

Sonography of the Gallbladder and Biliary Tract

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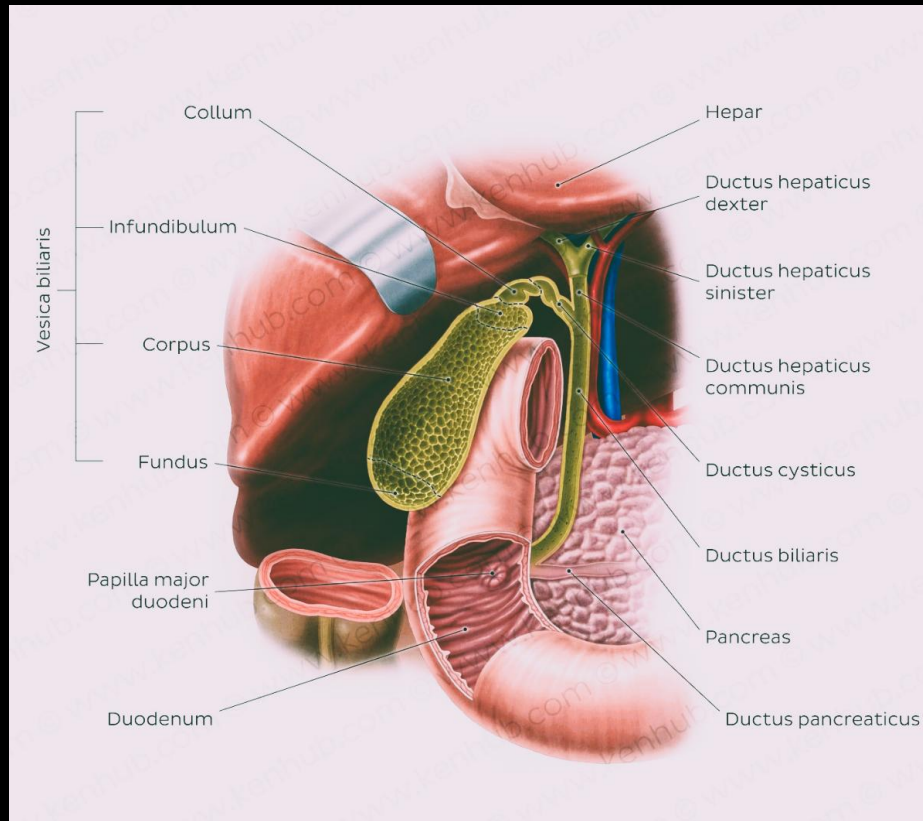
Agenda

- ▶ General Information
- ▶ Gallbladder Anatomy
- ▶ Sonographic Morphology
- ▶ Examination Technique
- ▶ Non-Visualized Gallbladder and Associated Pathologies
- ▶ Overview of Biliary Tract Anatomy and Ultrasound Examination

General Information

- ▶ Excellent ultrasound visualization due to the gallbladder's superficial location and the acoustic window provided by the liver parenchyma
- ▶ Examination can be performed with either a curvilinear abdominal transducer or a linear transducer
- ▶ Ultrasonography is the first-line imaging modality for the evaluation of inflammatory processes and gallstone disease

Gallbladder Anatomy



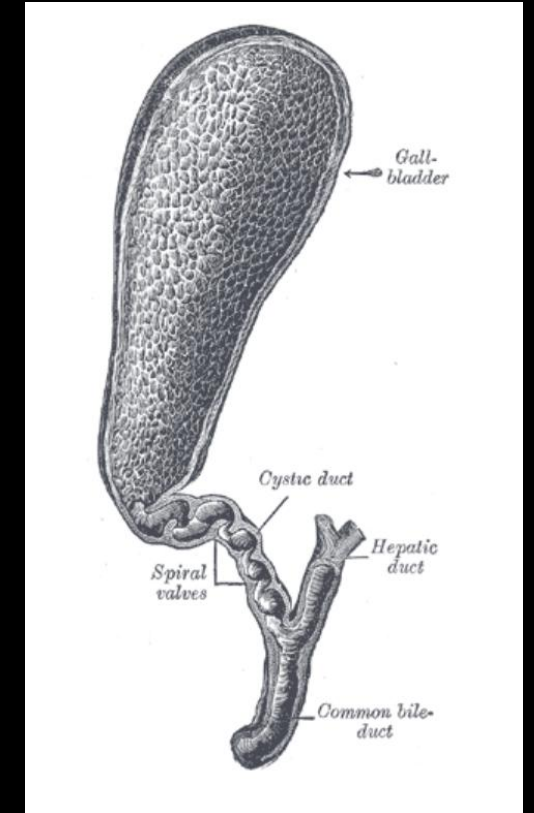
- ▶ Located in the gallbladder fossa (fossa vesicae biliaris) on the visceral surface of the liver
- ▶ Medial relations: duodenum and stomach; lateral relation: right colon
- ▶ Normal gallbladder volume: < 100 mL
- ▶ Blood supply: cystic artery, typically arising from the right hepatic artery (A. hepatica propria)

Sonographic Appearance

- ▶ African pear-shaped (ube), approximately 10 × 4 cm
- ▶ Hypoechoic to anechoic lumen
- ▶ Echogenic wall, thickness ≤ 3 mm
- ▶ Thin trilaminar gallbladder wall
- ▶ Blind-ending fundus; superficial to deep:
Fundus → Body → Infundibulum → Neck → Cystic Duct



AI created, African pear



<https://www.bartleby.com/lit-hub/anatomy-of-the-human-body/fig-1095/>

Sonographic Morphology of the Gallbladder (V)



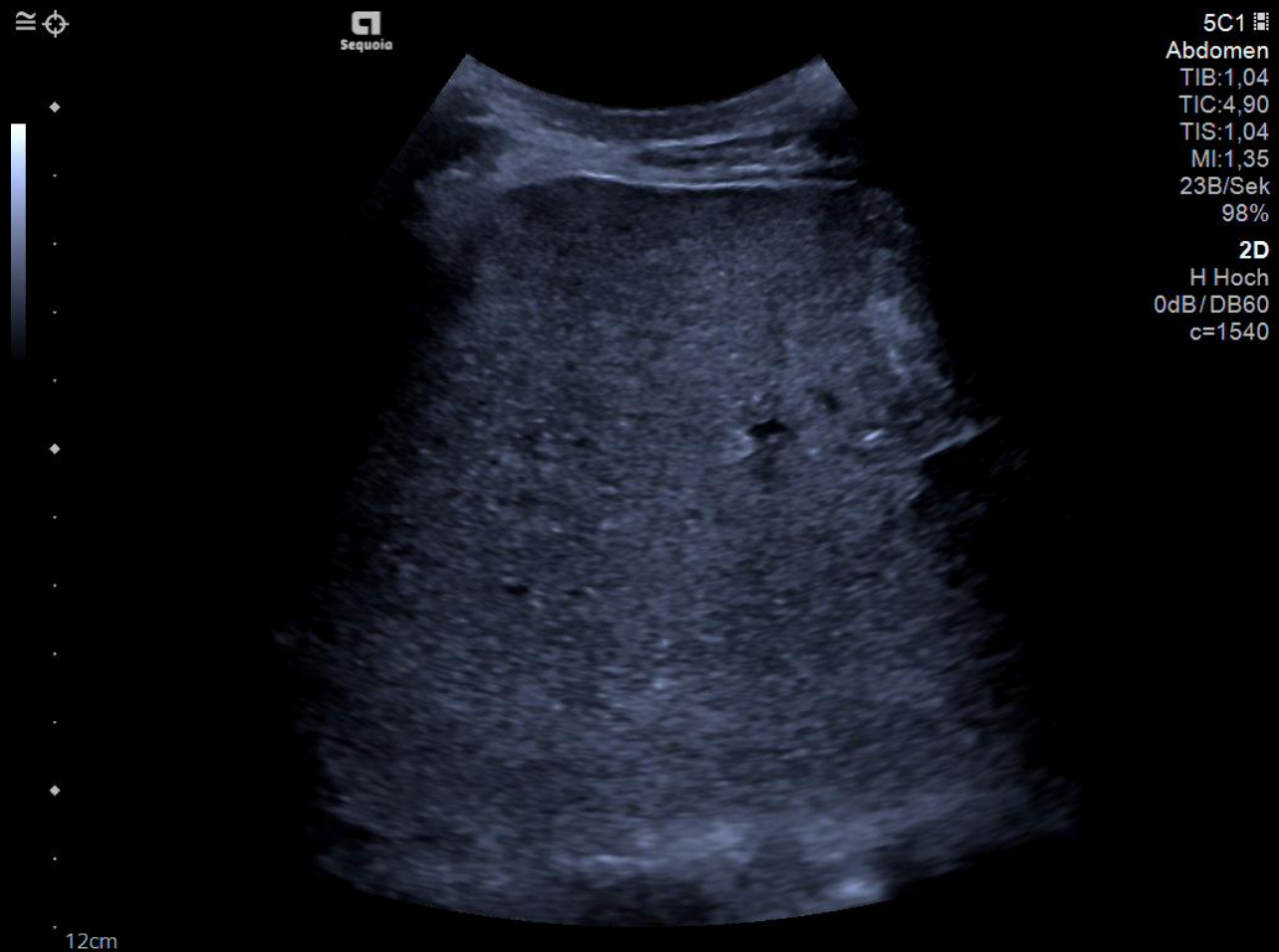
Examination Procedure

- ▶ Supine position
- ▶ Examination in longitudinal (subcostal scan at MCL) and transverse planes
- ▶ Evaluation of intraluminal lesions, wall thickening, and wall irregularities
- ▶ Color doppler / power doppler imaging for gallbladder wall (varices / inflammation)

