Manual for Abdominal Ultrasound in Cancer Screening and Health Checkups

Introduction

Abdominal ultrasonography is an essential diagnostic method for early diagnosis of refractory cancers in the abdomen, such as cancer in the liver, biliary tract, and pancreas. Because it causes no radiation exposure or distress and the device is simple, it is broadly used not only in general practices, but also in opportunistic screening and reported to be useful in early detection of cancer.

However, because abdominal ultrasonography in health screening generally handles multiple organs and lesions other than cancer and descriptions of findings at detection of cancer have not been unified, it has not been evaluated for its accuracy or efficacy as cancer screening. Furthermore, although diagnostic ability of ultrasonography depends on the examination environment and the operator's skill level, even the examination method has not been definitely specified.

The Ultrasonic Screening Committee (former Ultrasonography Working Group) of the Japanese Society of Gastrointestinal Cancer Screening took leadership in publishing the Examination Standard, aiming to improve quality of abdominal ultrasonic screening and Abdominal Ultrasonic Cancer Screening Standard[1,2] consisting of criteria to enable accuracy evaluation as cancer screening in 2011. Thereafter, they partially revised the standards and added some items in cooperation with the Subcommittee for Abdominal Ultrasonic Cancer Screening Category, Terminology/Diagnostic Criteria Committee of the Japan Society of Ultrasonics in Medicine. Furthermore, they prepared a manual including assessment criteria in cooperation with the Division of Abdominal Ultrasonography, Committee for Preparation of Imaging Assessment Guideline, Japan Society of Ningen Dock. Therefore, the content of the present manual is common to Manual for Abdominal Ultrasound in Cancer Screening and Health Checkups of the Japanese Society of Gastrointestinal Cancer Screening and the Japan Society of Ultrasonics in Medicine.

By broadly popularizing these standards, we would like to aim to improve and homogenize quality of abdominal ultrasonography procedures and unify assessment criteria for cancer to evaluate accuracy and efficacy of abdominal ultrasonic screening as cancer screening in the future.

Standard Procedure for Abdominal Ultrasound Cancer Screening

Standardization of ultrasonic screening

Target organs

Liver, biliary tract, pancreas, kidneys, spleen, and abdominal aorta

- The abdominal aorta is included for detection of swelling of surrounding lymph nodes and aortic aneurysm.
- Although the adrenal glands and lower abdomen (e.g., bladder, uterus, ovaries, and prostate) are not formally included in the target organs, findings in these organs may be recorded if detected.
- It is necessary to explain to subjects that some cases or sites may be difficult to observe in advance and report the presence of cases or sites difficult to observe after the examination if applicable.

Diagnostic devices

- Use a 3.5 to 5.5-MHz convex probe in screening.

- Use a device having as high-performance as possible.
- Devices capable of color Doppler and tissue harmonic image are desirable.
- Concurrent use of high frequency probe (e.g., 7.5 MHz linear type) or sector probe is also useful.
- Appropriate maintenance of the device should regularly be performed.
- Use of an expired device is undesirable.
- Probes and monitors are consumable.

Operators

It is desirable that the examination is conducted by a physician certified by the Japanese Society of Gastrointestinal Cancer Screening (hepatobiliary system and pancreas), a board certified fellow of the Japan Society of Ultrasonics in Medicine, or a registered medical sonographer (gastroenterology or medical check-up field) of the Japan Society of Ultrasonics in Medicine.

Diagnostic techniques

Pretreatment

It is desirable to take no solid food after dinner on the day before the examination.

Scanning (Fig. 1)

Define the sections to be recorded by each institution and scan according to certain criteria.

Record 16 images or more.

Exemplary sections to record are listed in Fig. 1.

No particular order of scanning is specified.

Utilize position changes (e.g., scanning in left lateral position) ad libitum.

A localized lesion must be recorded in images of 2 different directions.

Describe the maximum size and site of lesions of Category 3 or severer.

Measure foci by expanding the image sufficiently on the screen. Round off the measurements to integers in millimeter.

Pay attention not only to localized lesions, but also to diffuse lesions.

Standard duration of scanning operation is about 6 to 7 minutes per subject.

Scanning for less than 5 minutes has no adequate accuracy.

One should be skilled to be capable of scanning within 10 minutes per examination on average.

Recording

Storing as video is desirable.

If storing as still images, it is desirable to store in electronic media in DICOM format.

Interpretation/ultrasonic diagnosis

It is desirable that reports prepared by technologists be interpreted and diagnosed by physicians certified by the Japanese Society of Gastrointestinal Cancer Screening (hepatobiliary system and pancreas) or Ultrasonic Specialists of the Japanese Society of Ultrasonics in Medicine.

Assessment/Post-examination management

Assessment

It is desirable that assessment categories be assigned by physicians certified by the Japanese Society of Gastrointestinal Cancer Screening (hepatobiliary system and pancreas), board certified fellow of the Japan Society of Ultrasonics in Medicine, or certified physicians/specialists of Japan Society of Ningen Dock.

Assessment category

As described below, assessment categories are basically assigned in compliance with the manual. However, assessing physicians may change assessment category based on test results other than ultrasonography or comparison with the previous findings.

Examination interval

It is advisable to have annual screening even if no abnormality is present.

Selection of institutions providing thorough examination

Instruct/refer to medical institutions suitable for thorough examination items.

It is important to establish cooperative relationships with institutions providing thorough examination so that feedback of thorough examination results can be requested.

When referring a patient, it is desirable to attach images in addition to definite description of site, size, and property of the foci.

Accuracy management

Management of basic indices in screening

- Compile and manage examination rate, through examination rate by assessment category, cancer detection rate, and other indices.

Prognosis research

- It is necessary to recognize and follow up those who have thorough examination and those who do not.

  Thorough examination report and treatment recommendation, etc.

- Seek to recognize false-negative cancer cases and to identify sensitivity and specificity of the screening.

Use of national cancer registration, recognition of results from annual screening, information from public health nurse, and so forth

- Efforts to evaluate efficacy as cancer screening will be necessary in the future.

  Decrease in mortality risk in subjects (individuals) in opportunistic screening

  Decrease in mortality rate in the target population in population-based screening

Education of technologist

Active efforts to improve skill of ultrasonographers qualified by the Japan Society of Ultrasonics in Medicine is necessary, such as supports to obtain qualification as ultrasonographers and holding

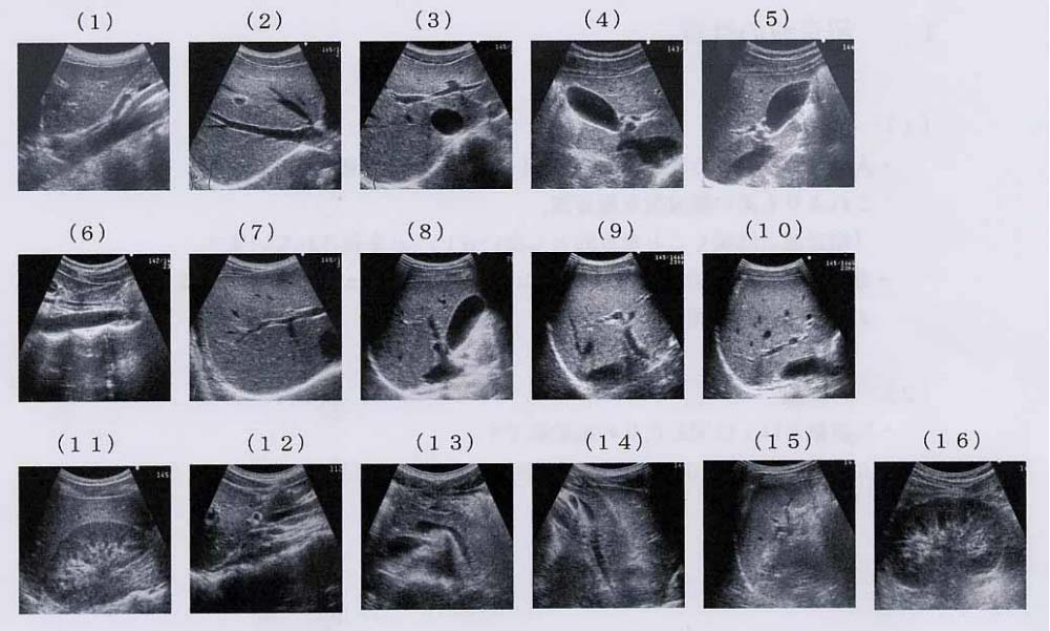
seminars and training programs for ultrasonographers.

References

1） Journal of Gastrointestinal Cancer Screening. 2011；49： 667-685.

2） Tanaka S, Okaniwa S, Kumada T, Nakajima M, Hirai T. Outline of the guideline for abdominal ultrasound cancer screening. Jpn.Jpn. J Med Ultrasonics 2013; 40: 549-565

Fig. 1. Exemplary sections recorded



1) Epigastric sagittal scan: Liver/aorta	9) Right intercostal scan: Liver
2) Epigastric horizontal scan to right subcostal scan: Hepatic vein	10) Right intercostal scan: Liver
3) Right Epigastric oblique scan: Horizontal portal vein	11) Right intercostal scan: Right kidney
4) Right Subcostal scan: Gallbladder	12) Epigastric vertical scan: Extrahepatic bile duct/pancreas
5) Right hypochondrium vertical scan: Gallbladder	13) Epigastric horizontal scan: Pancreas
6) Right hypochondrium vertical to oblique scan: Extrahepatic bile duct	14) Epigastric oblique scan: Pancreas
7) Right subcostal scan: Liver	15) Left intercostal scan: Pancreas
8) Right intercostal scan: Liver	16) Left intercostal scan: Left kidney

Categorized Criteria for Abdominal Ultrasound Cancer Screening

Ultrasonic imaging findings

Operators should consider in detail to which ultrasonic imaging finding item in the Manual the abnormal findings noted in observations of the liver, biliary tract, pancreas, kidneys, spleen, and other target organs correspond and select applicable items. Although observation of organs other than the target organs is not essential, findings suspected to be malignant or considered to be needing treatment in such organs may be described if present. If an organ cannot be imaged at all, it will be assessed as No image obtained. If an organ cannot be imaged partially, adopt findings from the imageable sites and describe the sites that cannot be imaged.

