

Ultrasonography in Hepatobiliary diseases

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Introduction of real-time linear scan ultrasonography to clinical practice has revolutionized the diagnostic approach to hepatobiliary disorders.¹ This modality allows the operator to scan the liver and biliary tract with a real-time effect, and obtain three dimensional images. One can follow vessels and ducts from one end to the other. The portal and hepatic venous systems are readily seen and distinguished. Real-time ultrasonography (US) using an electronically activated linear array transducer is becoming a stethoscope for the liver specialist, because a portable size real-time ultrasonograph is already available.

It is now established that real-time US is useful not only in the diagnosis of gallstones, dilatation of the biliary tract, and cystic lesions, but it can also assess liver parenchyma in various diffuse liver diseases. Thus, a wide range of diffuse liver diseases beside localized hepatic lesions can be evaluated by US. It can also make the diagnosis of portal hypertension²⁻⁴

In our unit, the patient with a suspected hepatobiliary disorder is examined by US on the first day of hospital visit, and the next investigation that will possibly provide a definitive diagnosis, such as ERCP, PTC, X-ray CT, angiography, scintigraphy, etc., is scheduled. Using a specially designed transducer, a needle can be guided while the vessel, a duct, or a structure is being aimed and entered (US-guided puncture).⁵ ;7 US-guided puncture technique has improved the procedure for percutaneous transhepatic cholangiography⁸, biliary decompression, percutaneous transhepatic catheterization for portography⁹, and obliteration of bleeding varices. The following are the major diagnostic applications of real-time US.

Biliary Tract Diseases

Gallstone disease. Gallstones in the gallbladder greater than 6 mm invariably and those between 3 and 6 mm almost always display strong echoes and posterior acoustic shadowing.

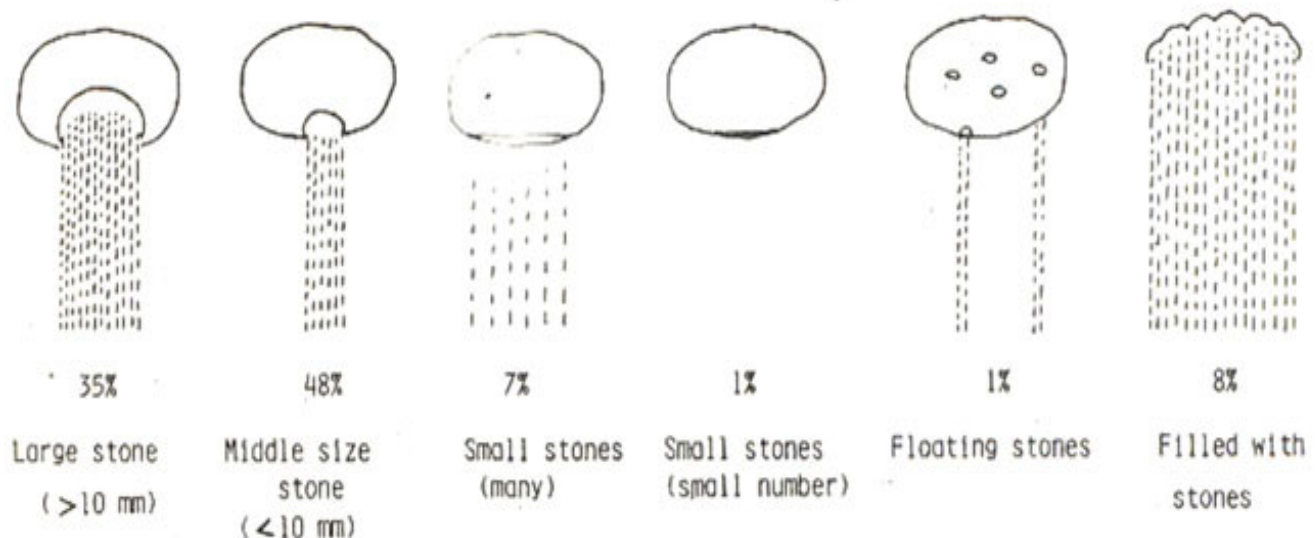
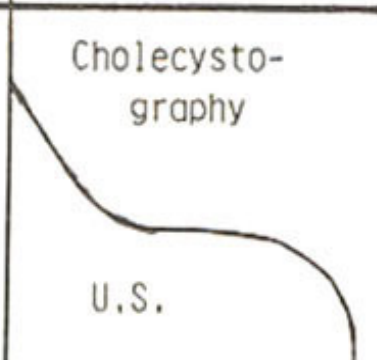