Examination Procedure

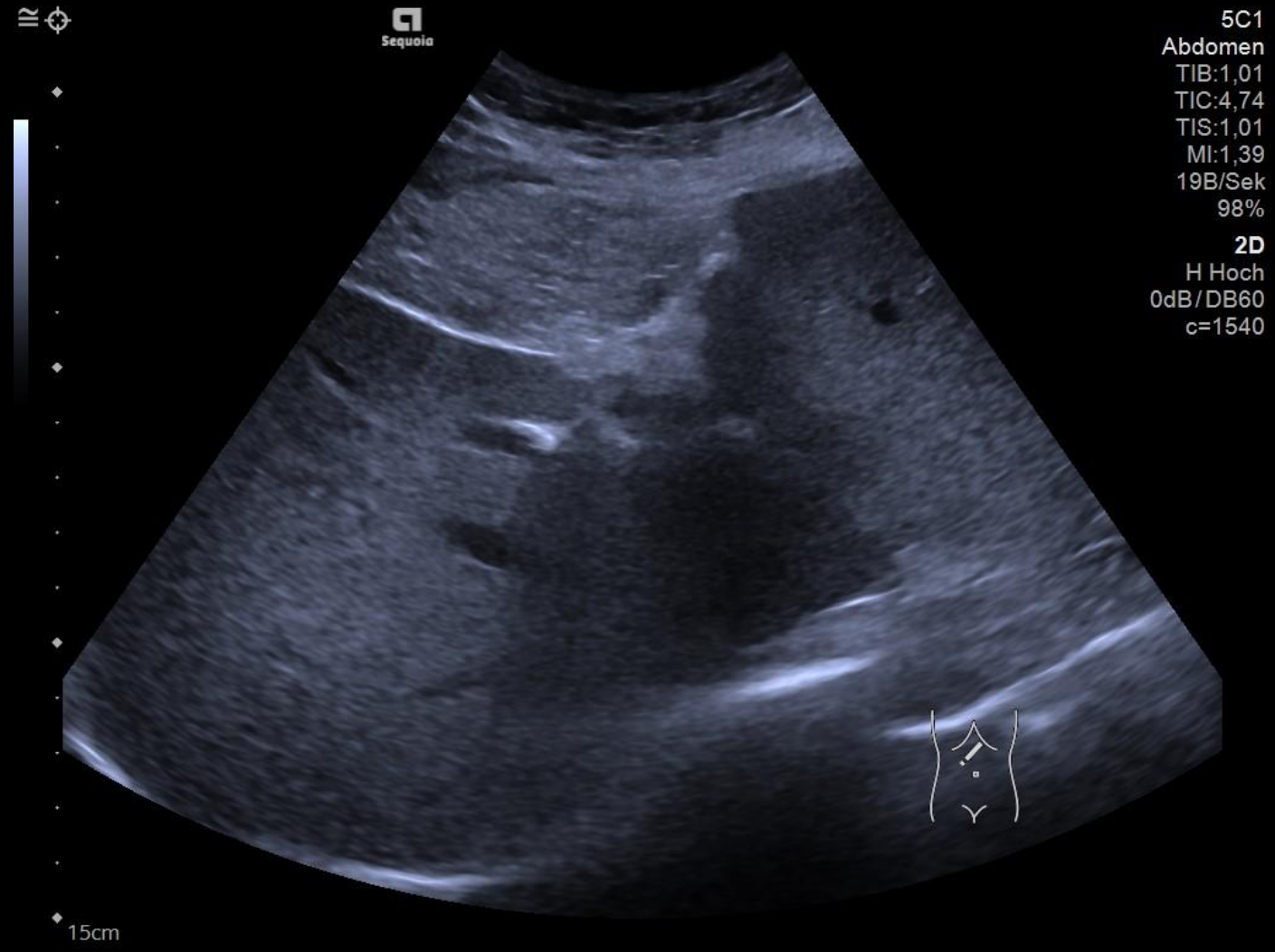
- ▶ Additional Examination in the Left Lateral Decubitus Position
- ▶ Gallstones and polyps may occasionally be detectable only in the LLDP
- ▶ Improved visualization of the cystic duct
- ▶ Improved visualization of the hepatoduodenal ligament

Non-visualized Gallbladder (V)



Post-cholecystectomy findings

Non-visualized Gallbladder



Status Post Cholecystectomy and Liver Bed Resection for Gallbladder Carcinoma

Non-visualized Gallbladder

Porcelain Gallbladder

Definition: Calcification of the gallbladder wall, typically associated with chronic cholecystitis and gallstones.

WES sign (Wall-Echo-Shadow sign) in a gallbladder completely filled with stones



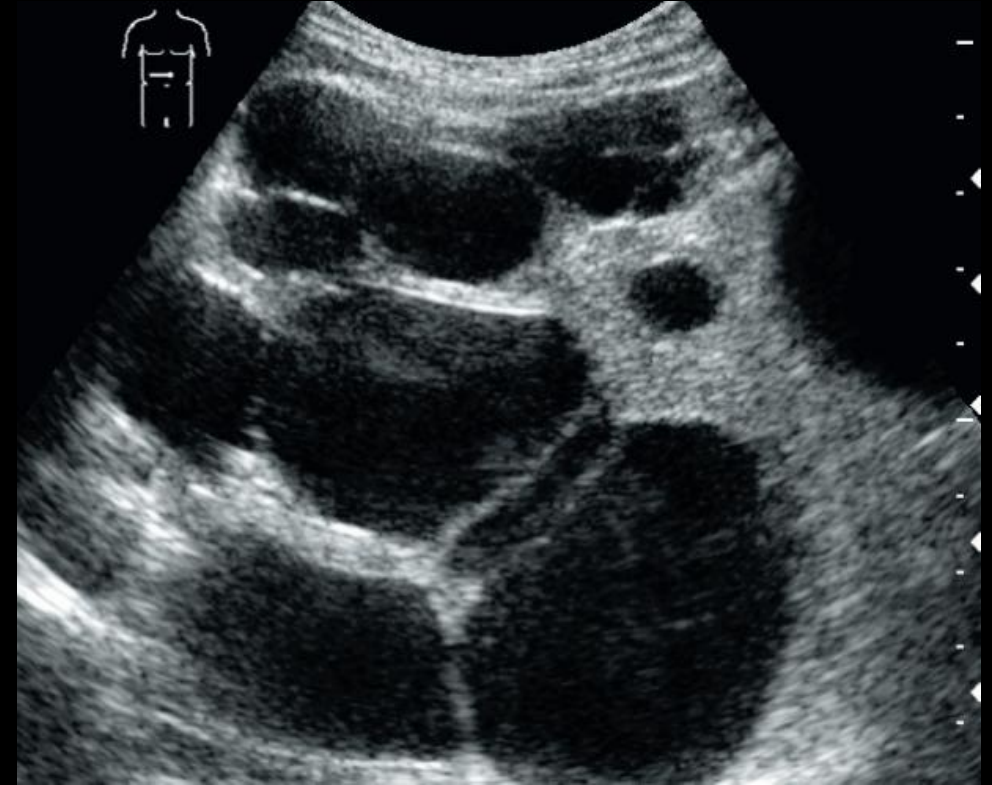
Non-visualized Gallbladder

Contracted/ shrunken Gallbladder



Non-visualized Gallbladder

Ectopic gallbladder: trace the cystic duct and examine hepatic segment V using a transcostal approach



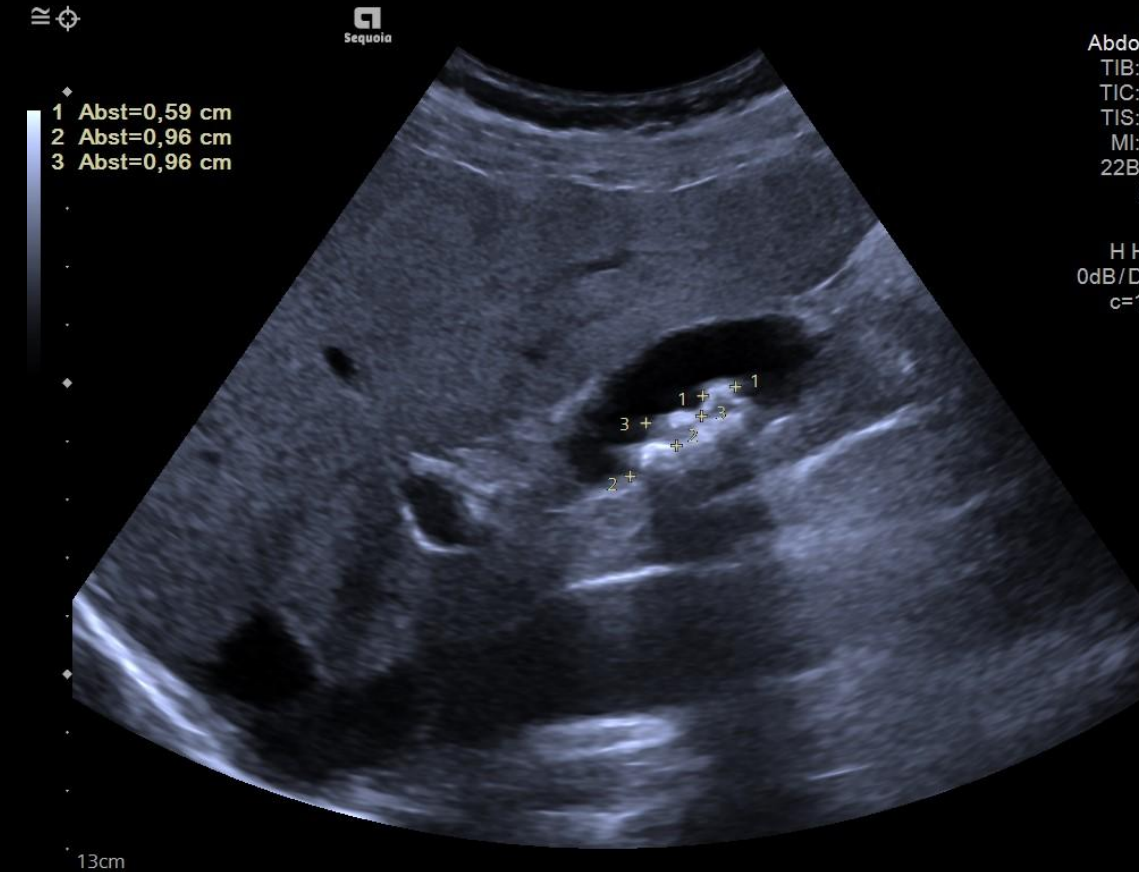
Cholelithiasis

- ▶ Prevalence: 15-20% in the Western world
- ▶ Risk factors: female sex, pregnancy, advanced age, obesity, diet, Crohn's disease, prior gastrectomy
- ▶ "6 Fs": Female, Fair, Fat, Forty, Fertile, Family
- ▶ Usually asymptomatic; may cause upper abdominal discomfort and postprandial nausea
- ▶ Complications: cholecystitis, cholangitis, biliary pancreatitis, perforation, gallstone ileus
- ▶ Porcelain gallbladder: premalignant condition → cholecystectomy recommended in suitable patients

Sonographic Findings in Cholelithiasis

- ▶ Solitary or multiple gallstones
- ▶ Echogenic intraluminal calculi with posterior acoustic shadowing (may be absent in non-calcified stones)
- ▶ Stone mobility ("rolling stone" phenomenon), differentiate stones from polyps or tumors
- ▶ Associated biliary sludge may be present
- ▶ Gallbladder wall thickness is usually normal in uncomplicated cholelithiasis
- ▶ WES sign (Wall-Echo-Shadow sign) in a gallbladder completely filled with stones

Cholelithiasis (V right)