Categories (Tables 1-1, 1-2)

Category for cancer, ultrasonography findings (described in Report Form), and assessment are determined in accordance with ultrasonic imaging findings selected.

Categories are criteria of cancer assessment and also summaries of findings noted in ultrasonography.

For each organ, the highest category noted is described as the category for the organ.

For a lesion that can be compared with the previous image, describe comments on chronological changes.

If a lesion has findings corresponding to Category 3 or higher in ultrasonic images but has been considered to be benign as a result of thorough examination, the Category in question is indicated with dash mark [e.g., 3' or 4'] and Assessment C is selected.

Ultrasonography findings (described in Report Form)

It consists of simplified terms for notification of description of ultrasonic imaging findings to subjects. Ultrasonography finding terms are described in the Report Form. Categories 4 and 5 are described as “Tumor” and Category 3 localized lesion as “Mass,” including suspected ones.

Assessments (Table 1-3) (Table 2)

Assessment is determined principally based on abnormal findings in ultrasonic images, and physicians in charge of assessment finally select the assessment taking into consideration laboratory results other than ultrasonography, such as blood tests and comparison with previous findings.

(Examples)

* A Category 3 lesion may be assessed as C if it has no chronological change compared with at least the past 2 results.
* Assessment D may be selected as necessary if the size of the localized lesion or lumen diameter definitely increases compared to the previous result.
* Assessment D may be selected for a localized lesion in the liver as necessary if chronic hepatic disease is suspected such as infection with HBV or HCV or presence of thrombocytopenia ($<15 \times 10^4/mm^3$).
* Assessment D2 may be selected if the biliary tract is poorly imaged with abnormal biliary tract enzyme.
* Assessment C may be selected if the case has undergone thorough examination in other medical institutions and been followed up by the institution.

Table 1-1 Category

Category 0	Unassessable	Assessment is impossible due to device malfunction or subject or operator factors.
Category 1	Normal	No abnormal findings. Normal variation included.
Category 2	Benign	Definite benign lesion.
Category 3	Difficult to assess malignancy	Lesions difficult to assess for benign/malignant or indirect findings indicating possible malignant lesion. Including high-risk group.
Category 4	Possibly malignant	Lesion likely to be malignant.
Category 5	Malignant	Definite malignant lesion

Table 1-2 Category Table

Organ	Category	Site with no image obtained
Liver	0 / 1 / 2 / 3 / 4 / 5	Present□
Biliary tract	0 / 1 / 2 / 3 / 4 / 5	Present□
Pancreas	0 / 1 / 2 / 3 / 4 / 5	Present□
Kidneys	0 / 1 / 2 / 3 / 4 / 5	Present□
Spleen	0 / 1 / 2 / 3 / 4 / 5	Present□
Others		

Shaded cells are filled only if applicable findings are present.

Table 1-3 Assessment

A	Normal	
B	Mild abnormality	
C	Following-up/reexamination/lifestyle instruction needed	
D (Medical care needed)	D1	Treatment needed
	D2	Thorough examination needed
E	Under treatment	

Table 2-1 Liver

Ultrasonic imaging findings	Category	Ultrasonography findings (described in Report Form)	Assessment
Solid lesion	**3**	Liver mass	**C**
Maximum diameter ≥15 mm	**4**	Liver tumor	**D2**
With category 3 diffuse lesion in the background liver	**4**	Liver tumor	**D2**
Any one of peripheral hypoechoic zone, posterior echo enhancement, or multiple	**4**	Liver tumor	**D2**
Peripheral bile duct dilation Fig. 2	**4**	Liver tumor	**D2**
Mosaic pattern Fig. 3	**5**	Liver tumor	**D1**
Cluster sign Fig. 4	**5**	Liver tumor	**D1**
With blockade of either intrahepatic bile duct or blood vessel Fig. 5	**5**	Liver tumor	**D1**
* Only if any one of marginal strong echo, chameleon sign, or wax and wane sign is present Figs. 6, 7	**2**	Liver hemangioma	**C**
Cystic lesion	**2**	Liver cyst	**B**
With solid portion (e.g., intracystic nodules, wall thickening, or septal thickening) Figs. 8, 9	**4**	Cystic tumor of liver	**D2**
Calcification image (including air image) Note 1) Fig. 10	**2**	Intrahepatic calcification	**B**
With intrahepatic bile duct dilation	**3**	Intrahepatic bile duct stone or emphysema	**D2**
Diffuse lesion			
Any one of bright liver, liver-kidney contrast, vascular blurring, or deep attenuation is present. Note 2) Figs. 11-13	**2**	Fatty liver	**C**
Dull liver edge, rough parenchymal echo pattern, and nodular rugged surface are present Figs. 14, 15	**3**	Chronic hepatic disorder	**D2**
Intrahepatic bile duct dilation	**3**	Intrahepatic bile duct dilation	**D2**
Abnormal blood vessel	**2**	Abnormal hepatic **blood** vessel	**D2**
No abnormal findings	**1**		**A**
No image obtained	**0**	No image obtained	**D2**

Note 1)

● Calcification image refers to hyperechoic spot with acoustic shadow.

● Confirm that it is not a part of solid mass with calcification such as metastatic liver cancer.

● If the lesions are multiple, focus on their locations and liver parenchyma echo pattern, with lesions derived from parasites such as *Schistosoma japonicum* and *Echinococcus* in mind.

Note 2) If it is irregular hypoechoic region in frequent site of focally spared area in fatty liver without disturbed speckle pattern and color Doppler detects no deviation in blood flow, it is not considered as solid lesion (Fig. Liver-1).

Fig. Liver-1

Frequent site of focally spared area in fatty liver

① Around the gallbladder: Cystic vein reflux region

② Dorsal S4 and S2: Ectopic reflux region by right gastric vein

③ Frontal S4 immediately below the liver surface: Sappey's venous reflux region

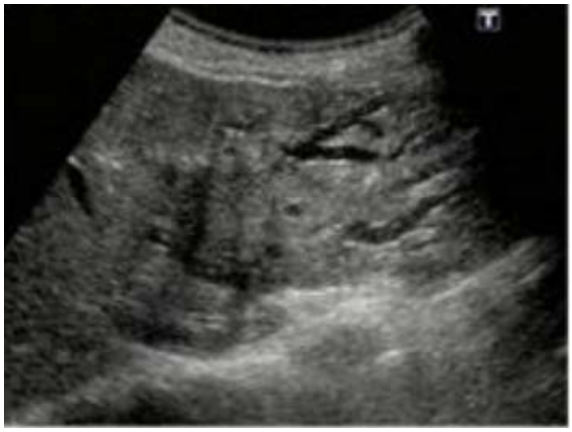


Fig. Liver-2 Solid lesion with peripheral bile duct dilation **(Category 4)**

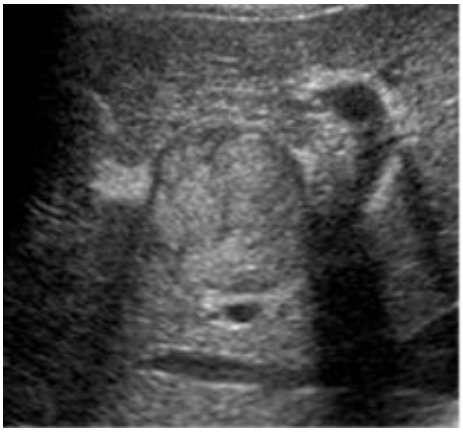


Fig. Liver-3 Mosaic pattern, marginal hypoechoic zone, and enhanced posterior echo **(Category 5)**