Fig. 1 Various ultrasound patterns of gallstones.

Figure 1 depicts typical acoustic shadows as related to the size and number of stones. It even provides indirect information regarding the chemical composition of the stones.

Table 1.

INCREASED DETECTION OF CHOLELITHIASIS WITH ULTRASOUND
(F. HOSPITAL)

Year	No. of outpatients	No. of cholelithiasis cases found	Method of diagnosis
1977	11,442	88	
1978	10,956	61	
1979	11,461	88	
1980	11,737	145	
1981	11,400	177	

Relative frequency of each method

Table I gives the number of patients found to have cholelithiasis in a five year period at a large hospital in Japan during which time conventional cholecystography was gradually replaced by US examination as the routine investigation for suspected stone disease. There was a two-fold increase in the number of cases diagnosed.

Table 2.

COMPARISON OF DIAGNOSTIC CAPABILITY OF I.V. CHOLECYSTO-
CHOLANGIOGRAPHY AND ULTRASOUND
(ORAL CHOLECYSTOGRAPHY NEGATIVE CASES, N = 32)

Method	Gallbladder stone	
	Positive	Negative
Cholangiography	6 (13.8%)	26 (81.2%)
Ultrasonography	28 (87.5%)	4 (12.5%)

Table II compares capability of intravenous cholecystocholangiography and US in 32 patients in whom stones were suspected but oral cholecystography failed to make the diagnosis. In this study, US identified stones in 28, or 87.5% of them.

Obstructive /audience. The sizes of various parts of the biliary tract as measured by US in Japanese

adults are given in Table III.

Table 3. SIZE OF THE BILIARY TRACT MEASURED BY ULTRASOUND

	Intrahepatic		Extrahepatic	
	Left hepatic	Right hepatic	Proximal	Distal
Normal	1.7±0.6 (n=38)	1.7±0.7 (n=35)	3.3±0.9 (n=40)	3.0±0.7 (n=31)
Obstructive jaundice	10.2±4.5 (n=47)	8.7±2.5 (n=47)	17.1±7.0 (n=44)	
Bile duct stone (anicteric)	4.0±1.4 (n=22)	4.1±1.5 (n=17)	10.0±3.7 (n=30)	

Figures, mm

The normal diameters of the left and right hepatic ducts were 1.7 mm, and of the extrahepatic bile duct, 3.0-3.3 mm. These figures are somewhat smaller than those obtained by cholangiography. It is probably due to excess echoes from the wall reducing the diameter of the lumen. In obstructive jaundice, these figures are clearly increased, and such dilation is readily recognized by US. Differential diagnosis of obstructive jaundice and intrahepatic cholestasis was possible by US alone in 174 of 175 patients (99.4%) (Table IV).

Figures, mm

DIFFERENTIAL DIAGNOSIS OF JAUNDICE BY REAL-TIME LINEAR ULTRASOUND

Jaundice	No. of cases	US Diagnosis		
		Obstructive	Parenchymal	% Correct
Obstructive	142	141	1	99.3
Parenchymal	33	0	33	100
Total	175	141	34	99.4

The only failure in diagnosis occurred in a patient with hilar carcinoma which was infiltrating along the major intrahepatic bile ducts causing no visible dilatation of the biliary tract.