Cholelithiasis without Cholecystitis

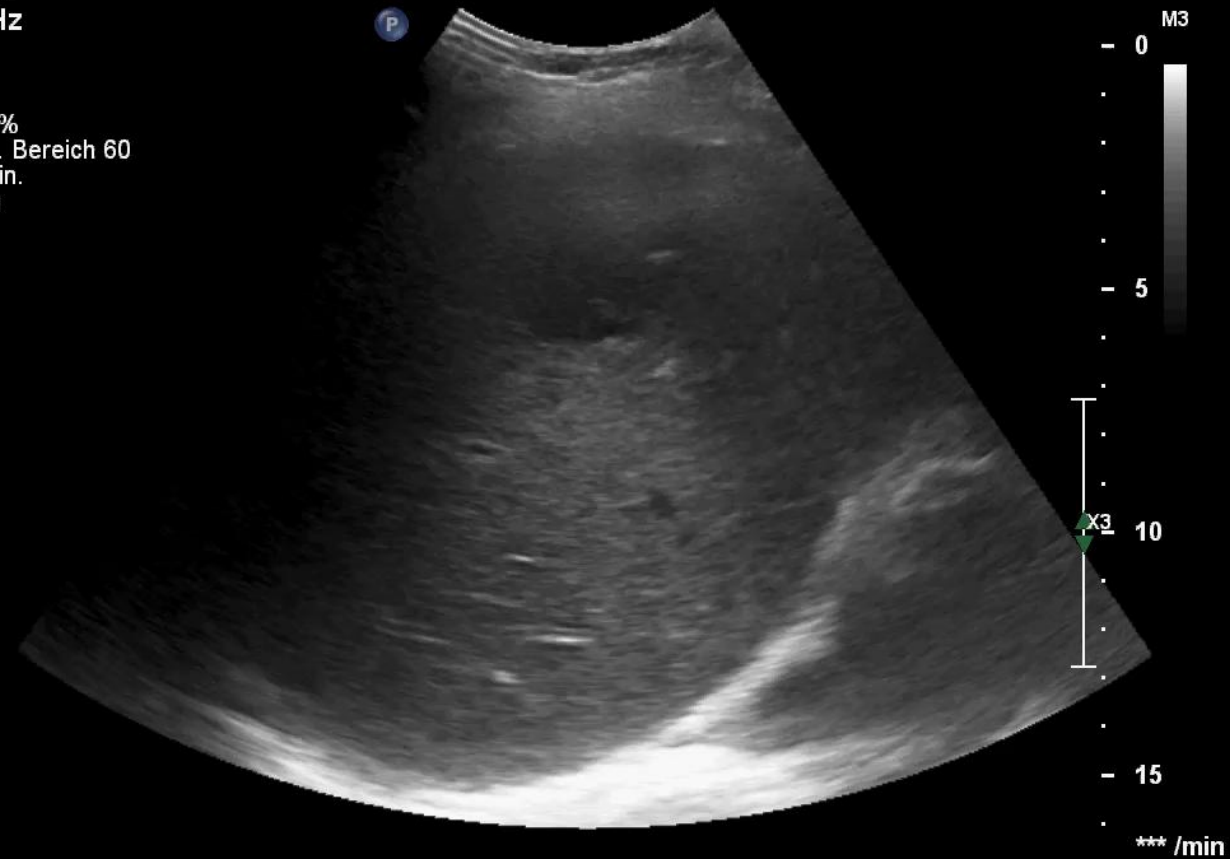


Cholelithiasis without Cholecystitis and Gallbladder Polyp

Cholelithiasis (V)

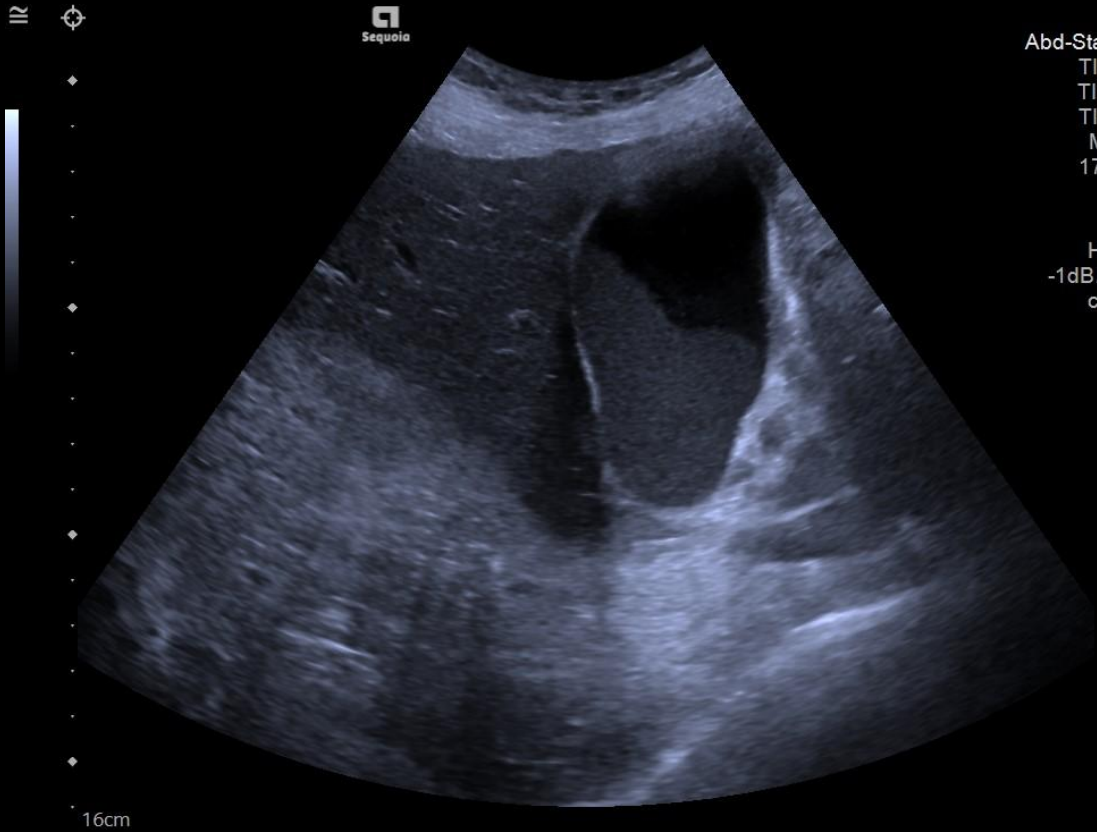
ABD
C5-1
32Hz
RS

2D
60%
Dyn. Bereich 60
P Min.
Allg

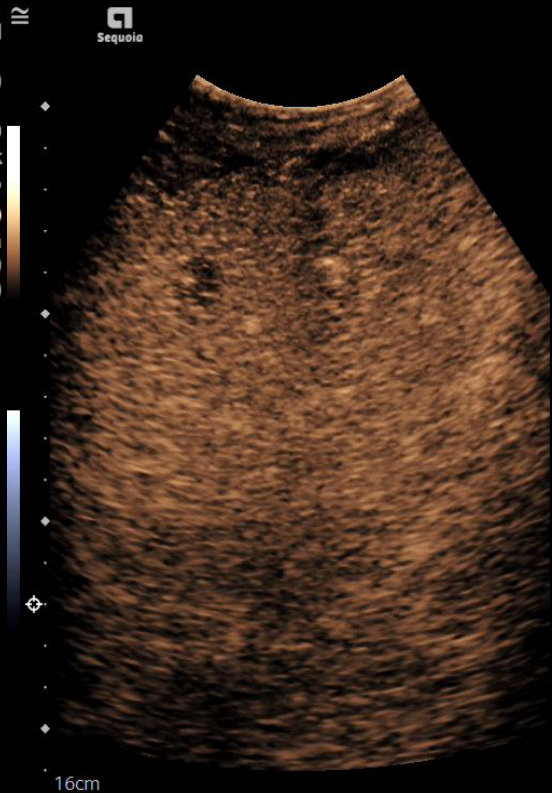


Cholelithiasis with Associated Cholecystitis and Liver Abscess

Cholelithiasis and Gallbladder Sludge (V right)



5C1
Abd-Standard
TIB:0,91
TIC:4,30
TIS:0,91
MI:1,39
17B/Sek
98%
2D
H Hoch
-1dB/DB60
c=1480



5C1
Abd-Standard
TIB:0,00
TIC:0,01
TIS:0,00
MI:0,11
8B/Sek
0,5%
2D
Mittel
0dB/DB60
c=1480
Kontrast
Niedrig
-5dB/DB70
D2

Cholecystitis

- ▶ Definition: Inflammation of the gallbladder, usually caused by gallstone obstruction of the cystic duct
- ▶ 90% associated with permanent or intermittent gallstone obstruction
- ▶ Acalculous cholecystitis: rare; mainly in critically ill patients
- ▶ Clinic: sonographic Murphy sign, right upper quadrant pain radiating to the back, fever, nausea, and occasionally vomiting

Sonographic Findings in Cholecystitis

- ▶ Gallbladder wall thickening (> 3 mm) with hypoechoic halo
- ▶ Three-layered? (multilayered!!!) gallbladder wall
- ▶ Gallstones and/or biliary sludge
- ▶ Distended gallbladder
- ▶ Positive sonographic Murphy sign
- ▶ Increased wall vascularity on Color Doppler
- ▶ Pericholecystic fluid / gallbladder fossa ascites
- ▶ Pericholecystitis: hypoechoic adjacent liver parenchyma

