enhanced CT scan of the upper abdomen in a patient with severe acute pancreatitis. Viable pancreas (arrowed) takes up the intravenous contrast material as opposed to the pseudocyst that lies anteriorly and the necrotic peripancreatic fat that lies posterolaterally.

example, delineates necrotic tissue in severe necrotizing pancreatitis (Fig. 1.2), whilst US will demonstrate the presence of pseudocysts and enable their percutaneous drainage. In addition, the technique of endoscopic ultrasound is now available in some centres: the entire pancreas can be visualized by a combination of transduodenal and transgastric scanning, using a 7.5 mHz transducer incorporated into the tip of a fibroptic endoscope. The resultant high spatial resolution has been reported to demonstrate important new information about pancreatic inflammation, not obtained on previous imaging, in up to 30% of selected patients (Shorvan et al 1987).

Gastrointestinal haemorrhage

Imaging techniques play a major role in the diagnosis and management of acute gastrointestinal haemorrhage. Traditionally, endoscopy is performed as the first step in the management of upper gastrointestinal bleeding. Arteriography may then be performed if necessary, either for diagnosis or therapy. The endoscopic examination enables identification of the bleeding site and may detect features indicating the likelihood of rebleeding (visible vessel, adherent clot). Endoscopic Doppler US, using a Doppler probe at the tip of the endoscope, is now being used to assess the patency of the artery beneath the bleeding point and thus predict the chances of rebleeding with greater accuracy (Beckly & Casebow 1986). Acute lower gastrointestinal bleeding does not always lend itself to endoscopy, and angiography has been considered to be the procedure of choice. However, because selective abdominal arteriography is invasive and expensive and may be difficult to perform, other less invasive diagnostic tests have been sought and radionuclide imaging studies have now gained acceptability. Two scintigraphic methods are currently in use: ^{99m}Tc sulphur colloid and ^{99m}Tc-labelled blood pool agents (red blood cells and albumin). Both are more sensitive than arteriography (Alavi & Ring 1981, McKusick et al 1981), being able to detect bleeding rates as low as 0.05–0.1 ml/min; indeed, angiography is likely to be negative if scintigraphy fails to show a bleeding focus. Sulphur colloid may be unable to identify upper GI bleeding, as hepatic and splenic activity may mask flexural bleeding sites, but labelled red cells can be used for upper and lower gastrointestinal haemorrhage and for intermittent

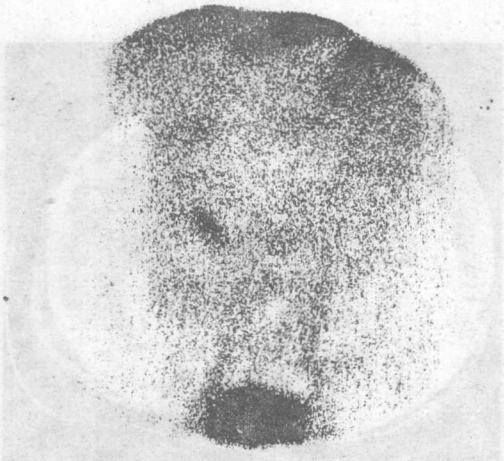

Fig. 1.3 Abnormal accumulation of ^{99m}Tc-labelled red cells indicating a bleeding site to the right of the umbilicus. Angiography was positive, and the patient (a woman of 75 years with melaena) was found to have bleeding from an inflamed jejunal diverticulum.

bleeding also. These examinations are most useful when performed before angiography either to eliminate the need for it or to guide the angiographer to the appropriate area (Fig. 1.3). Angiography itself is indicated prior to, or instead of, laparotomy, particularly where there is a history of previous surgery, suspected haemobilia or suspected small bowel bleeding, or where interventional therapy seems likely. It can identify the site and likely cause of bleeding at a rate of 0.5 ml/min and may enable non-surgical treatment by vascular infusion of constrictor drugs or by vascular embolization.

Trauma

New imaging techniques have made a large contribution to the diagnosis of visceral trauma. Abnormal fluid within the peritoneal cavity can be identified both on US and peritoneal lavage. Lavage will indicate the nature of the fluid, but US often detects the site of visceral damage, particularly in the upper abdomen. However, CT is of particular value because it is able to demonstrate the entire abdomen, pelvis, retroperitoneum and associated bony structures (Fig. 1.4) in one examination. The expansion of angiographic catheter techniques has led to dramatic improvements in the diagnosis and therapy of major blunt pelvic trauma, in particular permitting the control of bleeding by embolization. In addition, whilst CT and US can image most retroperitoneal structures accurately, and Doppler US can be used to show renal avulsion or occlusion by detecting the absence of arterial waveforms from within the renal parenchyma (Taylor & Burns 1985), angiography remains the best modality for identifying isolated renal trauma including renal fracture and pedicular injury (Chakravarty 1986).