Although the scanning of the extrahepatic bile duct is often hampered by intestinal gas, repeated examination will yield information for the determination of whether the obstructing lesion is located proximally or distally. Often, but less frequently, the distal end of the obstructing lesion is discerned (Table V).

ULTRASOUND DIAGNOSIS OF THE LEVEL OF OBSTRUCTION
(REAL-TIME LINEAR SCAN)

Level of obstruction*	No. of cases	Dx of level		Dx of Obstruction end	
		No.	%	No.	%
Hilar bile duct	41	41	100	40	97.6
Proximal duct	9	8	88.9	7	77.8
Distal duct	92	92	100	68	73.8
Total	142	141	99.3	115	81.0

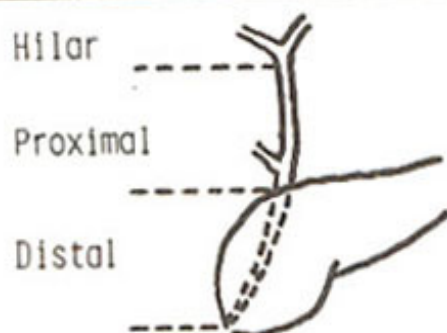




Fig. 2 A dilated common bile duct containing a protruding echogenic object is apparent. B, Percutaneous transhepatic cholangiogram made through a drainage catheter inserted by the US guided technique. Distal bile duct carcinoma obstructing the common bile duct is apparent (at arrow). It corresponds to the echogenic lesion in A.