Cholecystitis

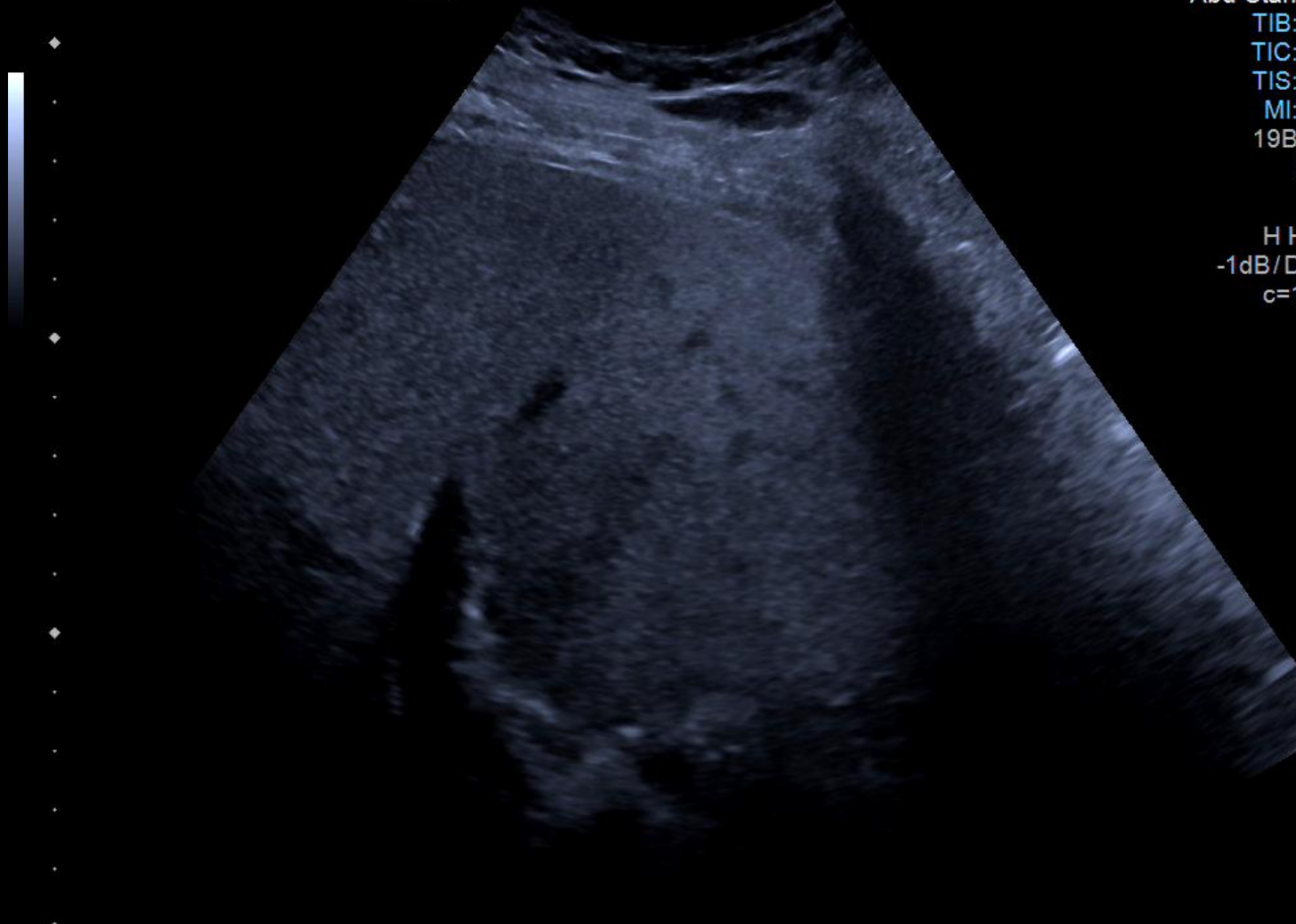
Complications

- ▶ *Acute cholecystitis*: gallbladder hydrops, pericholecystitis, gallbladder empyema, gallbladder perforation, abscess formation
- ▶ *Chronic cholecystitis*: contracted gallbladder, porcelain gallbladder

Cholecystitis (V)

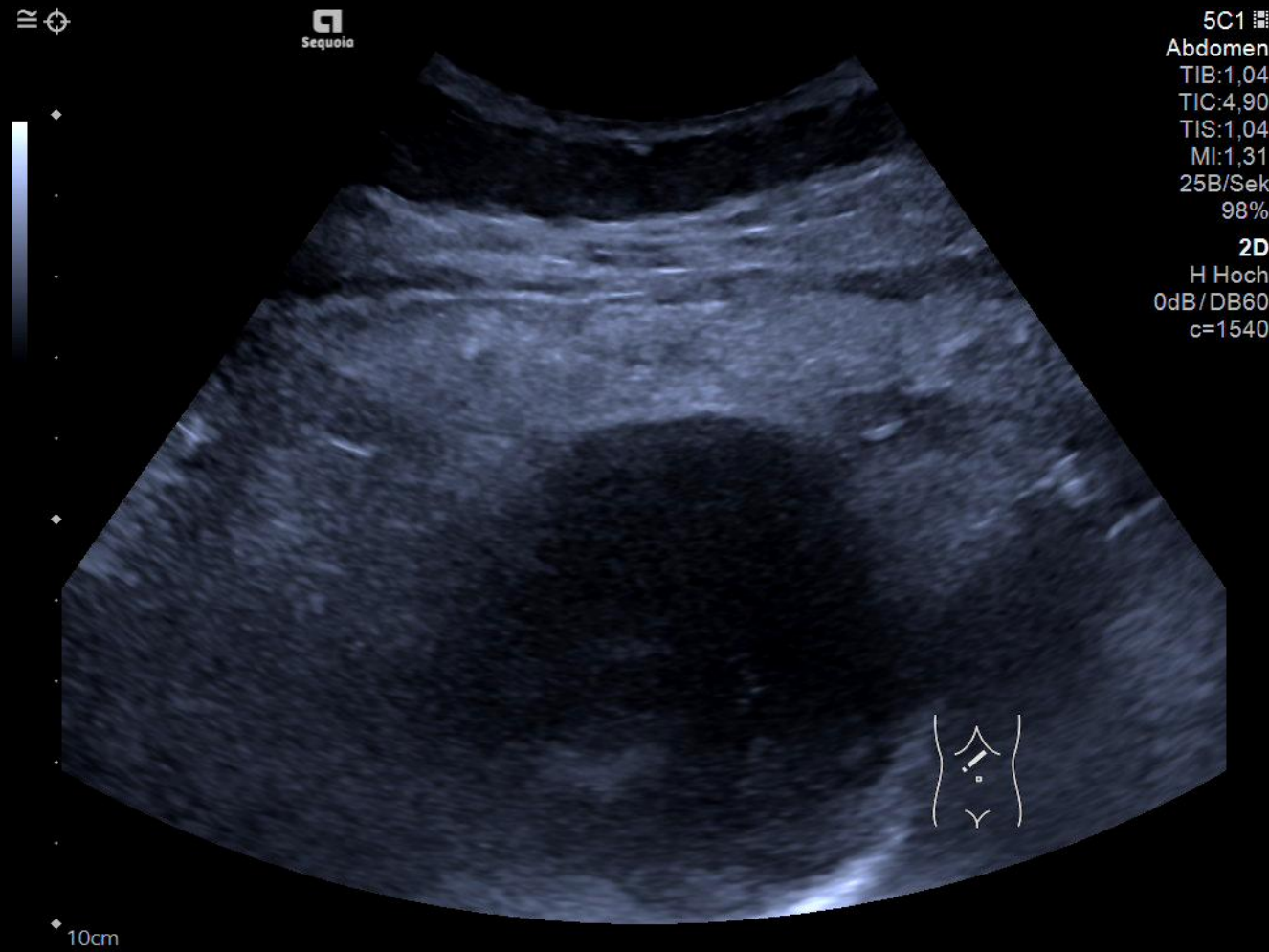


5C1
Abd-Standard
TIB:0,97
TIC:4,59
TIS:0,97
MI:1,39
19B/Sek
98%
2D
H Hoch
-1dB/DB60
c=1480



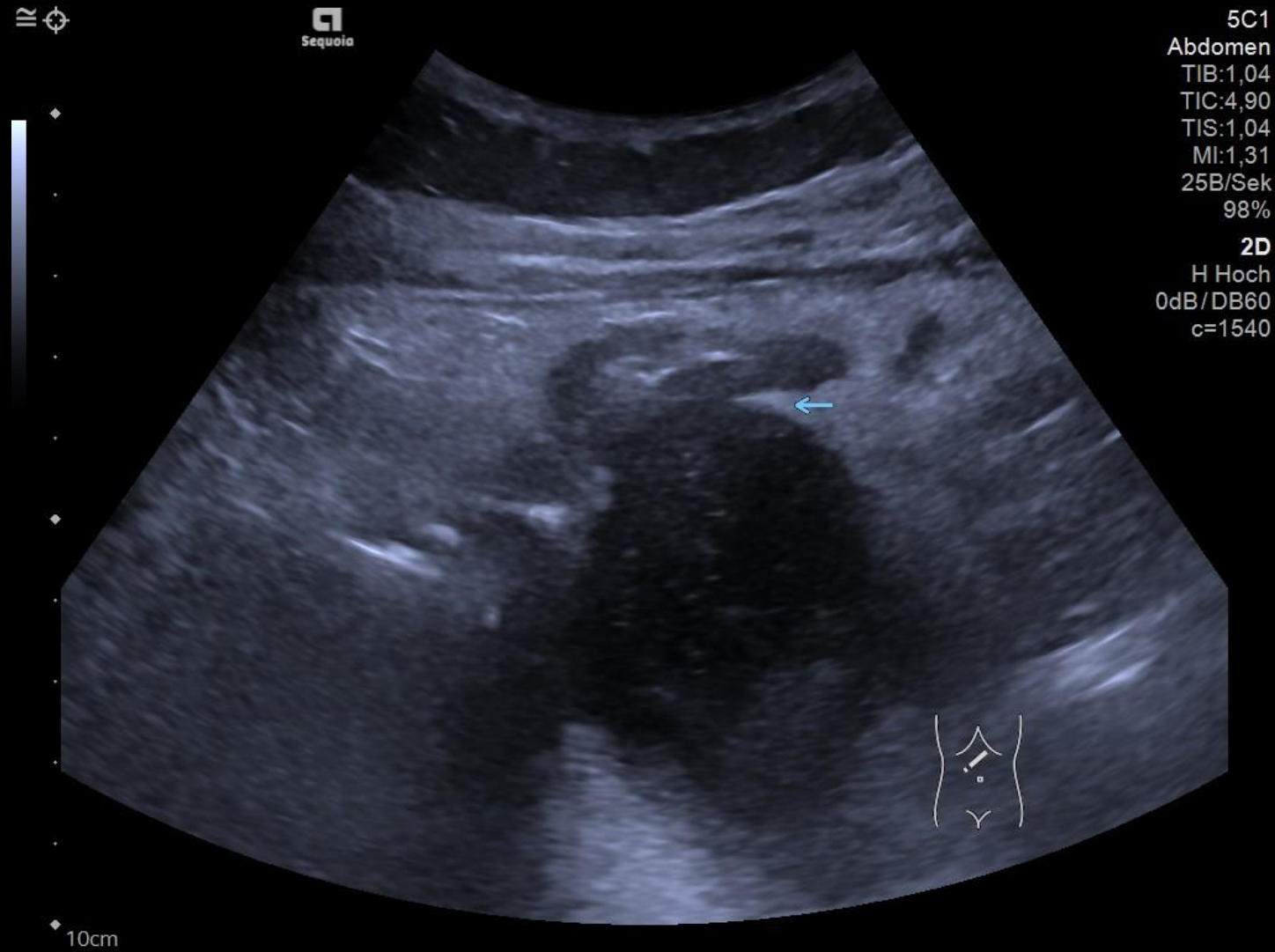
15cm

Cholecystitis (V)



Gallbladder Empyema with Cholecystocolonic
Fistula

Cholecystitis



Gallbladder Empyema with Cholecystocolonic Fistula

Gallbladder Lesions: Adenomyomatosis

General

- ▶ Non-inflammatory, non-neoplastic gallbladder wall thickening
- ▶ Etiology unclear; likely associated with increased intraluminal pressure
- ▶ Types: diffuse, segmental (usually fundal), localized (hourglass)