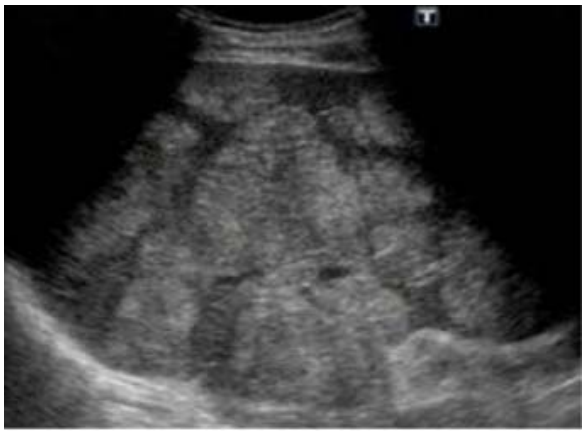


Fig. Liver-4 Cluster sign **(Category 5)**

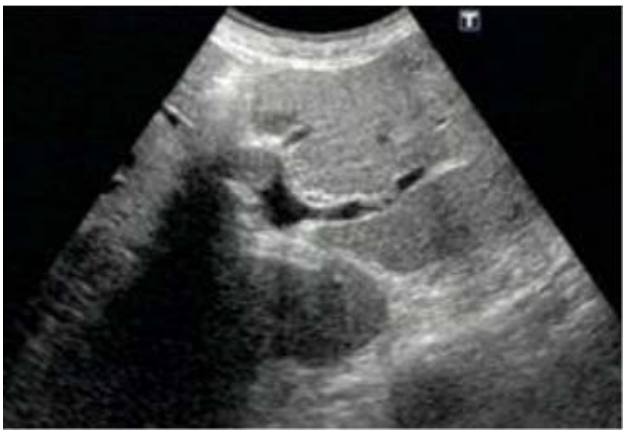


Fig. Liver-5 Solid lesion in the portal vein **(Category 5)**

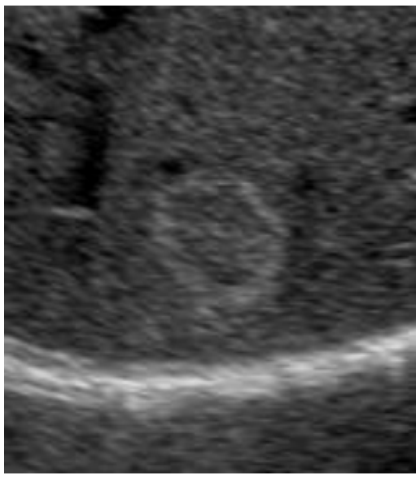


Fig. Liver-6 Marginal strong echo **(Category 2)**

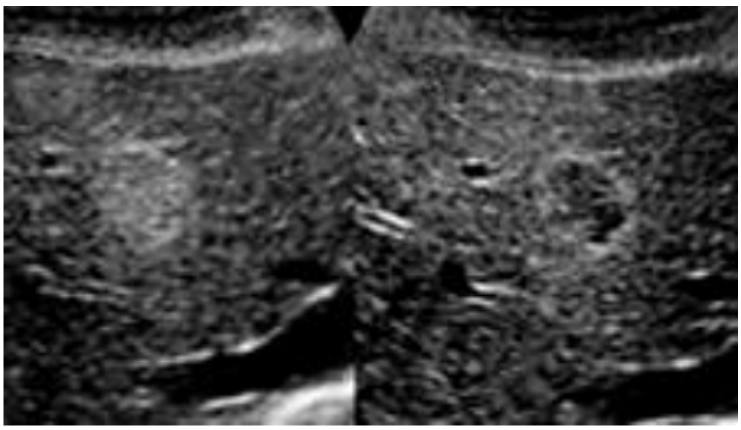


Fig. Liver-7 Wax and wane sign **(Category 2)**

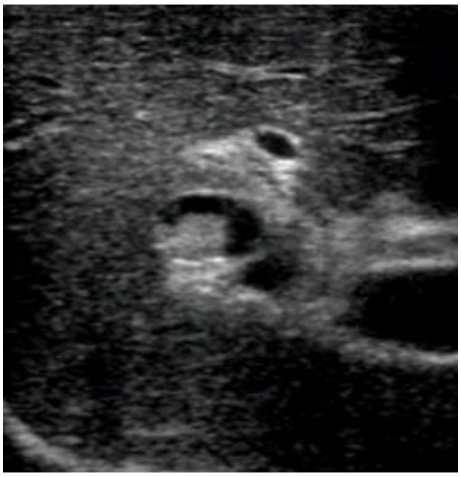


Fig. Liver-8 Cyst with nodules **(Category 4)**

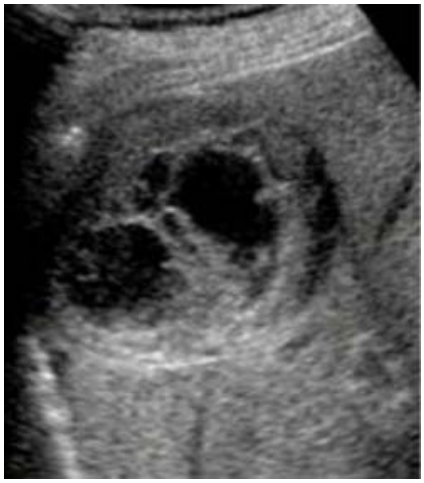


Fig. Liver-9 Cyst with septal thickening **(Category 4)**

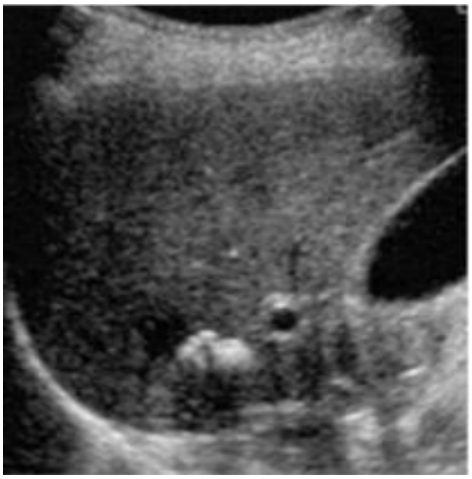


Fig. Liver-10 Calcification picture **(Category 2)**

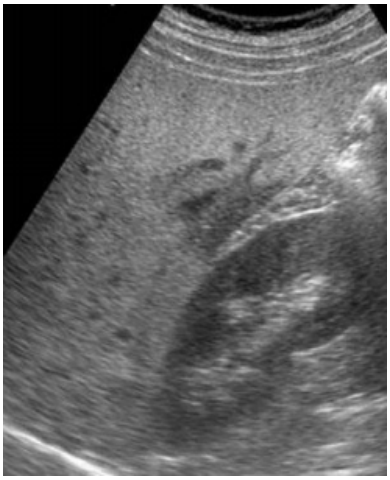


Fig. Liver-11 Bright liver, liver-kidney contrast **(Category 2)**

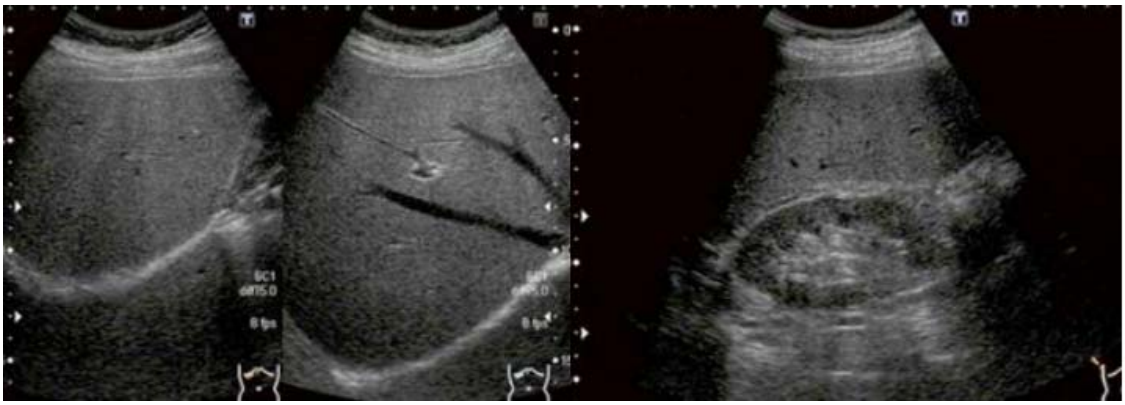


Fig. Liver-12 Mild fatty liver (mild bright liver with liver-kidney contrast, without attenuation or unclear vessels) **(Category 2)**

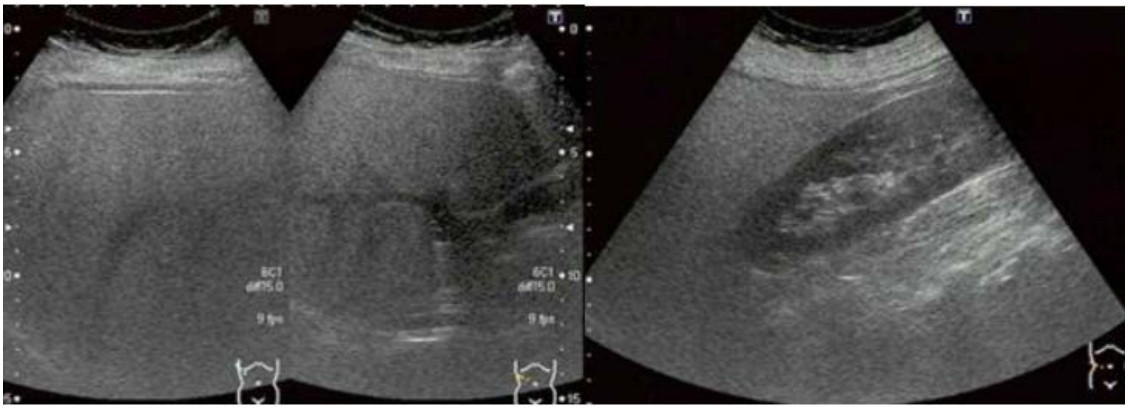


Fig. Liver-13 Severe fatty liver (Severe bright liver, with liver-kidney contrast, deep attenuation and vascular blurring) **(Category 2)**

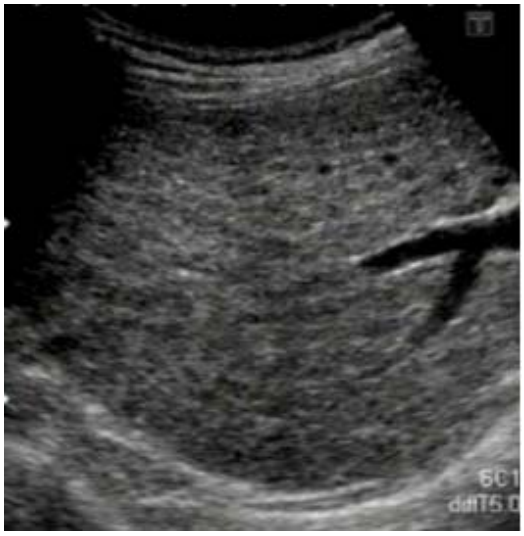


Fig. Liver-14 Rough speckle pattern of liver parenchyma

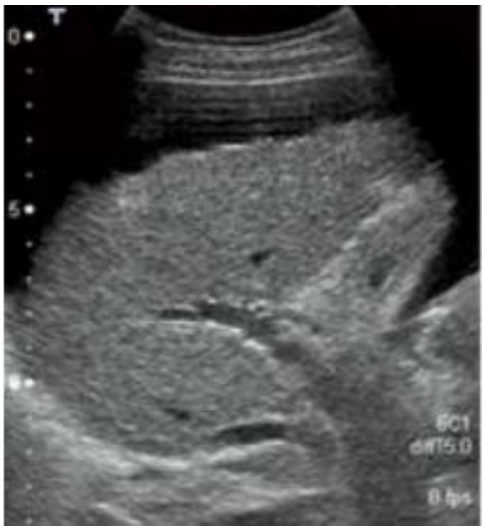


Fig. Liver-15 Irregularity on the surface of the liver **(Category 3)**

(Images provided by Takashi Kumada for #2-10 #12-15 and by Yasuji Arase for #11)

