# Diagnostic Ultrasound in Gastrointestinal Disease

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Kenneth J. W. Taylor, M.D., Ph.D.

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# Foreword

With the rapid proliferation in the number of books, one can indeed question the need for yet another. However, ultrasound is a new subject and there are at present very few journals devoted to it. Furthermore, the subject is changing rapidly and long delays await any article to be published in the radiological literature, so that published articles lag far behind current thought. Review articles tend to be even more out-dated, since they review the original literature from time to time and are themselves subjected to rewriting and publishing delays. We therefore believe that there is a need for authoritative review articles from centers that are very active in ultrasound, which will reflect contemporary thought on this rapidly changing subject.

It is the intention of this series to devote each issue to one subject, each organized by a Guest Editor. For the first few issues, these editors will be the members of the Editorial Board, who will produce the following further titles:

1979 Genitourinary Ultrasonography—Arthur T. Rosenfield, M.D.
Diagnostic Ultrasound in Obstetrics—John Hobbins, M.D.

1980 Diagnostic Ultrasound in Cardiology—Joseph Kisslo, M.D.
New Techniques and Instrumentation in Diagnostic Ultrasound—Peter N.T. Wells, Ph.D.
Diagnostic Ultrasound in Endocrinology—Frederick Sample, M.D.

Each editor will invite authors of acknowledged expertise to review a given subject, providing approximately ten articles per issue. It is hoped that this will summarize contemporary thought for the practicing radiologist as it pertains to the state-of-the-art in ultrasound techniques.

This first issue of the Clinics in Diagnostic Ultrasound is on Gastroenterology. It is hoped that this issue will be of interest not only to radiologists, but also to referring physicians in gastroenterology and internal medicine. It is important for the radiologist to appreciate the clinical problems involved in therapeutic decisions, so we invited the staff of our gastrointestinal unit, including its Chief, Dr. Howard Spiro, to contribute to this issue on the indications and efficacy of ultrasound examination from the clinician's viewpoint. We believe that this will be a valuable addition to the contributions from radiologists.

In this issue we have attempted to cover the entire field of gastroenterology to which ultrasound can make an important contribution at the present state of its development. The contributors include ultrasonologists from both east and west coasts of the United States, the United Kingdom and Denmark. We believe that the opinions expressed in each of these contributions reflect the state-of-the-art.

Finally, we have arranged a self-evaluation section in which clinical problems are presented together with the ultrasound examinations, and the solutions discussed on the reverse page. It is hoped that this will present the reader with an opportunity to assess objectively what he has learned from the perusal of this issue. We welcome constructive criticism of this format and hope that these periodic reviews on diagnostic ultrasound will prove to be a valuable learning experience for their readers.

*Kenneth J. W. Taylor*

# Contents

## CASE REPORTS

# The Gastroenterologist's View of the Indications and Efficacy of Ultrasound Examination

**FRED S. GORELICK**
**HOWARD M. SPIRO**

The gastroenterologist, like any other subspecialist, has to choose efficiently from an increasing number of diagnostic modalities while observing economy in patient care. How this dilemma can be solved remains uncertain, but here we will consider ultrasonography from the standpoint of the concerned clinician anxious to learn and willing to appreciate aesthetics, but mainly concerned with how ultrasound can change diagnostic opinion or therapeutic approach. Generally, ultrasound seems to be an advance which is safe, of modest cost, and with broad applicability, particularly in the detection of cystic lesions within the abdomen and in the delineation of enlarged bile ducts and gallstones.

Like many new diagnostic tests, ultrasound can be used 1) to confirm a strong clinical impression or to answer a specific question, 2) to resolve ambiguity raised by other morphological studies, 3) as a broad screening test, or 4) in the follow-up of previously identified lesions. In any new diagnostic study, especially one which depends upon the skill of an observer and upon a rapidly changing technology, exact percentages are not very meaningful. Figures at one hospital may be different from those at another, partly because of the interest and experience of the observer and partly because of the different kinds of patients studied. The ultimate place of ultrasound in clinical gastroenterology remains for definition, but just as Sisyphus could not roll the stone all the way up the hill, improvements in ultrasonic technology render each year's opinion very quickly archaic. In what follows, the importance

of these variables is implicit, but we will discuss the current clinical application of ultrasound and its contribution to clinical problems, recognizing overlap in the subdivisions which follow.