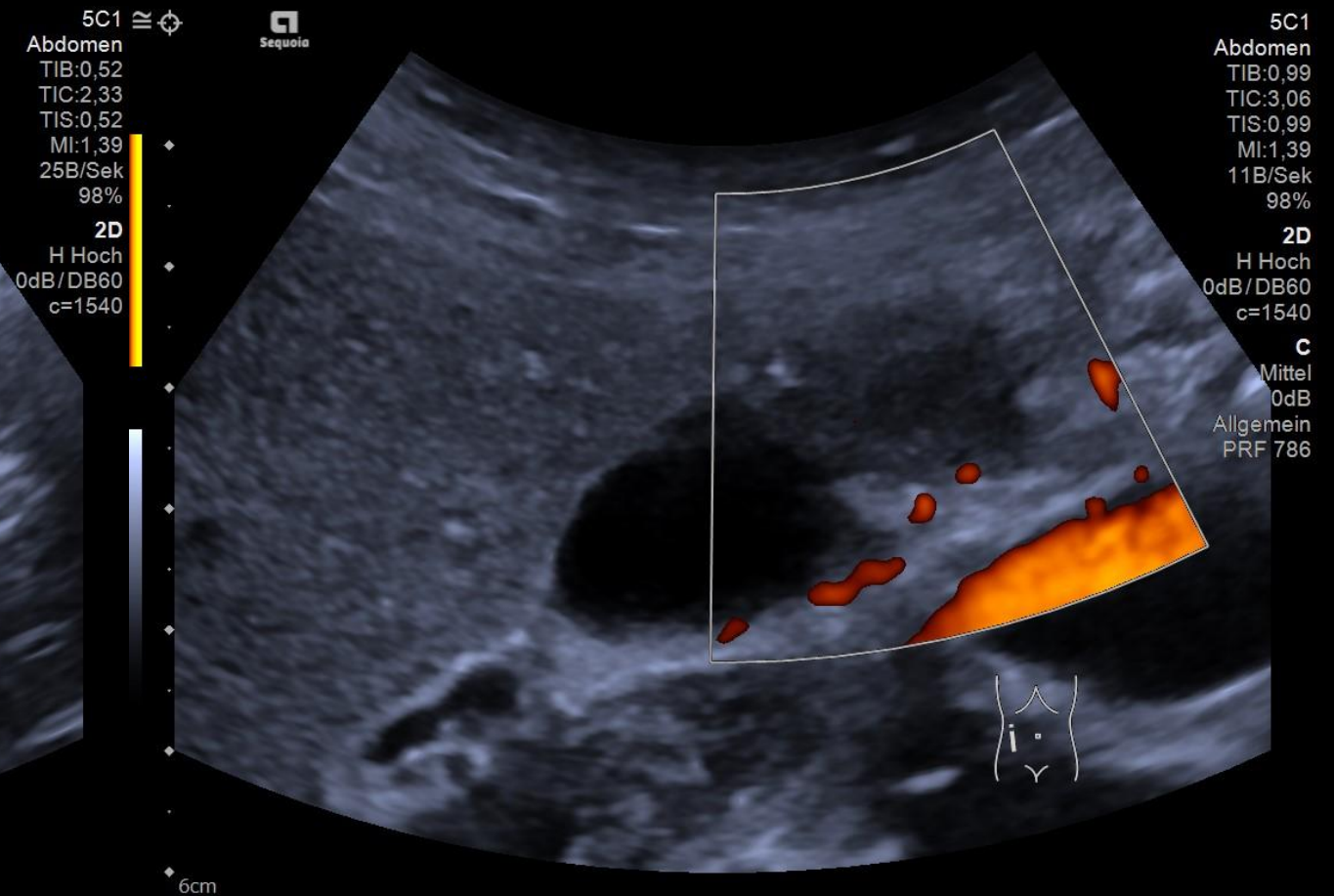
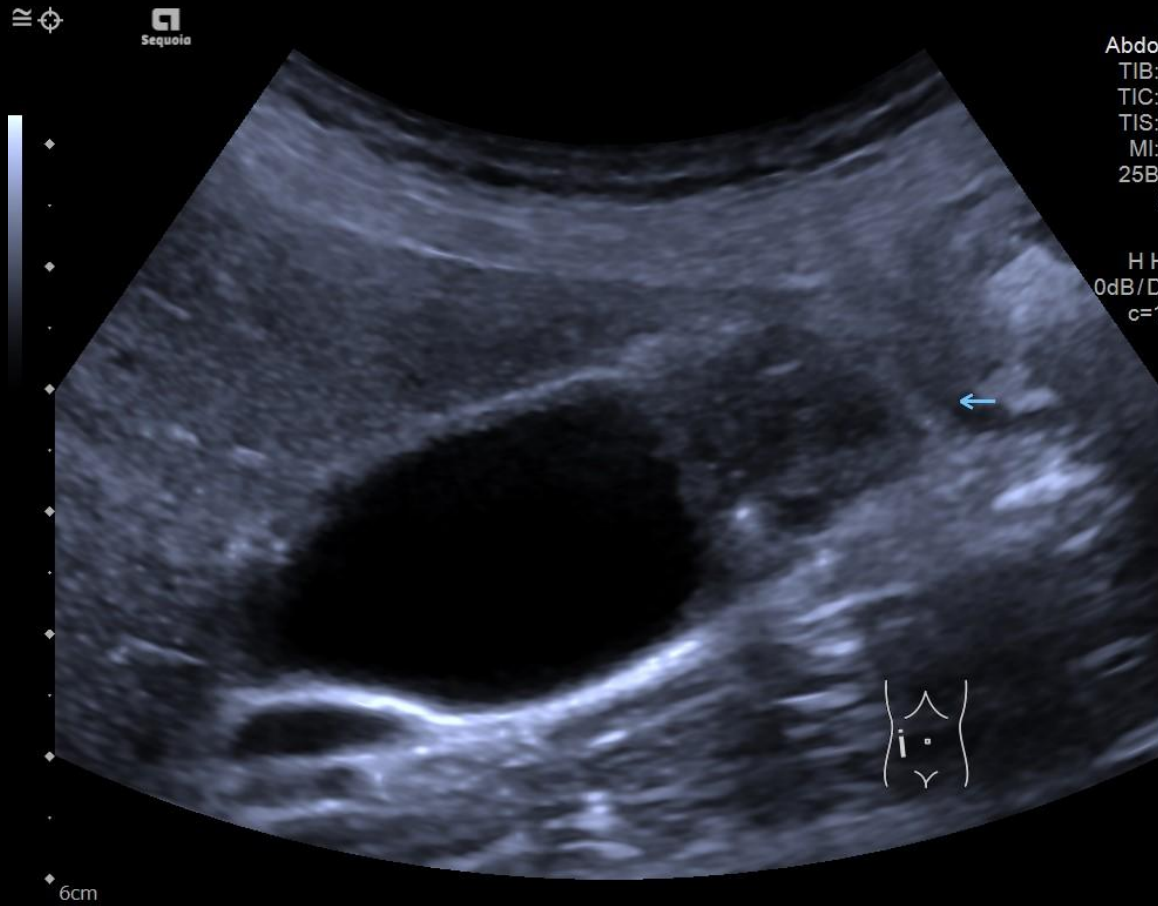
Clinical Presentation

- ▶ Usually asymptomatic

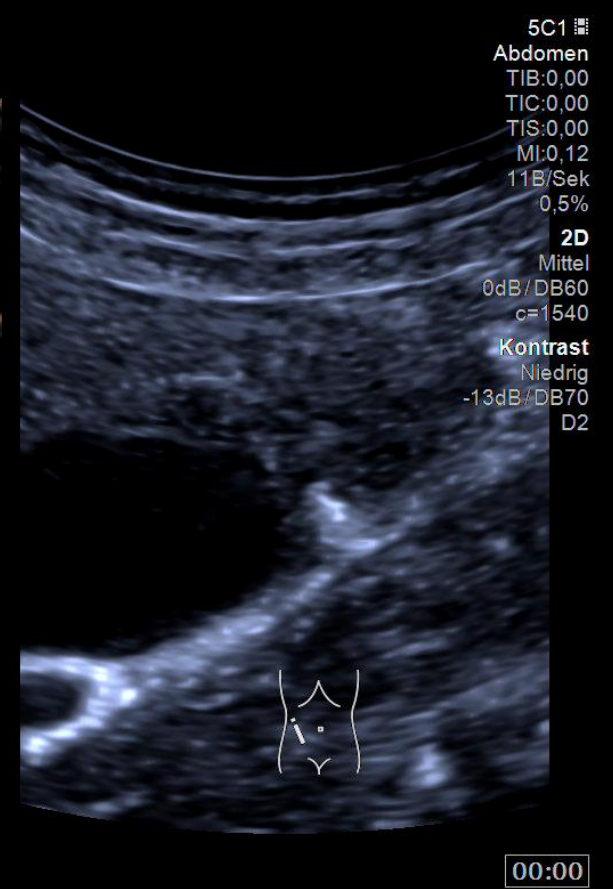
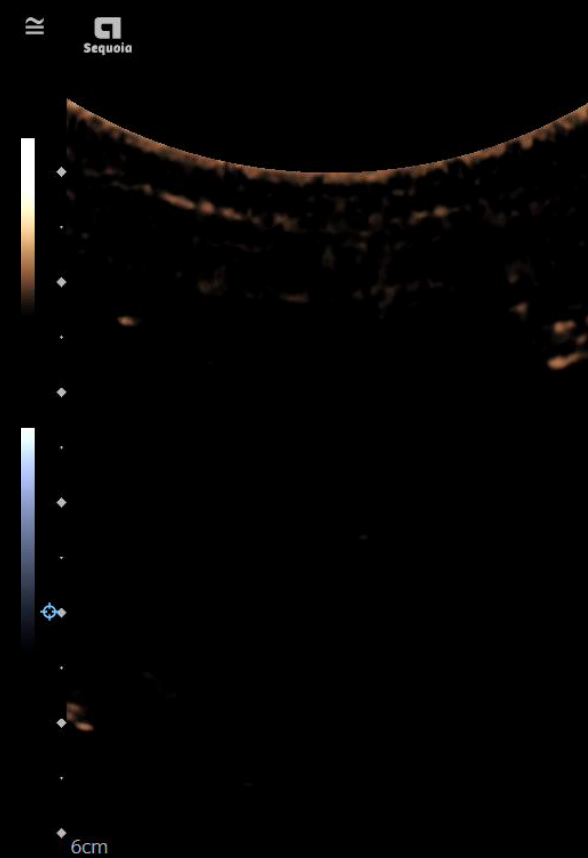
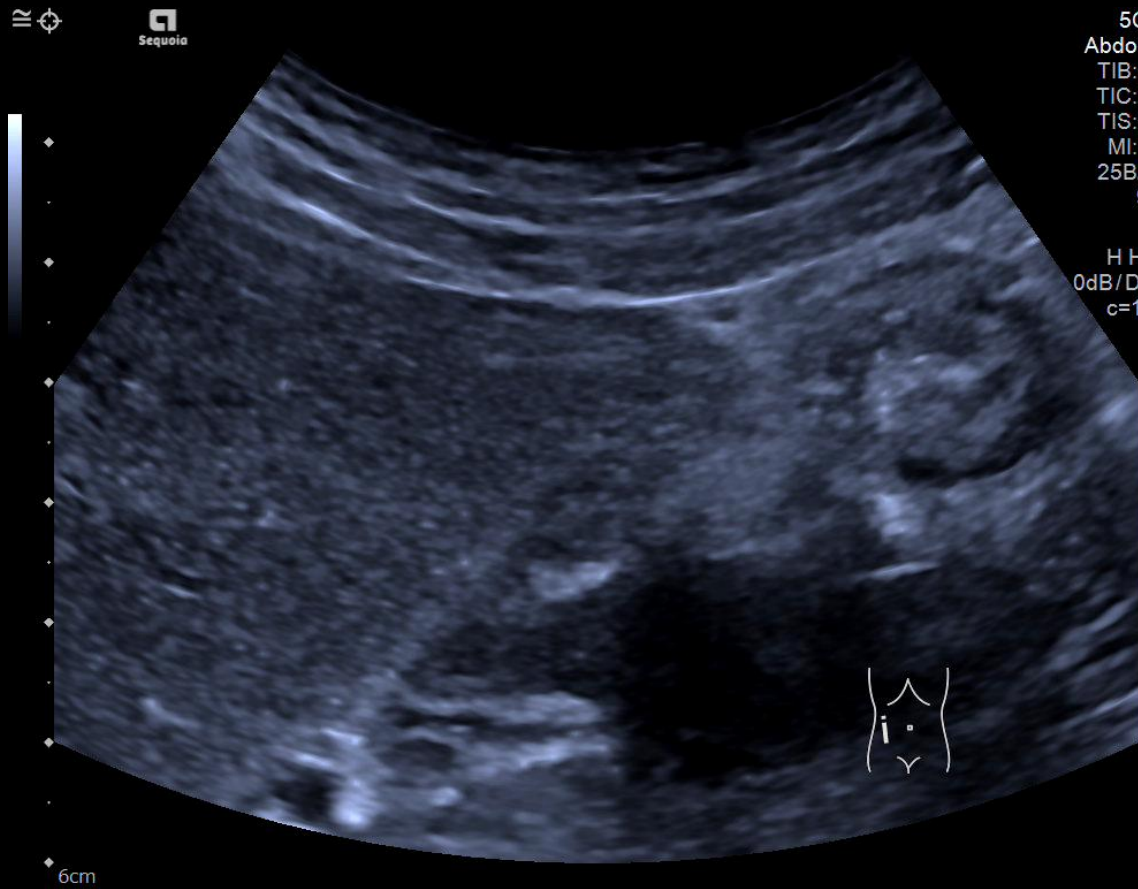
Gallbladder Adenomyomatosis