Table 2-2 Gallbladder/extrahepatic bile duct

Ultrasonic imaging findings	Category	Ultrasonography findings (described in Report Form)	Assessment
Gallbladder			
Protrusion or polypoid lesion			
Pedunculated			
<5 mm	**2**	Gallbladder polyp	**B**
≥5 mm, <10 mm	**3**	Gallbladder mass	**C**
If hyperechoic spot or mulberry-like echo is present Fig. 1	**2**	Gallbladder polyp	**B**
≥10 mm	**4**	Gallbladder tumor	**D2**
Sessile	**4**	Gallbladder tumor	**D2**
If small cystic structure or comet-like echo is present Fig. 2	**2**	Gallbladder adenomyoma	**C**
With irregularity or tear of the layered structure of the attached wall Fig. 3	**5**	Gallbladder tumor	**D1**
Wall thickening Note 1)			
Diffuse thickening (wall thickness ≥4 mm, in the liver bed side of gallbladder wall on the body)	**3**	Diffuse gallbladder wall thickening	**D2**
If any one of layered structure, small cystic structure, or comet-like echo is present Fig. 4	**2**	Gallbladder adenomyoma	**C**
With irregularity or tear of the layered structure of the wall	**4**	Gallbladder tumor	**D2**
Localized thickening (inner hypo echoic layer in a part of the wall) Fig. 5	**4**	Gallbladder tumor	**D2**
If small cystic structure or comet like echo is present.	**2**	Gallbladder adenomyoma	**C**
Swelling (minor axis ≥36 mm)	**3**	Gallbladder enlargement	**D2**
Without abnormal findings in the distal bile duct up to the near-papillary region	**2**	Gallbladder enlargement	**C**
Stone image (including calcification and emphysema)	**2**	Cholecystolithiasis or gallbladder emphysema	**C**
Wall cannot be evaluated	**3**	Cholecystolithiasis with poor evaluation of gallbladder wall	**D2**
Debris (describe separately from stone image) Fig. 6	**3**	Biliary sludge	**D2**
No abnormal finding	**1**	Normal gallbladder	**A**
No image obtained	**0**	Gallbladder cannot be imaged	**D2**

Post-cholecystectomy	**0**	Post-cholecystectomy	**B**
Extrahepatic bile duct			
Protrusion or polypoid lesion Fig. 7	**4**	Bile duct tumor	**D2**
With irregularity or tear of the layered structure Fig. 8	**5**	Bile duct tumor	**D1**
Wall thickening (wall thickness ≥3 mm or localized internal hypoechoic layer) Fig. 9	**3**	Bile duct wall thickening	**D2**
Irregular mucosal surface Fig. 10	**4**	Bile duct tumor	**D2**
Irregular layered structure	**5**	Bile duct tumor	**D1**
Bile duct dilation (≥8 mm, or ≥11 mm after cholecystectomy)	**3**	Bile duct dilation	**D2**
Without abnormal findings in the distal bile duct up to the near-papillary region	**2**	Bile duct dilation	**C**
Stone image (including calcification or emphysema)	**2**	Bile duct stone or bile duct emphysema	**D2**
If history of biliary system operation is present and it moves by position change	**2**	Bile duct emphysema	**B**
Debris Fig. 11	**3**	Biliary sludge	**D2**
No abnormal finding	**1**	Normal	**A**
No image obtained Note 2)	**0**	No image obtained	**C**

Note 1) Pay attention to coexisting protruded lesions in case with the wall thickening with small cystic structure or comet-like echo.

Note 2) Select D2 in assessment if abnormal findings are present in the gallbladder or intrahepatic bile duct.

Gallbladder/extrahepatic bile duct images

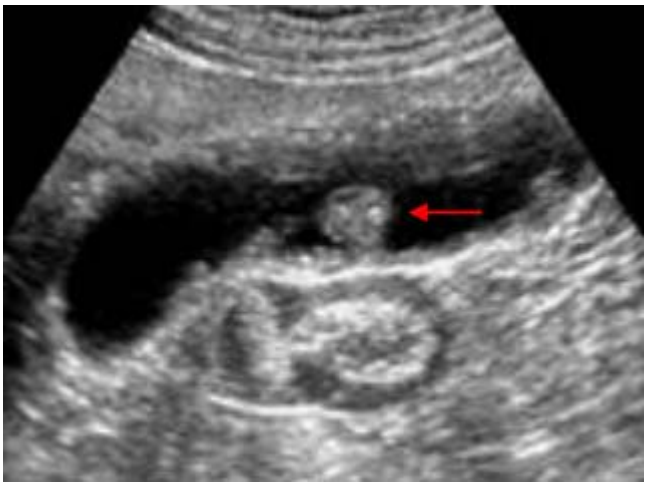


Fig. Gallbladder-1 A pedunculated polyp sized 5 to 9 mm with hyperechoic spot **(Category 2)**

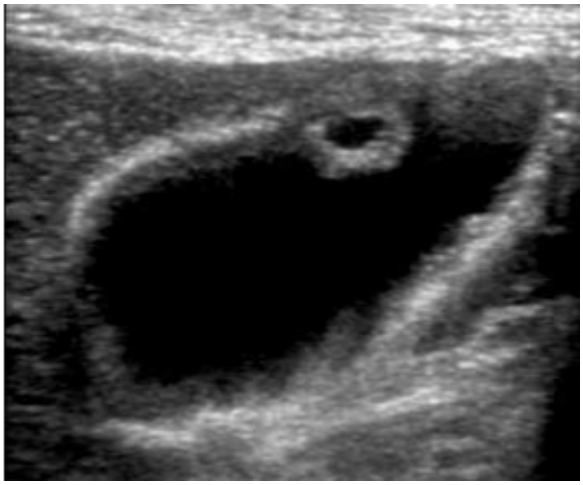


Fig. Gallbladder-2 A sessile polyp with small cystic structure **(Category 2)**

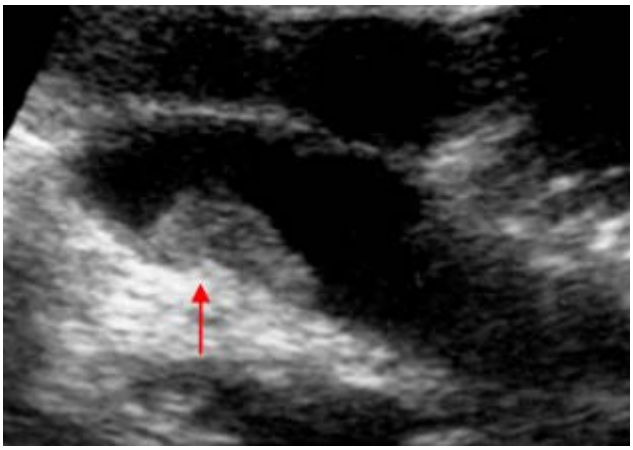


Fig. Gallbladder-3 A sessile polyp with irregular layered structure of the attached wall **(Category 5)**

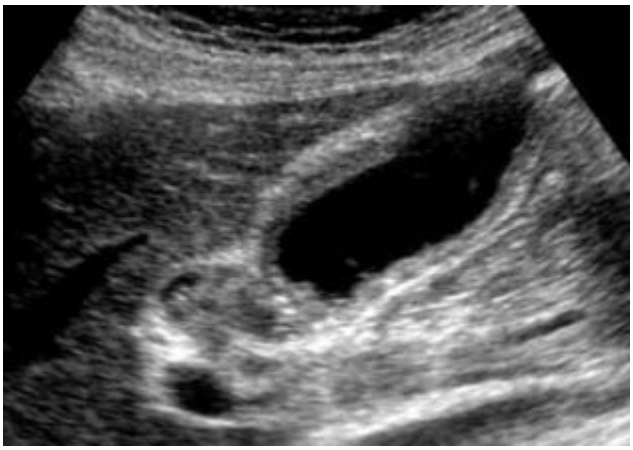


Fig. Gallbladder-4 Diffuse thickening with regular layered structure **(Category 2)**

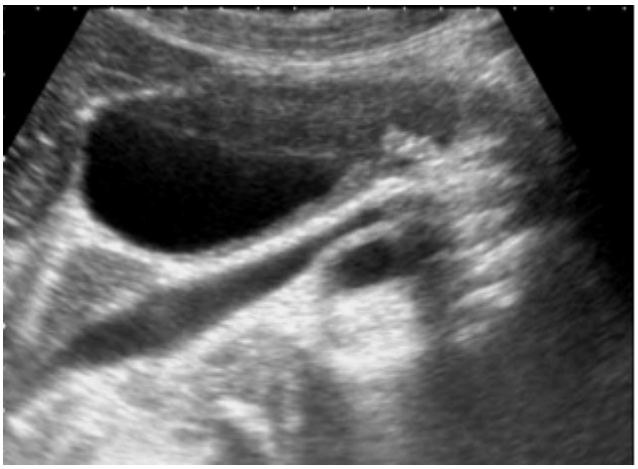


Fig. Gallbladder-5 Localized wall thickening **(Category 4)**

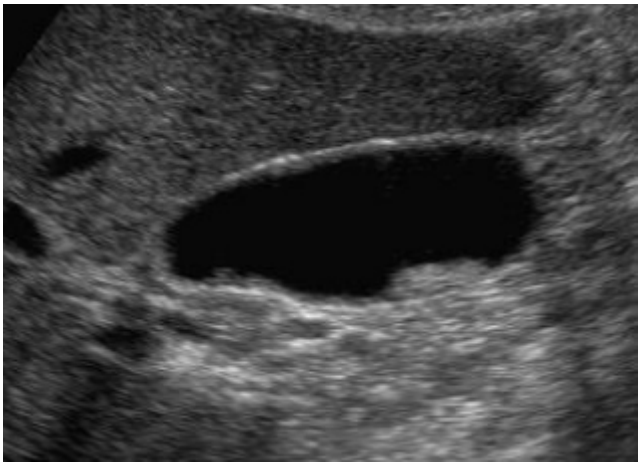


Fig. Gallbladder-6 Debris in the gallbladder **(Category 3)**

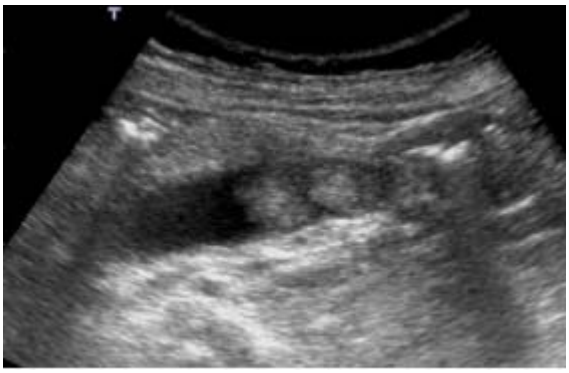


Fig. Gallbladder-7 Polypoid lesions in the extrahepatic bile duct **(Category 4)**