## To Confirm A Strong Clinical Impression

The most valuable use of ultrasound at present seems to be to confirm what is already suspected or to answer a specific clinical question.

### Pancreatic Disease

*Carcinoma of the pancreas*

Pancreatic carcinoma stands as the model disorder in which ultrasound can confirm the clinical impression. DiMagno et al[1] reviewed 70 patients suspected of having pancreatic carcinoma, in 30 of whom the diagnosis was confirmed at operation. Ultrasound was used to determine whether the pancreas was diseased, a specific diagnosis of pancreatic cancer not being required in this study. Only 75 percent of the patients who eventually proved to have *any* kind of pancreatic disease, including cancer or pancreatitis, were identified by ultrasound, a figure disappointing to the optimistic diagnostician. Moreover, about 30 percent of patients with cancer were already jaundiced; in the jaundiced patient the clinician can always opt for laparotomy so that a diagnosis of pancreatic disease in a patient with jaundice who still requires operation does not represent a significant diagnostic triumph. The paper did not provide information on how well ultrasound furthered the diagnosis in patients who were not jaundiced, nor how many patients had such overt disease at the time of study that ultrasound, though diagnostically correct, was not really clinically useful.

These are the kinds of questions that are never asked in the early enthusiasm for any new diagnostic technology; but they are worth evaluating early, for their answers are what the clinician needs for his diagnostic choices. The specific percentages at this stage are unimportant, although it is disappointing that Levitt et al[2] correctly identified by ultrasound only 60 percent of patients with pancreatic carcinoma, and Husband et al[3] identified only five out of nine patients. As we have already pointed out, advances in technology will no doubt raise the percentage of correct diagnoses, but still the clinician will watch to see how small a lesion will be detected by ultrasound and whether a minimal lesion can be detected before metastases have occurred. Most important of all, he will want to know whether ultrasound can ever distinguish pancreatic carcinoma from an inflammatory mass. He may regard the demonstration by ultrasound of a pancreatic mass in a 60 year old man with diabetes, weight loss, and unrelenting abdominal pain as no more helpful than the contrast studies which now show a different facet of the same mass. That McCormack et al[4] could show no increased survival after ultrasound diagnosis of pancreatic cancer underlines the clinical problem—symptoms which

lead to any investigation usually come too late for therapy to help. However much the sensitivity of ultrasound improves, its benefits may be limited by the late onset of symptoms. The most that the clinician can hope for is that ultrasound will shorten the time to diagnosis and make the diagnostic approach easier for patient and clinician.

For the latter, ultrasound may prove the greatest help in guiding biopsy needles to pancreatic masses. Hancke et al[5] and Smith et al[6] each demonstrated the safety and accuracy of percutaneous pancreatic biopsy, and the procedure is being more widely adopted. Pancreatic biopsy may not affect survival, but in the patient who is not jaundiced, it may make chemotherapy and irradiation possible without the need for exploration. So far, however, such diagnostic confirmation depends upon the keen eye of the cytopathologist.

It has even been suggested that different types of pancreatic tumors, carcinoma and lymphoma for example, may reflect diagnostic echogenic patterns because of varying cellular composition, density, pattern of invasion, and desmoplastic response. Only 100 percent reliability would give real help in this regard without biopsy. As the pancreas is the second commonest site of intraabdominal lymphoma, such echographic distinctions would indeed be very helpful. A few patients with gastrinomas have been reported in whom no neoplasm was identified by ultrasound or CT scan; a very small tumor or one with cells not so different from those of the parent organ may not be readily detected by ultrasound.