Sonographic Findings:

Hyperechoic gallbladder wall thickening involving the mucosal and muscular layers



Gallbladder Adenomyomatosis (V)



Gallbladder Lesions: Cholesterosis and Cholesterol Polyps

- ▶ General: benign cholesterol deposits in gallbladder wall histiocytes
- ▶ Pathogenesis: increased lipid absorption by the gallbladder mucosa, elevated cholesterol concentration in bile
- ▶ Clinical Presentation usually asymptomatic
- ▶ Sonographic Findings: small hyperechoic polyps, fixed to the gallbladder wall, usually multiple, no posterior acoustic shadowing

Cholesterol Polyps



Sonographic Findings: multiple, small hyperechoic mural nodules, typically only a few millimeters in size, fixed to the gallbladder wall, no posterior acoustic shadowing

Gallbladder Polyps

General:

- ▶ Usually an incidental finding
- ▶ Often benign and asymptomatic

Clinical Significance:

- ▶ Potential for malignant transformation via the adenoma-carcinoma sequence
- ▶ Risk increases with larger polyp

Gallbladder Polyps

Sonographic Findings

- ▶ Solitary or multiple lesions
- ▶ Hyperechoic, wall-adherent polyps
- ▶ No posterior acoustic shadowing
- ▶ May show vascularity on Doppler imaging or CEUS

Gallbladder Polyps (V)



Gallbladder Polyps

- ▶ Management of Gallbladder Polyps

- > 1 cm: Cholecystectomy

- < 1 cm: Ultrasound follow-up at 3 and 6 months, then annually, if stable growth and/or size > 1 cm: Cholecystectomy

Gallbladder Carcinoma

General Information

- ▶ Associated with porcelain gallbladder and large gallstones
- ▶ Predominantly affects elderly patients

Clinical Presentation

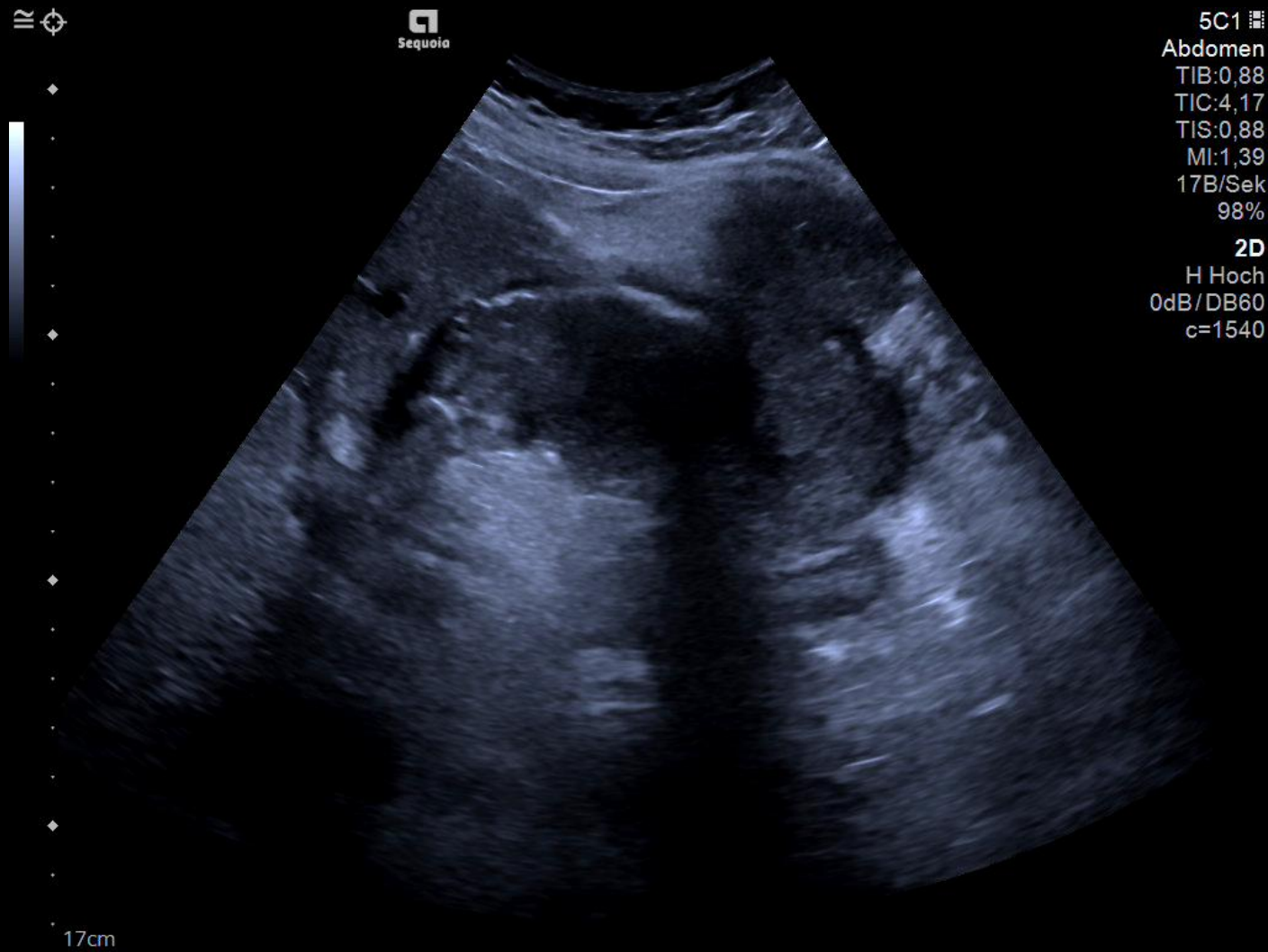
- ▶ Often asymptomatic in early stages
- ▶ Advanced disease may present with upper abdominal discomfort, nausea, and weight loss
- ▶ Palpable mass and obstructive jaundice may occur in advanced

Gallbladder Carcinoma

Sonographic Findings

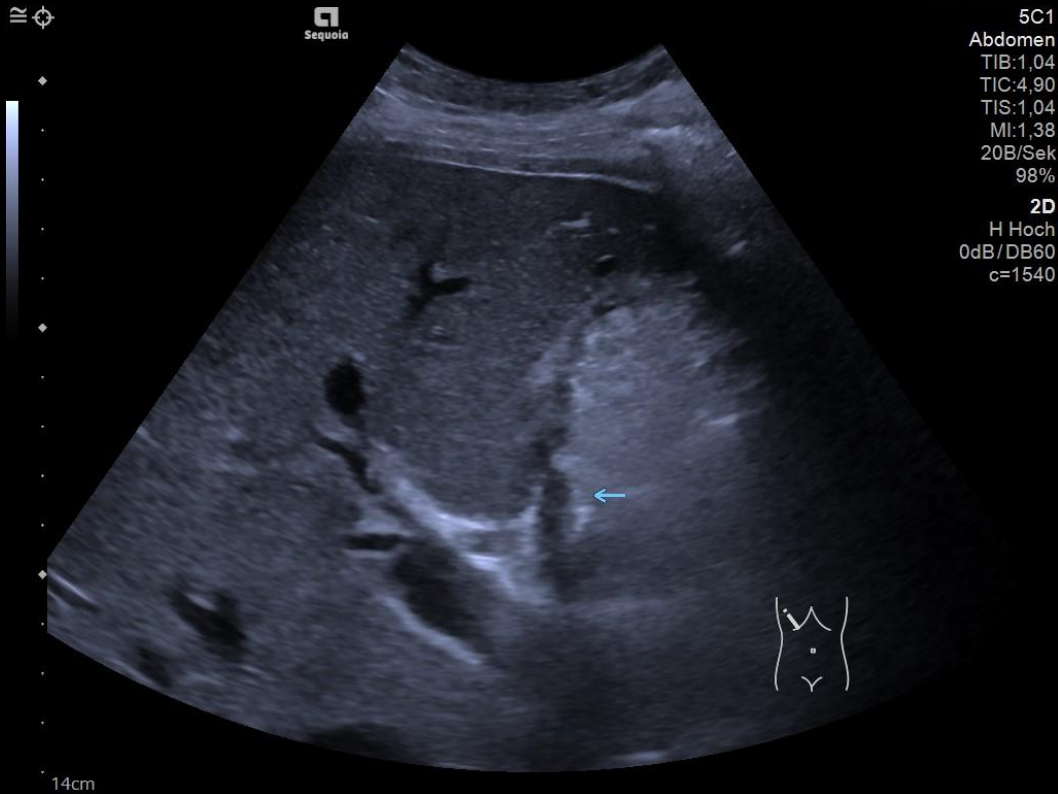
- ▶ Hypoechoic, heterogeneous intraluminal mass lesion
- ▶ Poor demarcation from the liver bed
- ▶ Adjacent hepatic parenchyma appears hypoechoic, heterogeneous, and ill-defined
- ▶ Pericholecystic ascites