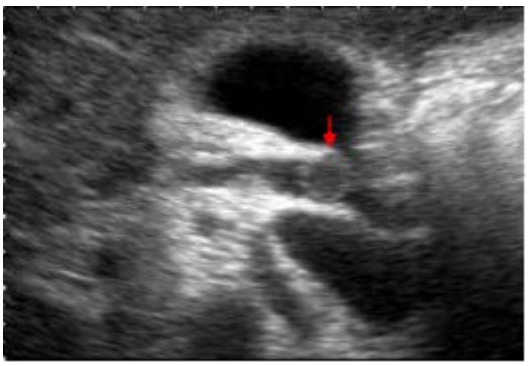


Fig. Gallbladder-8 Mass image in the extrahepatic bile duct with irregular layered structure in the holdfast

(Category 5)

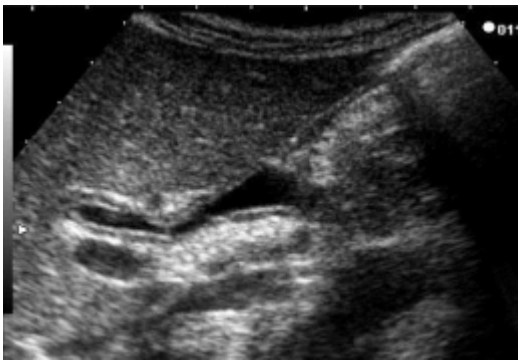


Fig. Gallbladder-9 Diffuse wall thickening of the extrahepatic bile duct with smooth mucosal surface

(Category 3)

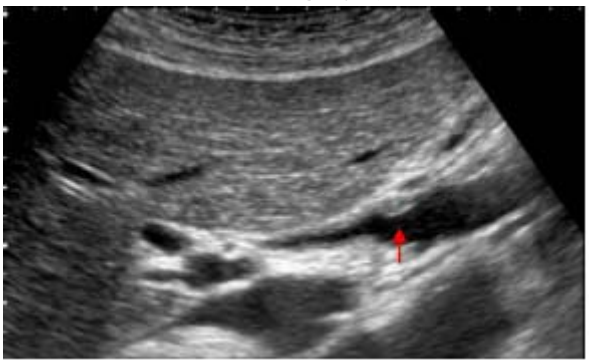


Fig. Gallbladder-10 Localized wall thickening of the extrahepatic bile duct with irregular mucosal surface

(Category 4)

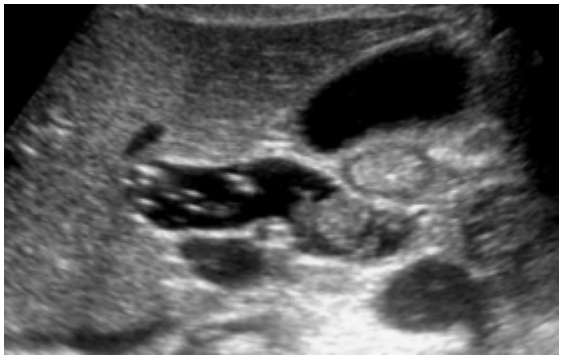


Fig. Gallbladder-11 Debris in the extrahepatic bile duct **(Category 3)**

(Images provided by Shinji Okaniwa)

Table 2-3. Pancreas

Ultrasonic imaging findings	Category	Ultrasonography findings (described in Report Form)	Assessment
Solid lesion Note 1)			
Hyperechoic mass image Fig. 2	**2**	Pancreatic mass	**C**
Hypo (iso) image Fig. 3	**4**	Pancreatic tumor	**D2**
With blocking in any of the main pancreatic duct, extrahepatic bile duct, or peripancreatic blood vessels Fig. 4	**5**	Pancreatic tumor	**D1**
Cystic lesion	**2**	Pancreatic cyst	**B**
Diameter ≥5 mm Figs. 5, 6	**3**	Pancreatic cyst	**D2**
With solid portion (e.g., intracystic nodule, wall thickening, or septal thickening) Figs. 7-9	**4**	Pancreatic cystic tumor	**D2**
Calcification Fig. 10	**2**	Pancreatic stone	**C**
Main pancreatic duct dilation (≥3 mm in the pancreatic body) Note 2) Figs. 11, 12	**3**	Pancreatic duct dilatation	**D2**
Nodule in the main pancreatic duct Fig. 13	**4**	Pancreatic tumor	**D2**
Downstream stenosis Fig. 14	**4**	Pancreatic tumor	**D2**
Morphological abnormality (swelling or atrophy)			
Maximum minor axis ≥ 30 mm	**2**	Pancreatic enlargement	**D2**
Maximum minor axis <10 mm	**2**	Pancreatic atrophy	**D2**
Localized swelling Note 3)	**2**	Deformation	**B**
The swollen region has any of decreasing echo level, irregular echo pattern, or unclear internal structure such as main pancreatic duct. Fig. 15	**4**	Pancreatic tumor	**D2**
No abnormal finding	**1**	Normal	**A**
No image obtained	**0**	No image obtained	**D2**

Note 1) Mixed pattern mass lesion may be classified into either solid or cystic lesion.

Note 2) Measuring between the upper edge of the anterior line and the posterior line of the main pancreatic duct in magnified image (Fig. Pancreas-1)

Note 3) “localized swelling” means locally increased thickness with smooth surface contour.

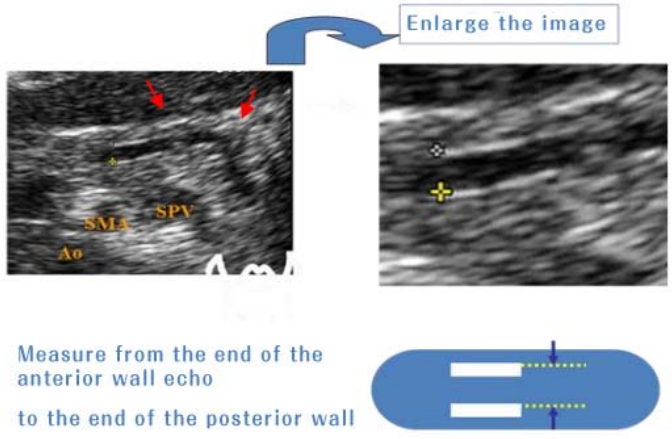


Fig. Pancreas-1
Measurement of lumen diameter (round off the measurements to integers in mm)

Pancreas images

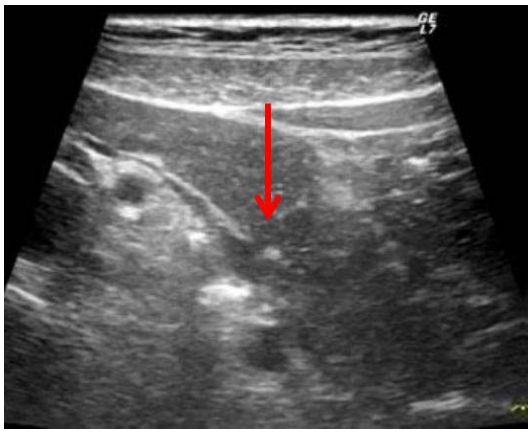


Fig. Pancreas-2 Hyperechoic mass image **(Category**

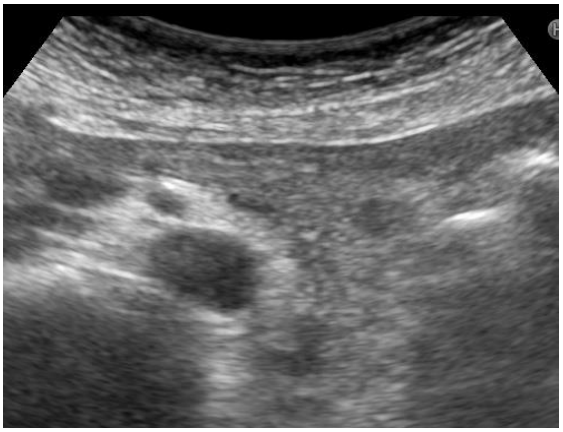


Fig. Pancreas-3 Hypoechoic mass image **(Category 4)**

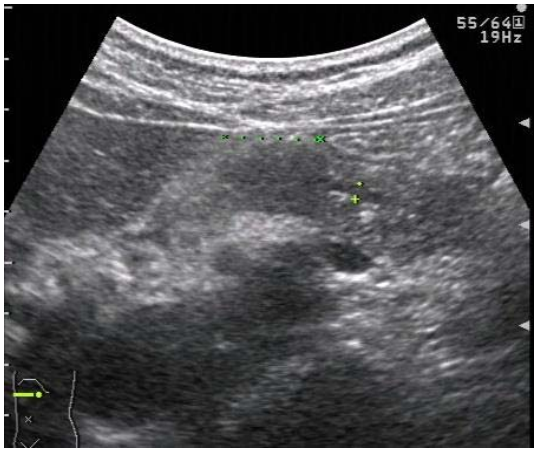


Fig. Pancreas-4 Hypoechoic mass image with obstraction of the main pancreatic duct **(Category 5)**