*Pancreatic pseudocyst*

It is in the demonstration of pancreatic pseudocysts that ultrasound has proven such an enormous boon. Before ultrasound, documentation of a pseudocyst was difficult, requiring indirect evidence of presence and size by barium studies, arteriography, or endoscopic pancreatography. Pancreatic pseudocysts are now distinguished with ease from the pancreatic phlegmon which in the past provided such a problem in differential diagnosis for the clinician. With its definitive and noninvasive depiction of a pseudocyst, ultrasound has made other techniques generally obsolete for diagnosis and follow-up. Ultrasound has reminded the clinician that a pseudocyst may be present with minimal or no enzymatic abnormalities, that they are more common than previously suspected, and may resolve spontaneously. How small a pseudocyst can be detected and its clinical significance remain subjects for study however, as pathologists have long found incidental pseudocysts at autopsy. Doust and Pearce[7] detected cysts as small as one centimeter, but also failed to demonstrate a one centimeter pseudocyst in the tail of the pancreas later seen at endoscopic pancreatography. Kressel et al[8] compared CT scans with ultrasound in the diagnosis of surgically proven pseudocysts and reported that ultrasound found a pseudocyst in seven of eight patients but, because of extensive bowel gas, missed two of four with infected pseudocysts. The following is an example of a patient with a pseudocyst we have followed.

A 29 year-old male chronic alcoholic with a 3 year history of recurrent bouts of pancreatitis, was admitted with pain, nausea and vomiting. On physical examination, he had hepatomegaly, but no other evidence of chronic liver disease. There was a tender area of increased fullness in the right upper quadrant. The serum amylase was slightly elevated at 183 (nl<155) with a normal serum lipase An abdominal X-ray revealed a few calcifications at the head of the pancreas. An abdominal ultrasound examination at this time revealed a large pseudocyst of the pancreas (Figure 1a and b). The patient was treated conservatively and did well. Six weeks later, repeat ultrasound demonstrated some diminution in the size of the pseudocyst (Figure 1c and d). A third examination (Figure 1e and f) four months later, when the patient was asymptomatic and the mass no longer palpable, documented disappearance of the pseudocyst, although the remaining pancreatic echogenic abnormalities were suggestive of residual pancreatic disease.

This case illustrates what we now appreciate as one of the natural histories of the pancreatic pseudocyst. We need to know more from prospective studies relating sonographic findings to clinical course. Do smaller pseudocysts have a greater probability of resolving or a lesser chance of becoming infected? How soon in the course of pancreatitis does a pseudocyst form, and does its location in the gland affect the possibility of spontaneous drainage?

*Acute pancreatitis*

Ultrasound should be helpful in the patient with pancreatitis not only to exclude gallstones, but also to confirm an uncertain diagnosis or to look for a pseudocyst in the patient with recurrent or protracted disease. Ileus, so characteristic of pancreatitis, may limit the contribution of ultrasound by making satisfactory examination of the pancreas difficult in the acute stages. In a retrospective study, the overall accuracy in the diagnosis of acute pancreatitis was about 80 percent, but the 16 percent of normal controls who also had an "enlarged pancreas" suggests an uncomfortable degree of overlap.[7] A similar degree of accuracy has been reported by Husband et al.[3] Following 12 patients with acute pancreatitis, Doust and Pearce[7] reported that serum enzyme levels usually return to normal before echographic resolution, a sequence similar to that already recognized in pancreatitis, with the rapid fall of amylase levels to normal despite continuing clinical manifestations.

Evidence of biliary tract disease in patients with acute pancreatitis is the most helpful evidence of all. The demonstration of gallstones in patients with acute pancreatitis is particularly helpful but, to the clinician, demonstration of dilated biliary ducts on ultrasound may mean obstruction either by stones in the common duct or simply by inflammation in the head of the pancreas. In an appropriate clinical setting, ultrasound may well prove diagnostic of pancreatitis, but no doubt it will not replace the simpler measurements of serum enzymes for diagnosis. Ultrasound may prove to be a guide to the seriousness of the disorder, however. The clinician will be interested in knowing whether the patient with elevated pancreatic enzymes and a normal pancreas at ultrasound has less severe disease than a patient with an abnormal pancreas at ultrasound; whether such distinctions can serve as a guide to