Gallbladder Carcinoma (V)



Postoperative Conditions

Fluid collection: physiologic in appearance
and consistent with fibrin-rich exudate

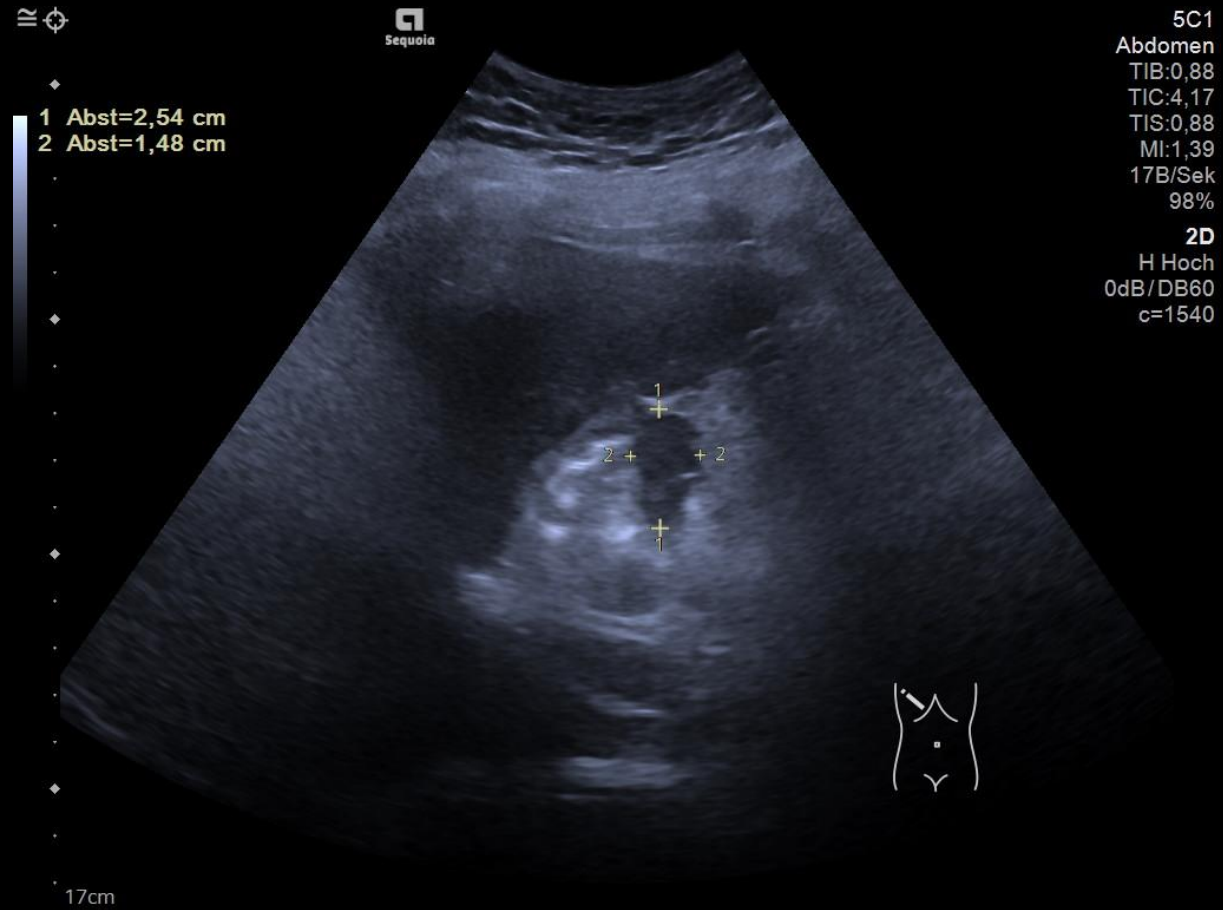


Post-Cholecystectomy Exudate



Post-cholecystectomy hematoma

Postoperative Conditions



Biloma following cholecystectomy secondary to cystic duct stump leakage

Findings

Case 1: Normal Gallbladder

Findings: Gallbladder well distended and adequately visualized. No evidence of cholelithiasis. No biliary sludge. Gallbladder wall thickness within normal limits. No pericholecystic fluid.

Impression: Normal sonographic appearance of the gallbladder. No evidence of gallstones or cholecystitis.

Case 2: Cholelithiasis

Findings: Gallbladder adequately visualized. Two echogenic calculi are present within the gallbladder body, measuring up to 2.0 cm in diameter, with posterior acoustic shadowing. No biliary sludge. Gallbladder wall thickness is normal. No pericholecystic fluid.

Impression: Cholelithiasis without sonographic evidence of acute cholecystitis.

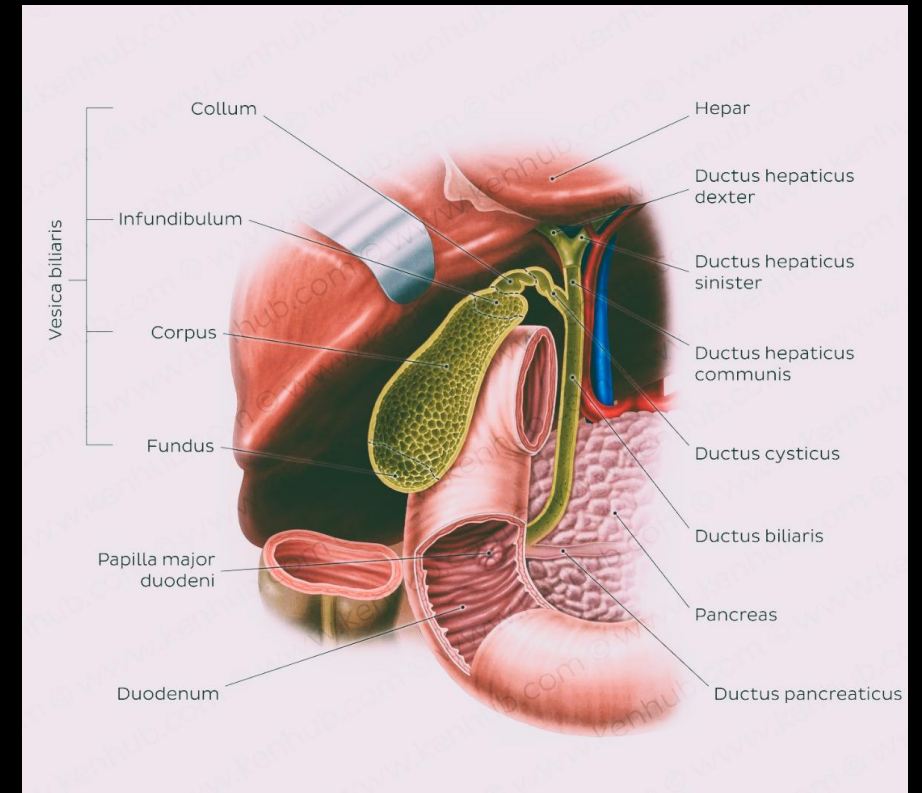
Biliary Tract Anatomy and Ultrasound Examination

Biliary Tract

- ▶ Right + left hepatic ducts → common hepatic duct (CHD)
- ▶ CHD + cystic duct → common bile duct (CBD)
- ▶ Normal CBD diameter: 6-7 mm (up to >10 mm post-OP)
- ▶ CBD + pancreatic duct → Papilla of Vater

Ultrasound

- ▶ Intrahepatic ducts run anterior to portal vein branches
- ▶ Longitudinal and transverse views
- ▶ + left lateral decubitus position
- ▶ Color Doppler for duct-vessel differentiation



<https://www.kenhub.com/de/study/gallenblase>

Types of Cholestasis

- ▶ Without bile duct dilatation: viral hepatitis, drug-induced cholestasis, primary biliary cholangitis
- ▶ Intrahepatic cholestasis with bile duct dilatation: intrahepatic tumors, hepatolithiasis, Caroli syndrome, primary sclerosing cholangitis
- ▶ Extrahepatic cholestasis: choledocholithiasis, postoperative strictures, cholangiocarcinoma, pancreatic tumors, Mirizzi syndrome