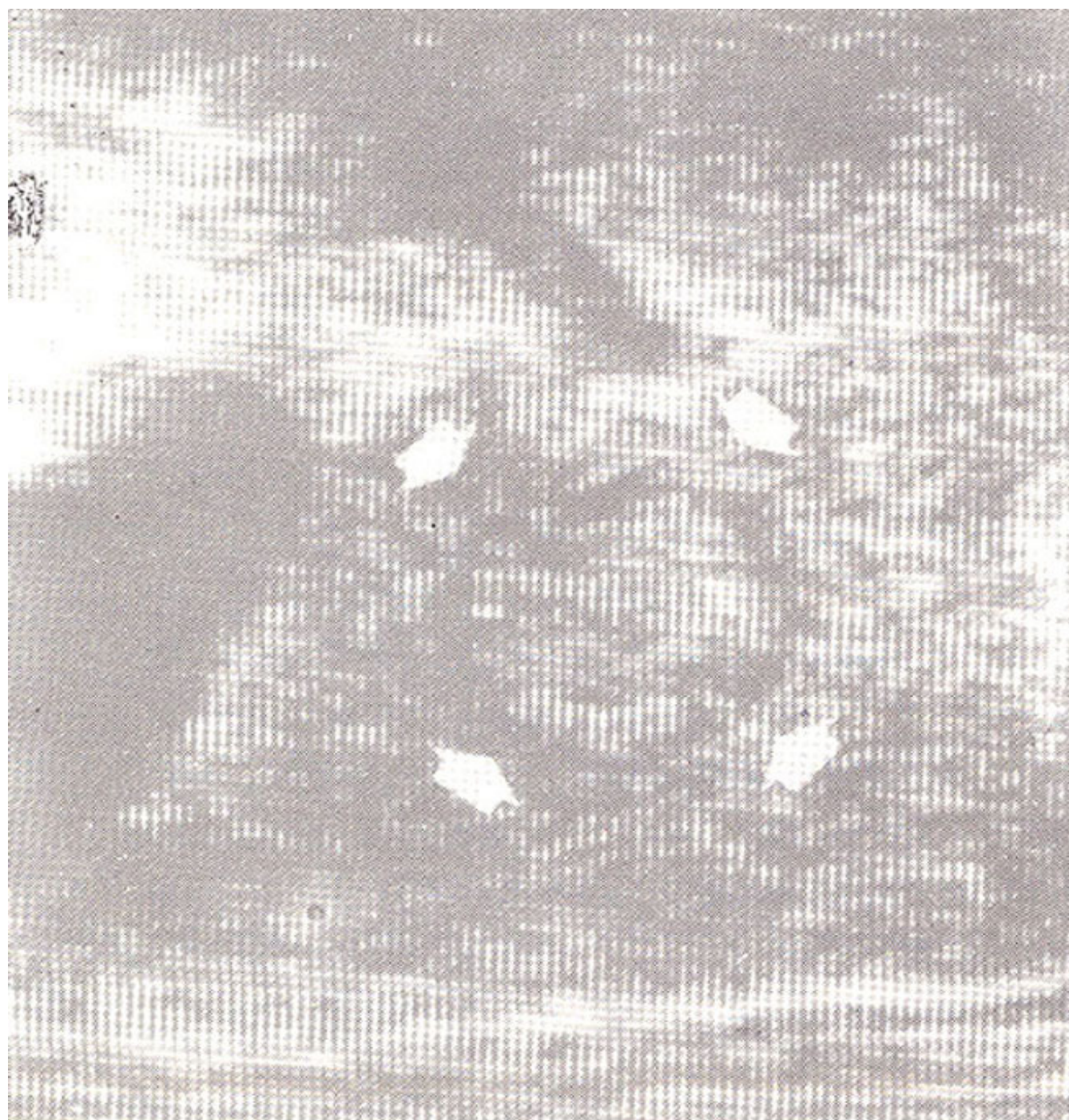


Fig. 3 Hepatocellular carcinoma 2.5 cm in diameter, seen in a cirrhotic liver. Note the low echo periphery or rim of the mass suggesting the presence of a pseudocapsule.



Fig. 4 Hepatocellular carcinoma invading into the left portal vein branch (at arrow).