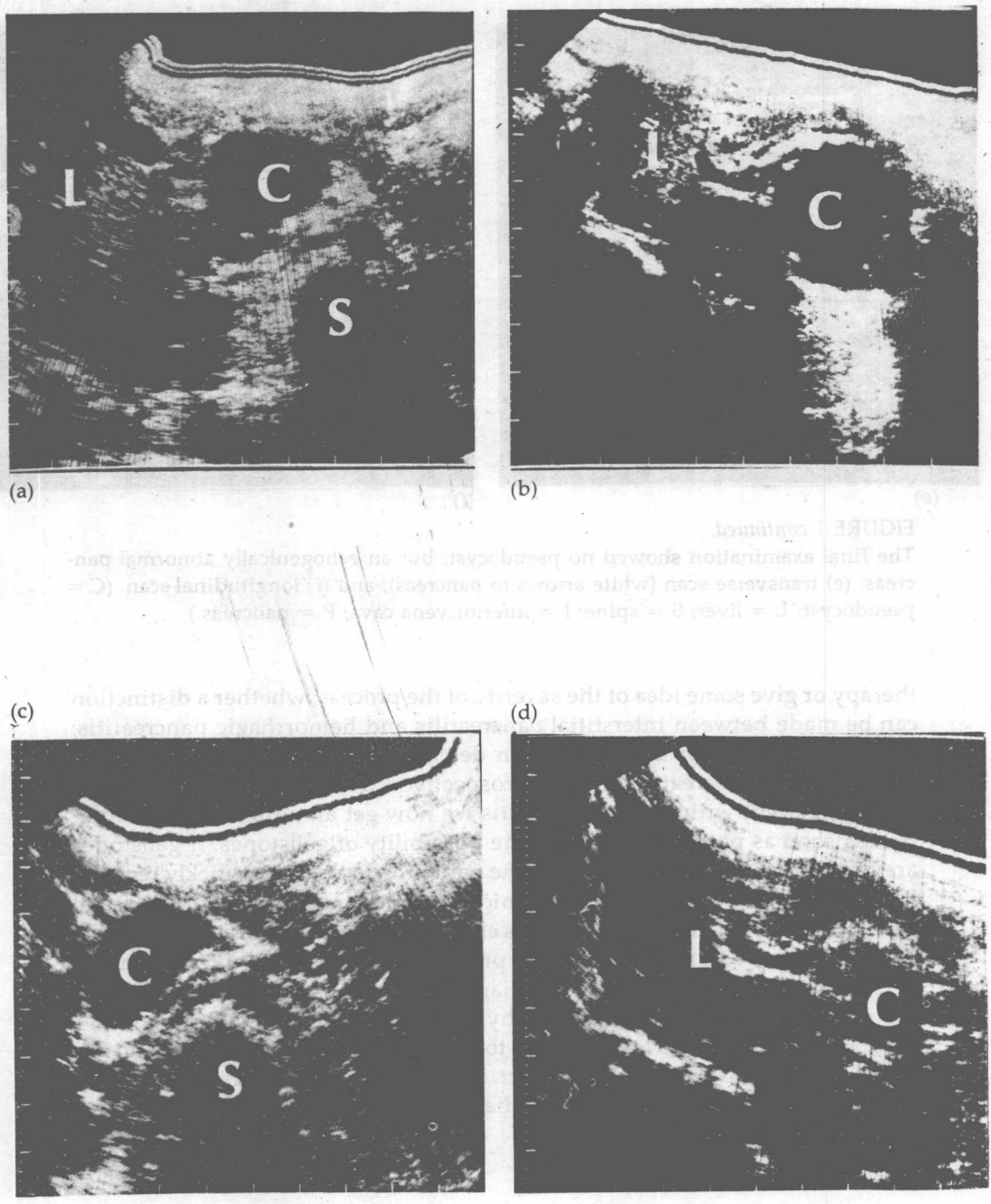
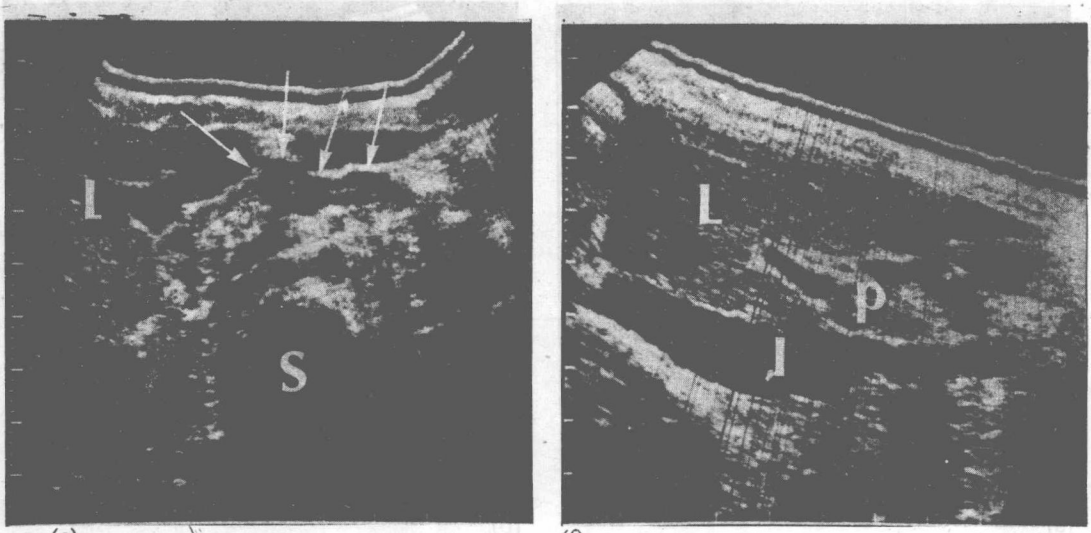