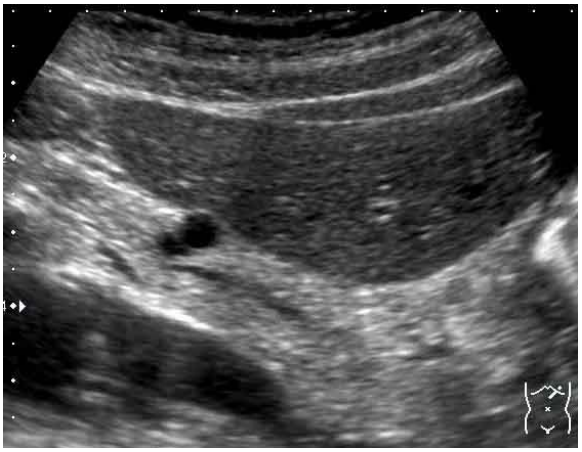


Fig. Pancreas-5 Cystic lesion or diameter ≥5 mm **(Category 3)**

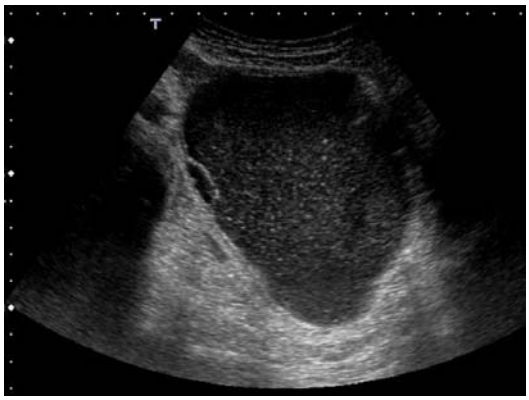


Fig. Pancreas-6 Cystic lesion of diameter ≥5 mm without septal thickening **(Category 3)**

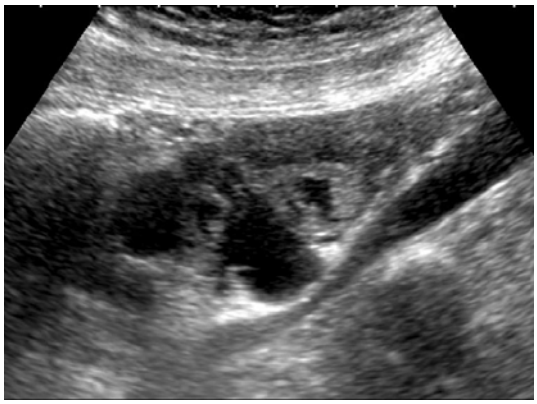


Fig. Pancreas-7 Cystic lesion with septal thickening **(Category 4)**

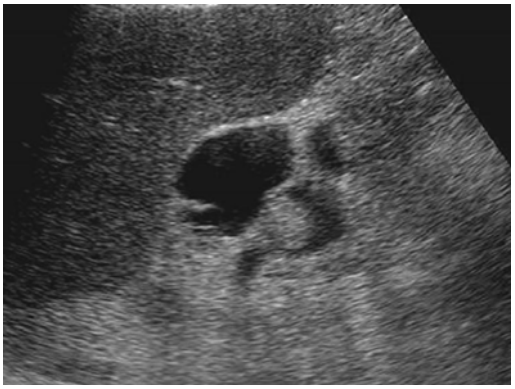


Fig. Pancreas-8 Cystic lesion with intracystic nodules and septal thickening **(Category 4)**

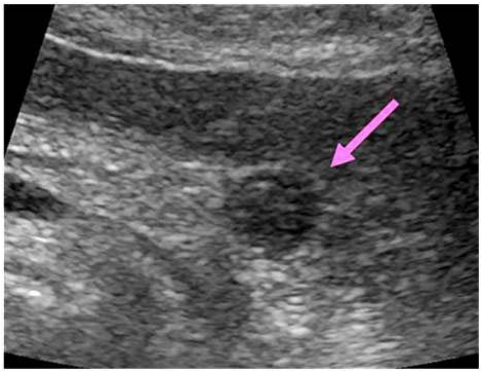


Fig. Pancreas-9 Cystic lesion with solid portion **(Category 4)**

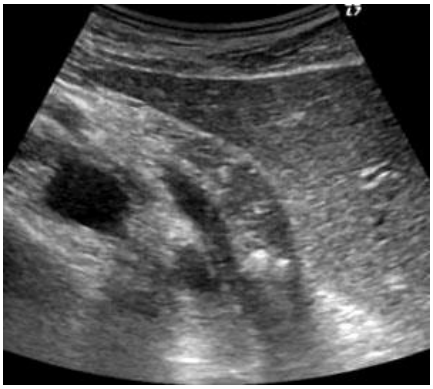


Fig. Pancreas-10 Calcification **(Category 2)**

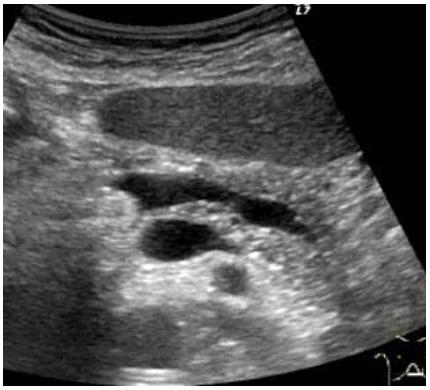


Fig. Pancreas-11 Calcification with main pancreatic duct dilation **(Category 3)**

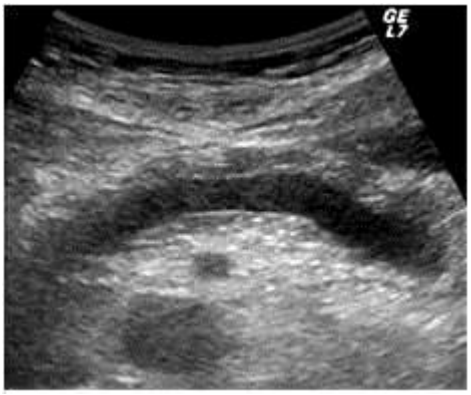


Fig. Pancreas-12 Main pancreatic duct dilation **(Category 3)**

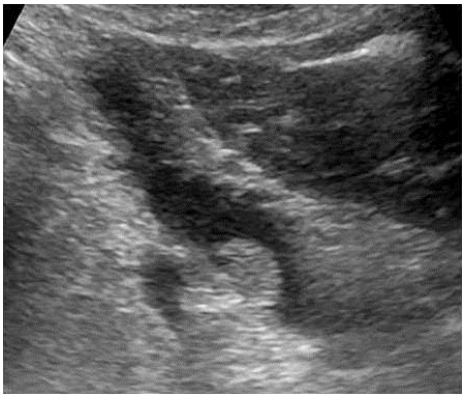


Fig. Pancreas-13 Main pancreatic duct dilation with nodules in the main pancreatic duct **(Category 4)**

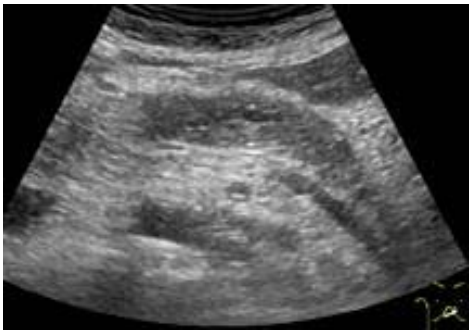


Fig. Pancreas-14 Main pancreatic duct dilation with downstream stenosis **(Category 4)**

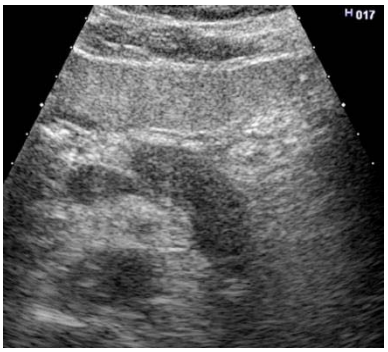


Fig. Pancreas-15 Localized swelling with decreasing echo level and unclear internal structure **(Category 4)**

(Images provided by Sachiko Tanaka for #2-5, #9-15 and by Shinji Okaniwa for #6-8)

Table 2-4 Kidneys

(Images provided by Yukiko Tanaka for # 1-5 and Shinji Okaniwa for # 6-8)

Ultrasonic imaging findings	Category	Ultrasonographic findings (described in Report Form)	Assessment
Solid lesion	**3**	Renal mass	**D2**
Round shaped mass image with smooth contour Fig. 1	**4**	Renal tumor	**D2**
With any one of internal anechoic region, peripheral hypoechoic zone, or lateral shadow.	**4**	Renal tumor	**D2**
With dissociation or deformation of central echo complex Fig. 2	**4**	Renal tumor	**D2**
Round shaped mass image with smooth contour and internal anechoic region Fig. 3	**5**	Renal tumor	**D1**
Internal anechoic region is present with either of peripheral hypoechoic zone or lateral shadow	**5**	Renal tumor	**D1**
If it has brightness equal to or higher than that of the central echo complex with irregular contour or comet picture. Fig. 4	**2**	Renal angiomyolipoma	**C**
Cystic lesion	**2**	Renal cyst	**B**
Multiple cysts are aggregated bilaterally with unclear renal parenchyma	**3**	Polycystic kidney disease	**C**
Septum without thickening or calcification picture	**3**	Renal cystic tumor	**C**
With solid portion (e.g., intracystic nodules, wall thickening, or septal thickening) are noted Figs. 5, 6	**4**	Renal cystic tumor	**D2**
Calcification	**2**	Nephrocalcinosis or renal stone	**B**
Diameter ≥10 mm	**2**	Nephrocalcinosis or renal stone	**C**
Pelvic dilatation (unknown cause of occlusion)	**3**	Pelvic dilatation, hydronephrosis	**D2**
Mild dilatation (without caliectasis)	**2**	Pelvic dilatation	**B**
Dilated region or occluded region with calcification Fig. 7	**2**	Renal stonestone	**D2**

Occluded with solid mass Fig. 8	**4**	Renal tumor	**D2**
Morphological defect (e.g., different size between the bilateral kidneys and malformation)	**2**	Kidney deformity	**B**
Nodular rugged surface or deformation of central echo complex Fig. 9	**3**	Renal mass	**D2**
Bilateral maximum diameter ≥12 cm	**3**	Kidney enlargement	**D2**
Bilateral maximum diameter <8 cm	**2**	Renal atrophy	**D2**
No abnormal finding Note 1)	**1**	Normal	**A**
No image obtained	**0**	No image obtained	**D2**
Post-nephrectomy	**0**	Post-nephrectomy	**B**

Note 1) Nodular deformation of renal contour or localized bulge into the central echo complex with isoechoic level and echo pattern similar to that of renal cortex is assessed as Category 1 (normal variant). It is desirable to confirm vascular construction similar to that of normal renal parenchyma in color Doppler (Figs. Kidney-10 and -11)