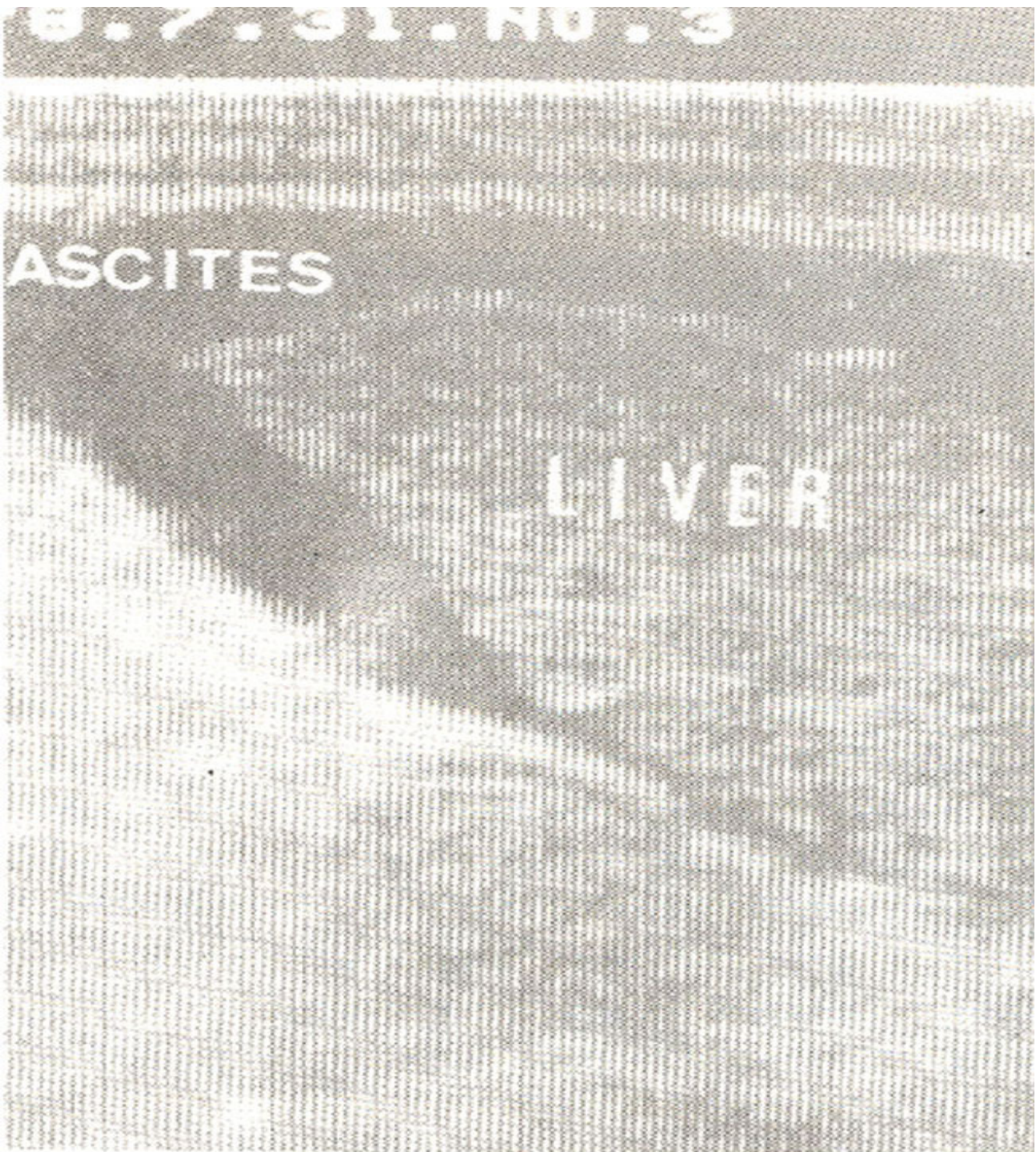


Fig.5 Liver cirrhosis with ascites. The obtuse edge of the liver and irregular anterior surface of the liver are apparent.

Figure 2 illustrates the US finding of a distal bile duct carcinoma and its cholangiogram. Intrahepatic stones. Intrahepatic stones or hepatolithiasis is a common disorder in the Far East¹⁰, as contrasted by the Western countries where it is a rarity. In Hong Kong, recurrent pyogenic cholangitis secondary to intrahepatic stones is one of the major surgical problems. For the detection of intrahepatic

stones, US proves most diagnostic, particularly when it is combined with UG-guided PTC (Table VI).

Table 6.
DIAGNOSIS OF HEPATOLITHIASIS BY VARIOUS PROCEDURES IN 30 PATIENTS

Procedure	No. of negative Dx	No. of suspected Dx	No. of definite Dx	
			All stones shown	Part of stones shown
PTC & ERC	8 (26.7%)	7 (23.3%)	6 (20.0%)	9 (30.0%)
Ultrasonography	0	1 (3.3%)	2 (6.6%)	27 (90.0%)
PTC under US guidance	0	0	30 (100%)	

U-guided PIC and biliary drainage. With the use of the puncture transducer⁵⁻⁷, an intrahepatic bile duct greater than 5mm can be aimed and entered with a very high success rate. Since puncture carried out while the vessels and ducts are being observed, inadvertent puncture of blood vessels can be avoided. Similarly, transhepatic biliary decompression and drainage in obstructive jaundice^{11,12} can be easily achieved with the use of US guidance system, avoiding damage to blood vessels, which is the major cause of severe complications (Table VII).