FIGURE 1. Initial ultrasound scans showing (a) transverse and (b) longitudinal views of the large pseudocyst. The second examination demonstrated some decrease in size of the pseudocyst in the (c) transverse and (d) longitudinal projection. (C = pseudocyst; L = liver; S = spine; I = inferior vena cava; P = pancreas.)

Figure 1 *continued overpage:*




(e) (f)

FIGURE 1 *continued.*
The final examination showed no pseudocyst, but an echogenically abnormal pancreas: (e) transverse scan (white arrows to pancreas); and (f) longitudinal scan. (C = pseudocyst; L = liver; S = spine; I = inferior vena cava; P = pancreas.)

therapy or give some idea of the severity of the process; whether a distinction can be made between interstitial pancreatitis and hemorrhagic pancreatitis; and finally how early ultrasound can detect peritoneal complications from the seepage of pancreatic enzymes. Prospective studies are indicated.

In the patient with acute pancreatitis we now get an ultrasound examination as soon as possible to exclude the possibility of gallstones. If gallstones are found, we urge early surgery for the patient who does not quickly recover. If the ultrasound is negative or technically inadequate because of intestinal gas, we usually ask for an intravenous cholangiogram to exclude the possibility of gallstones. In the patient with protracted pancreatitis, ultrasound can detect a pseudocyst and is our first diagnostic choice, but if it is not helpful, we turn to endoscopic pancreatography or CT scans. Occasionally, endoscopic pancreatography will be necessary to distinguish pseudocysts from an extraordinarily enlarged pancreatic duct. At present, we believe ultrasound to be the most useful technique for the diagnosis of pancreatic pseudocysts and for their follow-up.

*Chronic pancreatitis*

The detection of sonographic abnormalities in the patient with chronic pancreatitis has proven little help so far except in the detection of pseudocysts. Prominent echo-dense abnormalities in patients with chronic pancreatitis and pancreatic calcification have been reported[3], but Doust and Pearce[7] found no distinguishing characteristics except for pseudocysts in 10 of 12

patients with chronic pancreatitis. Indeed, two patients with pancreatic calcification on plain film showed normal appearances at ultrasound. Improved technology may change matters, but at present ultrasound cannot help much in the patient with chronic pancreatitis, especially as the diagnosis is usually so obvious in the alcoholic with pancreatic calcification on abdominal films.

## Hepatic Disease

In the investigation of liver disease, ultrasound can evaluate 1) focal process, usually metastases or abscesses; 2) the liver parenchyma; and 3) extrahepatic changes associated with liver disease. Evaluation of focal processes will be discussed in a later section (pp. 35–58).