Renal Images

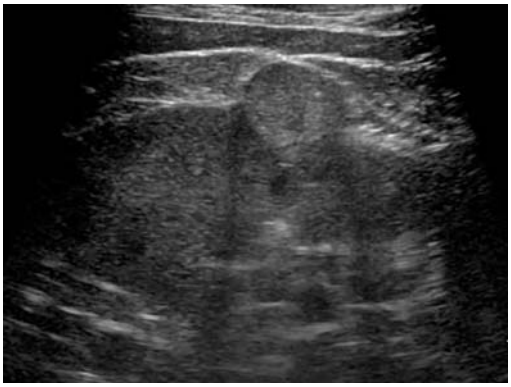


Fig. Kidney-1 Round shaped solid mass image with clear and smooth contour **(Category 4)**

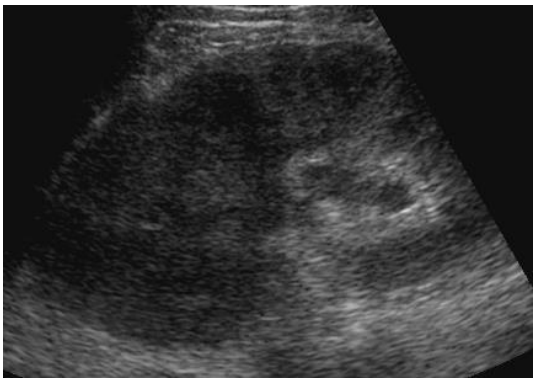


Fig. Kidney-2 Solid lesion with central echo complex dissociation or deformation **(Category 4)**

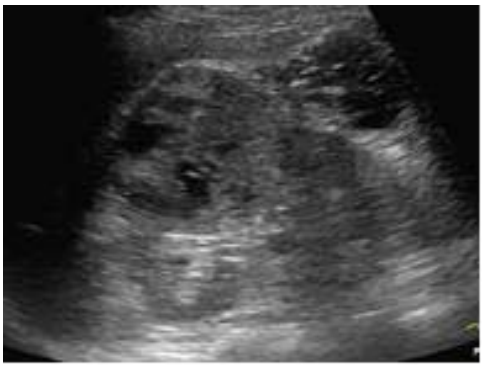


Fig. Kidney-3 Clear and smooth contour solid mass image with marginal hypoechoic zone and internal anechoic region **(Category 5)**

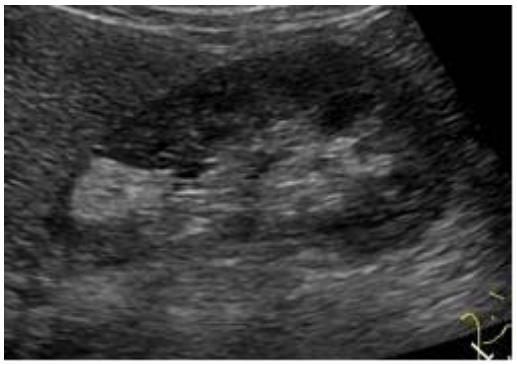


Fig. Kidney-4 Solid mass image with irregular contour brighter than the central echo complex

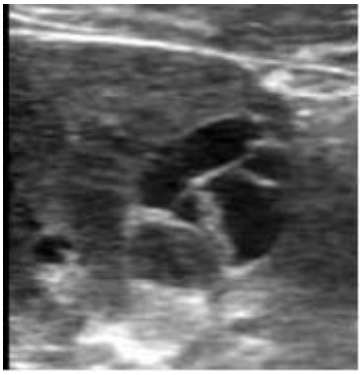


Fig. Kidney-5 Cyst with septal thickening **(Category 4)**

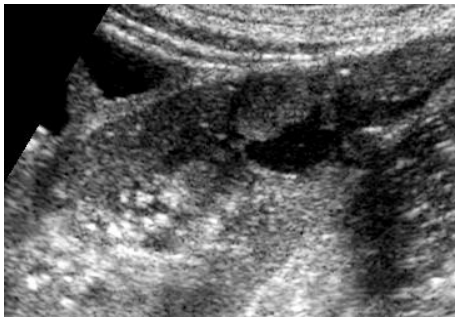


Fig. Kidney-6 Cyst with solid portion **(Category 4)**

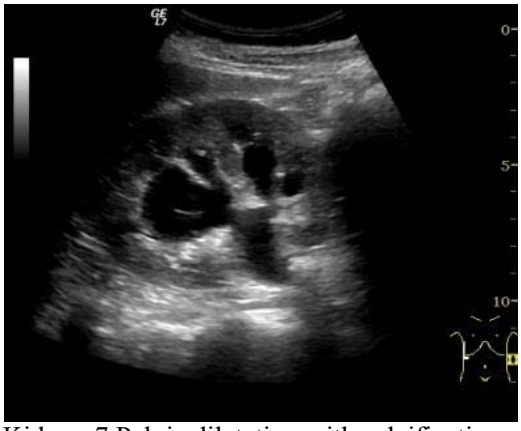


Fig. Kidney-7 Pelvic dilatation with calcification picture in the occluded region **(Category 2)**

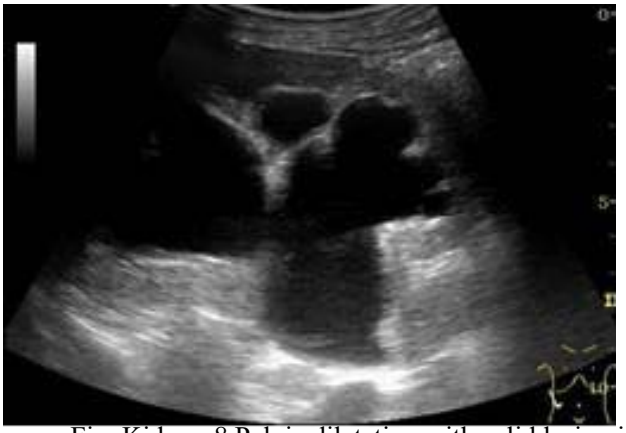


Fig. Kidney-8 Pelvic dilatation with solid lesion in the occluded region **(Category 4)**

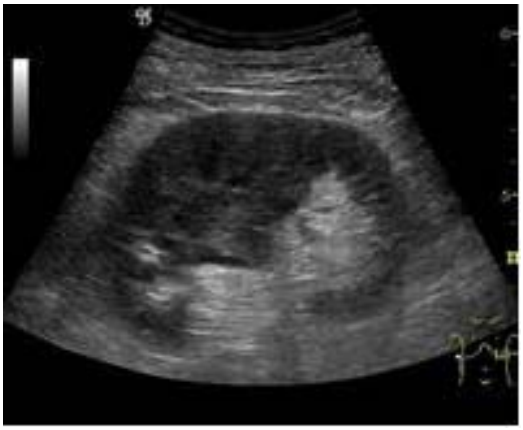


Fig. Kidney-9 Deformation of central echo complex **(Category 3)**

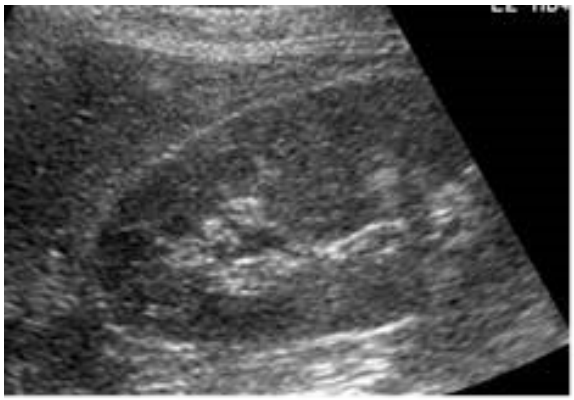


Fig. Kidney-10 Localized bulge into central echo complex with isoechoic level and echo pattern similar to that of renal cortex **(Category 1)**

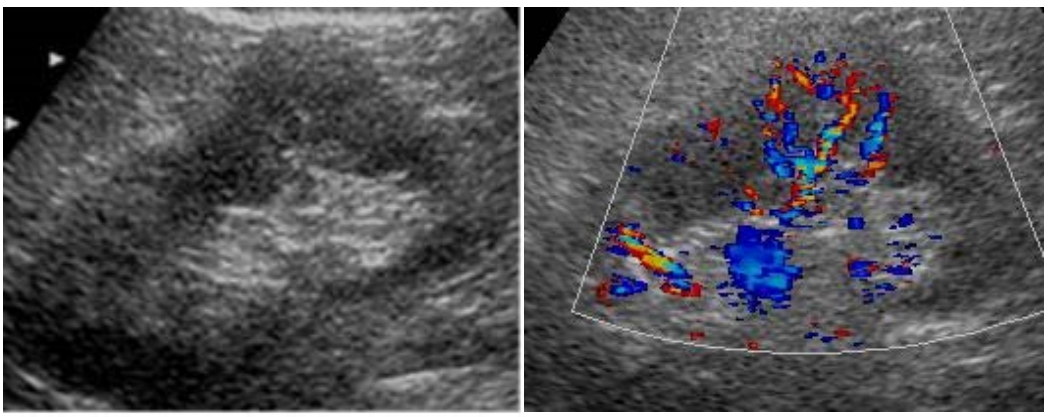


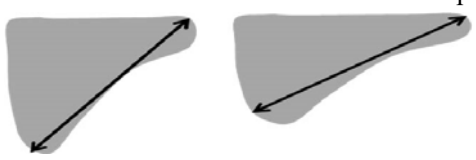
Fig. Kidney-11 Localized bulge with vascular construction similar to that of normal renal parenchyma with color Doppler image **(Category 1)**

(Images provided by Toshiko Hirai)