Table 7.
COMPLICATIONS OF PERCUTANEOUS BILIARY DRAINAGE
(356 cases)

Complication	X-ray control	Ultrasound guidance
	(n=181)	(n=175)
Biliary peritonitis	0	0
Massive bleeding (abdominal)	1*	0
Massive bleeding (biliary)	3	0
Pneumothorax	2	0
Aggravated bacteremia	2	0

* Death due to puncture of hemangioma

Liver Diseases

Hepatic tumors. US is very sensitive in detecting space occupying lesions. However, due to lung air, examination of the anterior superior area of the right lobe is not always reliable. For more accurate examination of this particular area, other types of grey-scale scanner may be used. Small hepatocellular

carcinoma (HCC) is usually solitary, and has a hypoechoic interior or an anechoic rim around (Fig.3), in contrast to metastatic tumors which are frequently hyperechoic or mixed hypo. and hyperechoic, and multiple¹³ Large hemangioma is invariably hyperechoic, but some of the very small ones may not be distinguishable from small HCC. US examination carried out regularly at a set interval in patients with cirrhosis together with measurement of serum alpha-fetoprotein is an established practice in Japan for the early detection of HCC, and hundreds of cases of small HCC have been found^{14,15}. In advanced cases, the portal vein system should be carefully examined to determine whether a major portal branch has already been invaded (Fig.4). Such information is important when hepatic resection is contemplated.

Cysts and abscesses. Cysts, whether simple, hydatid, or otherwise, are seen as round anechoic lesions with exaggerated back echoes due to reduced attenuation. Whereas the shape of cysts is circular, that of an abscess is much more irregular, and the interior has more echoes. Abscess in its early phase of formation may look like a mass, but after liquefaction, the interior looks more like a cyst except for the shape.¹⁶ Ultrasound guided puncture and drainage is now an established procedure for the treatment of liver abscess¹⁷. We have treated 21 consecutive cases of idiopathic liver abscess by puncture and/or drainage combined with systemic antibiotics without requiring operation.

Liver cirrhosis. The surface of a normal liver is smooth as seen by US, and a grossly nodular liver surface can easily be recognized. Obtunded angle of the liver edge is another important finding 'to suggest cirrhosis. Ascites which is also readily recognized by US, and signs of portal hypertension discussed below are highly suggestive of cirrhosis

Portal hypertension. The size of the spleen can be semiquantitatively assessed by the left intercostal scan¹⁸. Increased diameters of the portal trunk and major branches of the portal vein suggest portal hypertension. Large shunts involving the left renal vein are seen as a cystic lesion in front of the spleen¹⁹. The umbilical portion of the left portal vein branch is perpendicular to the anterior plane of the body, and readily recognized by US; if a dilated paraumbilical vein is seen coursing anteriorly and inferiorly along the round ligament, it is a good indication of portal hypertension. The left gastric (coronary) vein which is the main feeding vein for esophageal varices, can also be discerned in the section where the splenic vein, left lobe of the liver and the lower esophagus are seen².

Fatty liver. Normal liver parenchyma and renal parenchyma have similar echo patterns. In advanced fatty liver, the liver exhibits much stronger echoes diffusely, and the difference from the renal parenchyma as a control is evident in a section in which both the liver and kidney are seen.

Vascular diseases. Thrombosis of the hepatic vein and membranous obstruction of the inferior vena cava (Budd-Chiari syndrome)²⁰ can be diagnosed by US. For more definitive diagnosis, angiographic examination is required. In the eyes of the experienced hepatologist-sonographer, cavernous transformation of the portal vein in the hilar area, indirect evidence for portal obstruction, is seen as an irregular vascular structure²¹

Other diseases. In acute hepatitis, intrahepatic vascular structures show exaggerated walls. Advanced schistosomiasis demonstrates irregular echoes in the liver, and they may prove diagnostic in the endemic areas.

Summary

Real-time ultrasonography is imperative in the diagnosis of hepatobiliary diseases in modern medicine. It will prove diagnostic not only for gallstones, biliary obstruction and localized hepatic lesions, but also for some of the diffuse liver diseases such as cirrhosis. It must be done as a routine, as is the stethoscope used by the physician, in patients in whom hepatobiliary disease is suspected.

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