### *Diffuse liver disease*

The ability of ultrasound to detect diffuse liver disease such as fat or cirrhosis may reduce the incidence of sampling error on liver biopsy, provide an indication for biopsy, and guide the needle to the right site. In an ongoing study, now at 53 patients, we have compared hepatic ultrasound with liver biopsy for evaluating the hepatic parenchyma. So far the study suggests that ultrasound can establish the relative normality of the liver and distinguish metastases from fat or fibrosis, but that moderate amounts of fat or cirrhosis are more reliably detected by liver biopsy. Although ultrasound can readily detect major amounts of fat or fibrosis, it does not reliably distinguish moderate amounts of one from the other, or either from a completely normal liver. Needle biopsy is a more sensitive, although more invasive, technique. In the ordinary alcoholic with acute "alcoholic hepatitis," the clinician may some day come to depend upon ultrasound to assess overall changes in the liver, but at present he will probably still rely on liver biopsy. There may well be times when all that is needed is to distinguish major amounts of fat or fibrosis from a normal liver, and in such circumstances the patient may be grateful for ultrasound rather than for liver biopsy. Our study confirms the impressive ability of ultrasound to detect focal lesions in the liver: in two patients, neoplasia was easily distinguished from the surrounding cirrhotic tissue, something not easily accomplished by other means. Eighteen patients with apparent metastatic disease on ultrasound had histologically proven tumor.

### *Extrahepatic abnormalities suggestive of liver disease*

Ultrasound has some place in the detection of extrahepatic abnormalities of liver disease, to provide objective data in patients with suspected cirrhosis or confirmatory data in patients with known cirrhosis. Ultrasound has been used to assess the size and patency of the portal or splenic veins, the size of the spleen, and the presence of ascites. Indeed, a fluid layer as shallow as 1 cm in the sitting position and a volume as small as 100 ml have been demonstrated by ultrasound and could be a spur to the aspiration of ascitic fluid.

## Biliary Tract Disease

### *Gallstones*

In the routine detection of gallbladder stones, ultrasound so far has no advantage over oral cholecystography, but its relative simplicity, the lack of radiation, and the fact that the patient need take no pills may well make it the first diagnostic step in the near future. Radiolucent and radiopaque stones can be detected with equal frequency, but the reported false negative rate for ultrasound of 10 percent, with a false positive rate of 1–5 percent[10-12] is greater than the false negative rate for oral cholecystography which runs about 3–5 percent, along with a much smaller false positive rate of about 1–2 percent. A more recent study by Crade et al[13] which relied on surgical and pathological assessment of gallbladder disease, found ultrasound to be even more accurate than oral cholecystography for the identification of gallstones if the classical findings of cholelithiasis were seen sonographically. The simplicity of ultrasound may shortly lead the clinician to forego any statistical advantages of the oral cholecystogram in favor of this noninvasive approach, reserving oral cholecystography for those patients in whom his clinical suspicions were not confirmed by standard X-ray. For the moment, however, ultrasound finds its place as the second diagnostic step—to confirm the possibility of gallstones in patients with faint gallbladder visualization on the standard single dose oral cholecystogram.

The distinctive appearance of gallstones at ultrasound is now well recognized, but the clinician still has many questions about the significance of "sludge" or echoes which move within the gallbladder without definitive evidence of stones; about the "false positive" echoes which have been reported; or how to deal with the patient whose gallbladder fails to visualize on double dose cholecystography, but who has a normal ultrasonogram. Finally, most of the time he does not need to know how well the gallbladder contracts or empties after a fatty meal except when deciding whether to use chenodeoxycholic acid to dissolve gallstones.

In some patients, ultrasound is already the standard first diagnostic approach to the gallbladder: 1) patients with predictable blocks to the absorption and excretion of oral cholecystographic dye, including patients with jaundice, hepatocellular disease, malabsorptive disorders, or motility disturbances of stomach or esophagus; 2) pregnant women with abdominal pain; 3) patients with acute cholecystitis or acute pancreatitis; 4) the rare patient with allergy to oral cholecystographic dye; 5) in patients with acute cholecystitis or pancreatitis, ultrasound is particularly useful to exclude gallstones.

### *Obstructive jaundice—dilated biliary ducts*

By showing a dilated biliary tree, ultrasound now provides one of the first and most valuable clues in the jaundiced patient to distinguish intrahepatic from extrahepatic cholestasis. The overall accuracy of ultrasound in jaun-