Table 2-5 Spleen/abdominal aorta/others

Ultrasonic imaging findings	Category	Ultrasonography findings (described in Report Form)	Assessment
Spleen			
Solid lesion			
Hyperechoic mass image Fig. 2	**3**	Splenic mass	**D2**
Hypoechoic mass image Figs. 3, 4	**4**	Splenic tumor	**D2**
Mass image with hyperechoic portion in the central area Fig. 5	**5**	Splenic tumor	**D1**
Mass image with mixture of hyperechoic portion and hypoechoic portion Fig. 6	**4**	Splenic tumor	**D2**
Cystic lesion	**2**	Splenic cyst	**B**
With solid portion (e.g., intracystic nodule, wall thickening, or septal thickening) Fig. 7	**4**	Splenic cystic tumor	**D2**
Calcification	**2**	Calcification	**B**
Abnormal vessel in the splenic hilum	**2**	Abnormal vessel in the splenic hilum	**D2**
Swelling Note 1)			
Maximum diameter ≥10 cm, < 15 cm	**2**	Splenomegaly	**B**
Maximum diameter ≥15 cm	**3**	Splenomegaly	**D_2**
Solid lesion in the splenic hilum	**3**	Mass in the splenic hilum	**D_2**
Round shape mass with homogeneous internal echo at echo level equal to that of the spleen	**2**	Accessory spleen	**B**
No abnormal finding	**1**	Normal	**A**
No image obtained Note 2)	**0**	No image obtained	**B**
Post-splenectomy	**0**	Post-splenectomy	**B**
Abdominal aorta			
Localized aortic dilation			
Maximum diameter ≥3 cm, <5 cm	**2**	Abdominal aortic aneurysm	**C**
Maximum diameter ≥5 cm Fig. 8	**2**	Abdominal aortic aneurysm	**D2**
Others			
Lymph node swelling (minor axis ≥7 mm) Fig. 9	**3**	Lymph node swelling	**C**
Either minor axis ≥10 mm or minor/major axis ratio ≥0.5 Fig. 10	**4**	Lymph node swelling	**D2**
Ascites	**3**	Ascites	**D2**
With solid mass image	**4**	Ascites	**D2**
Pleural effusion	**3**	Pleural effusion	**D2**
With solid mass image	**4**	Pleural effusion	**D2**
Fluid retention in the cardiac cavity	**2**	Pericardial fluid	**D2**
Mass image in the abdominal cavity, retroperitoneum, or pelvic cavity	**4**	Abdominal tumor	**D2**

Note 1) Measurement of maximum diameter of spleen (Fig. Spleen/others-1)



Note 2) Confirm presence of history of splenectomy

Images of spleen, abdominal aorta, or others

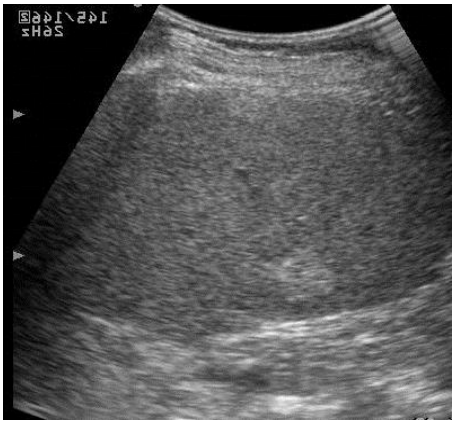


Fig. Spleen/others-2 Hyperechoic mass image **(Category 3)**

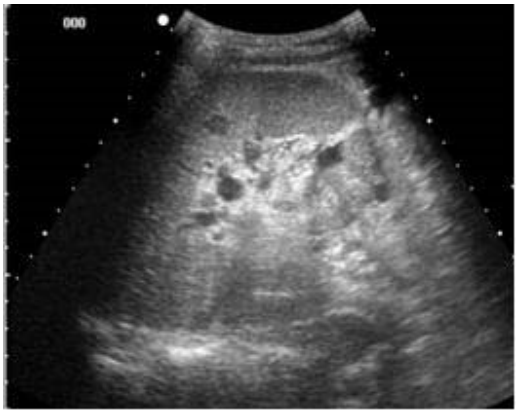


Fig. Spleen/others-3 Hypoechoic mass image**(Category 4)**

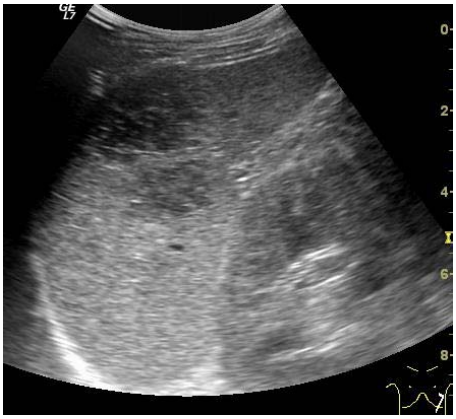


Fig. Spleen/others-4 Hypoechoic mass image **(Category 4)**

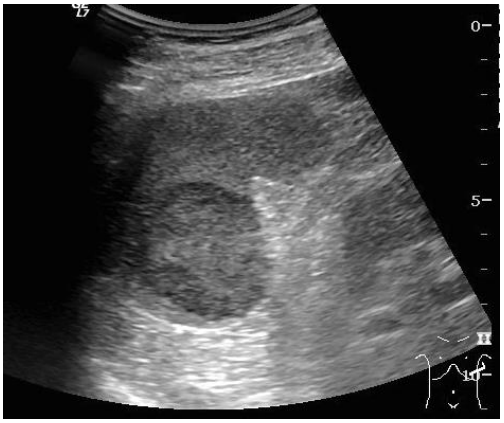


Fig. Spleen/others-5 Hypoechoic mass image with hyperechoic portion in the central area **(Category 5)**

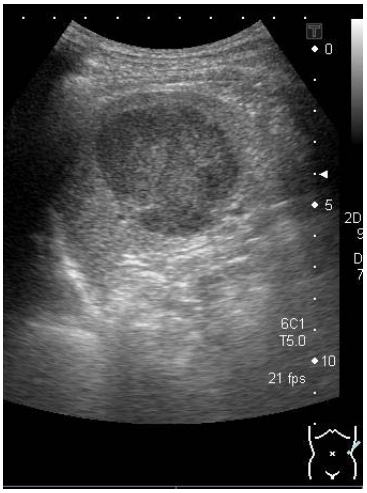


Fig. Spleen/others -6 Mass image with mixture of hyperechoic portion and hypoechoic portion**(Category 4)**

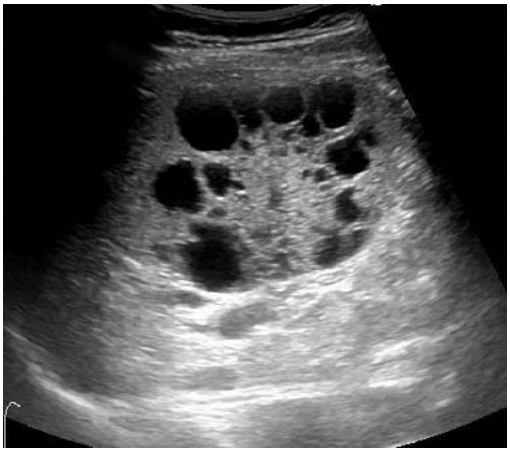


Fig. Spleen/others-7 Cystic lesion with solid portion **(Category 4)**

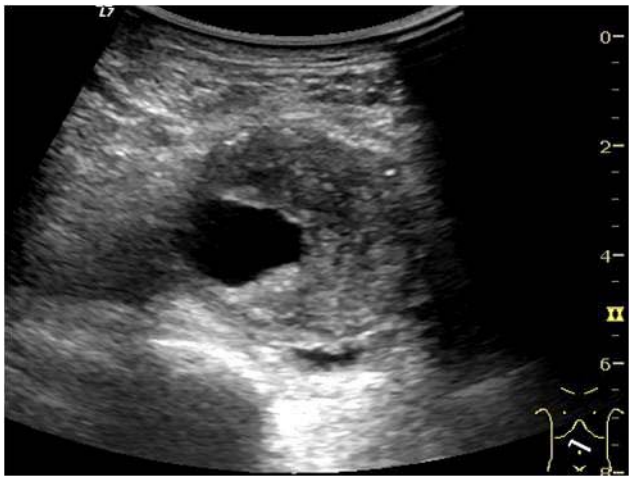


Fig. Spleen/others-8 Abdominal aortic aneurysm
(Category 2)

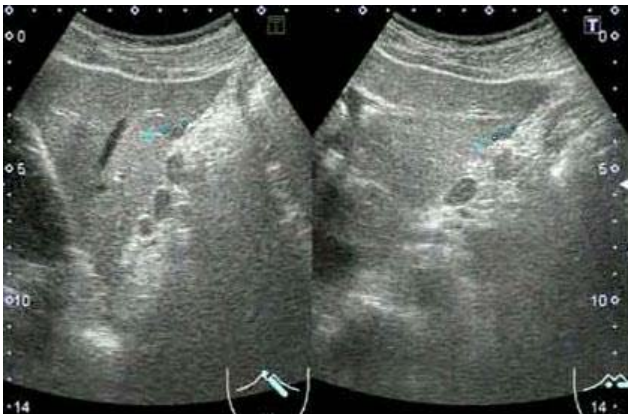


Fig. Spleen/others-9 Lymph node swelling with minor axis ≥7 to 9 mm **(Category 3)**

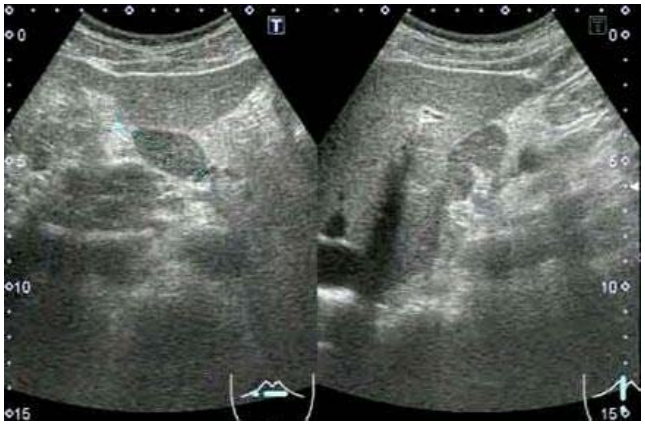


Fig. Spleen/others-10 Lymph node swelling with minor axis ≥10 mm **(Category 4)**

(Images provided by Michiko Nakajima for #2, 3 and 6, Toshiko Hirai for #4, 5, 7, and 8, and Yasujiji Arase for # 9 and 10)

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