Aortic disease

In aortic disease US and CT have 97–100% sensitivity in the detection of aneurysmal dilatation, but angiography may still be necessary to determine if this is limited to the infrarenal portion. The diagnosis of aneurysmal rupture is usually made on clinical grounds alone and leads to immediate operation. When further evaluation is

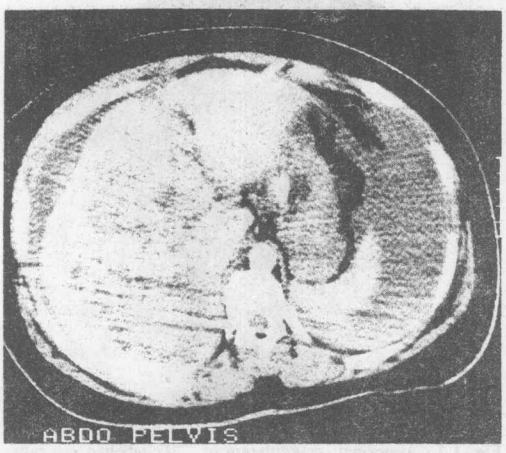

Fig. 1.4 CT scan of the upper abdomen in a 41-year-old unconscious woman after trauma. A right rib fracture was present, and there is haemorrhagic contusion of the liver with a considerable haemoperitoneum.

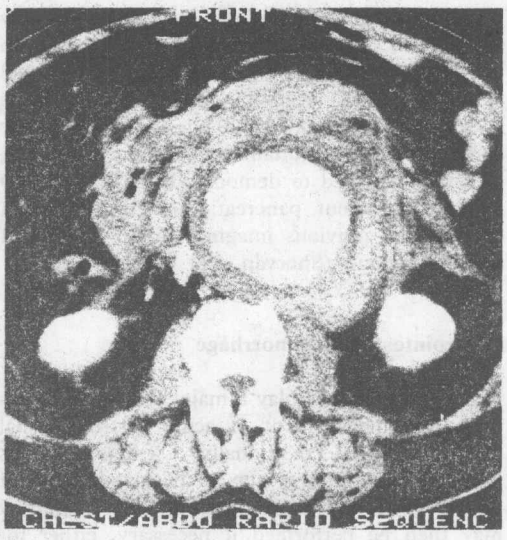

Fig. 1.5 A CT scan of the abdomen in a 70-year-old man showing marked aneurysmal dilatation of the abdominal aorta. There is a large retroperitoneal haemorrhage indicating aneurysmal rupture.

necessary, both US (provided that the accompanying ileus does not limit visualization) and CT can easily and reliably demonstrate the characteristic appearances of a dilated aorta and extensive retroperitoneal haemorrhage (Fig. 1.5). In aortic dissection real-time and Doppler US can clearly demonstrate the flap, with its characteristic undulating motion and two distinct patterns of flow in the true and false lumina, and also the extent of dissection. CT is thus often unnecessary and angiography only rarely indicated. With increasingly frequent aortic surgery, the frequency of complications presenting as an acute abdomen and the need to make accurate pre-operative diagnoses has increased. US and Doppler may demonstrate complications of aortoiliac grafts, but CT has been found to be most useful in the diagnosis of aortic graft–enteric fistulae by the identification of a periaortic mass with or without associated gas (Ackroyd et al 1985, Haaga et al 1978).

Intra-abdominal abscess

Ultrasound is usually employed as the first imaging technique in patients with suspected intra-abdominal abscesses and has an overall sensitivity of 82% (Knochel et al 1980). It may, however fail to identify collections that are small or lie in the mid-abdomen or are obscured by bowel gas. In these situations, two radionuclide techniques are available. ^{111}In-labelled leucocyte scanning is superior to ^{67}Ga citrate owing to greater accumulation of the radionuclide in inflammatory lesions and the absence of colonic activity (Fig. 1.6), and it has a reported sensitivity of 93% in suspected intra-abdominal abscesses (Knochel et al 1980, Goldman et al 1987). However, CT has been found to be the most accurate imaging modality, with a sensitivity of 98%. All modalities have a specificity of 95% (Knochel et al 1980).

Fig. 1.6 Positive ^{111}In-labelled leucocyte scan (right iliac fossa abscess).

Acute appendicitis and diverticulitis

In some emergencies such as acute appendicitis and acute diverticulitis, the clinical diagnosis is obvious and appropriate treatment is implemented without radiological confirmation. In suspected acute appendicitis, however, there is still a false-positive laparotomy rate of 10–15% (Berry & Malt 1984). Attempts have therefore been made to reduce this figure and to shorten the clinical observation time in patients with atypical signs and symptoms by using accurate imaging techniques. Both sonography and scintigraphy have a high accuracy rate, but neither technique is widely utilized in the UK. The normal appendix is not visible on US scanning, but the demonstration of a non-compressible appendix with or without mural thickening, appendicoliths or localized periappendiceal fluid, has been shown to have 89% sensitivity, 95% specificity and 93% overall accuracy in the diagnosis of acute appendicitis (Puylaert 1986, Brooke Jeffrey et al 1987). In addition the ultrasound examination can identify gynaecological pathology as the cause of symptoms where appropriate. Similarly, ^{111}In-labelled leucocyte scanning is reported to have 86% sensitivity, 93% specificity, and 91% overall accuracy in the diagnosis of clinically atypical appendicitis (Navarro et al 1987).

In acute diverticulitis, when radiographic examination of the colon is indicated, the double contrast barium enema is the method traditionally used. Recently, however, CT has been advocated as an appropriate and useful imaging technique