Common Bile Duct: D. hepatocholedochus

ABD
C5-1
32Hz
RS

2D
60%
Dyn. Bereich 60
P Min.
Allg



BF 33Hz
A/G
Z 1.1
2D
64%
K 48
M Niedrig
H Allg



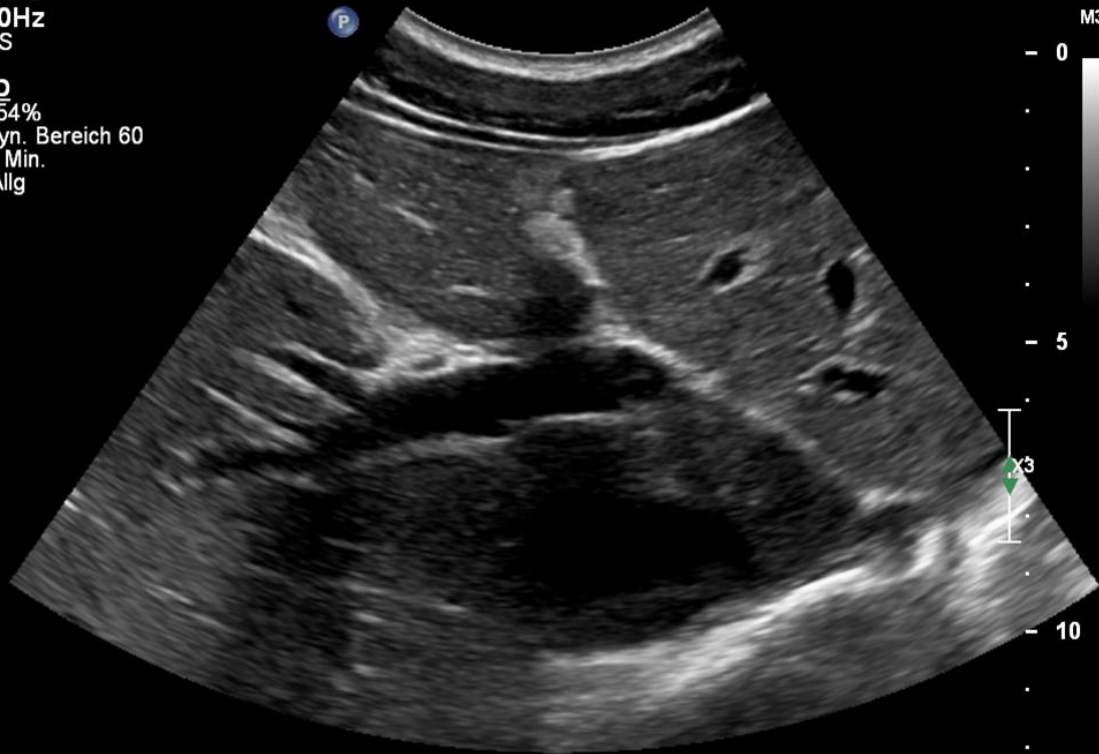
✦ Abstand 1.29 cm

<https://sonographiebilder.de/cholestase>

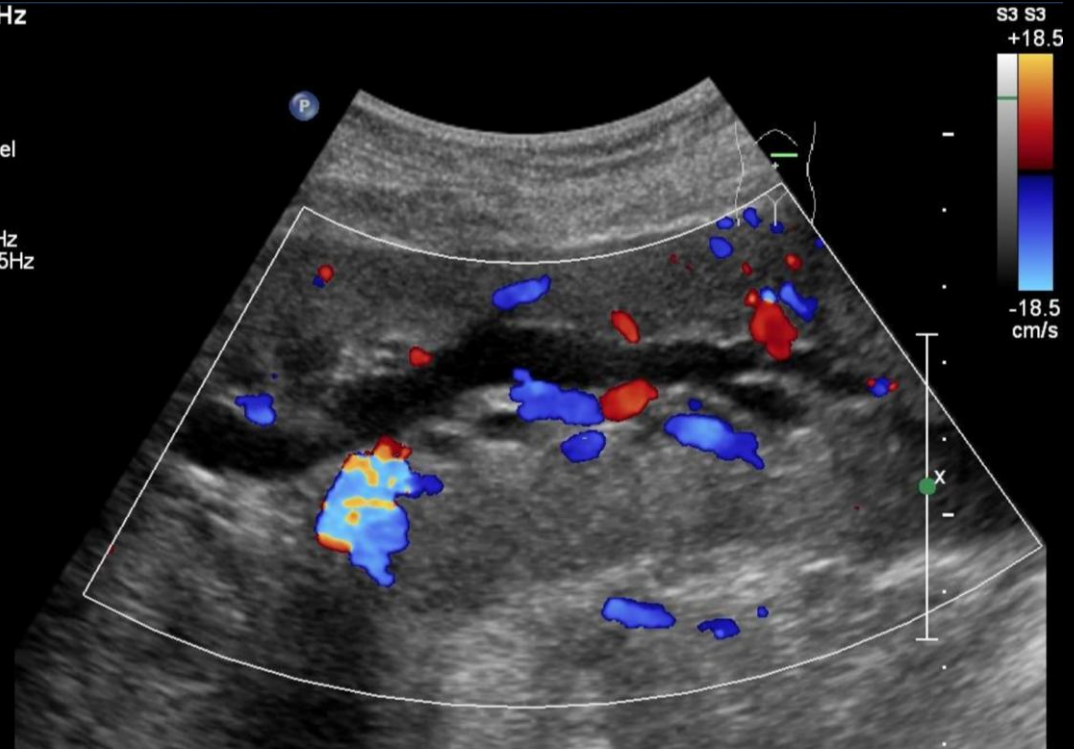
Intrahepatic Bile Ducts

C5-1
40Hz
RS

2D
54%
Dyn. Bereich 60
P Min.
Allg

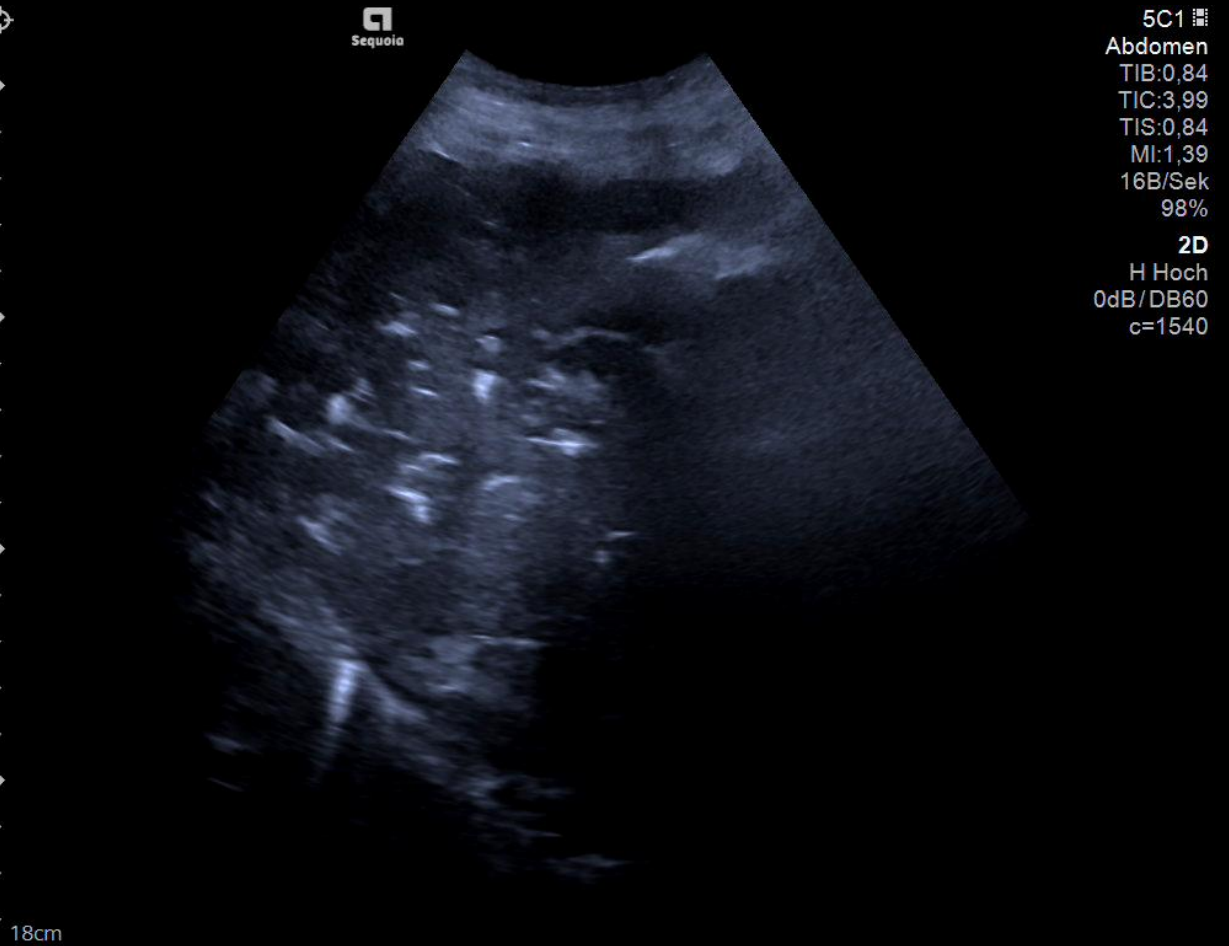
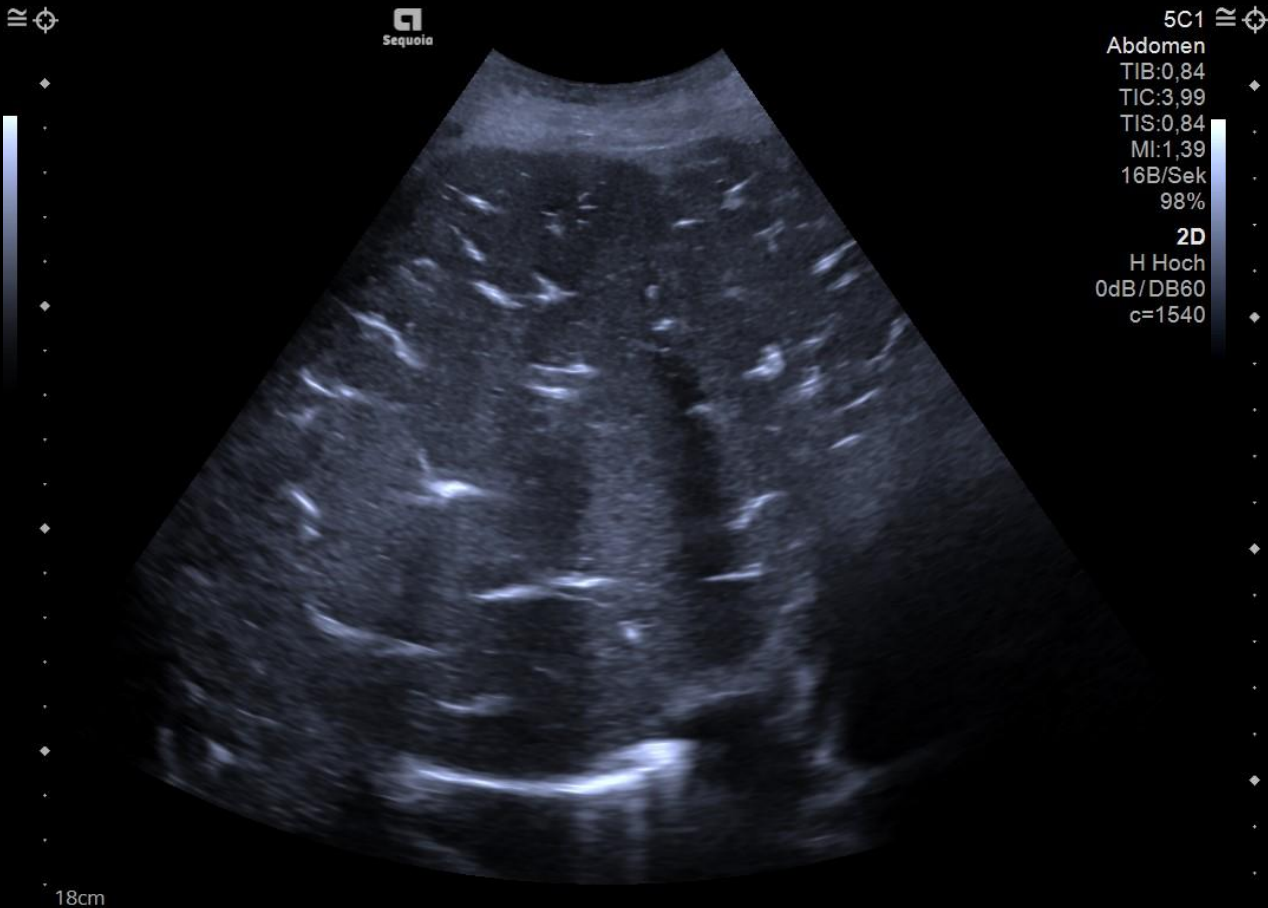


BF 8Hz
P1
Z 1.4
2D
42%
K 54
M Mittel
Allg
FD
63%
1320Hz
WF 85Hz
Mittel



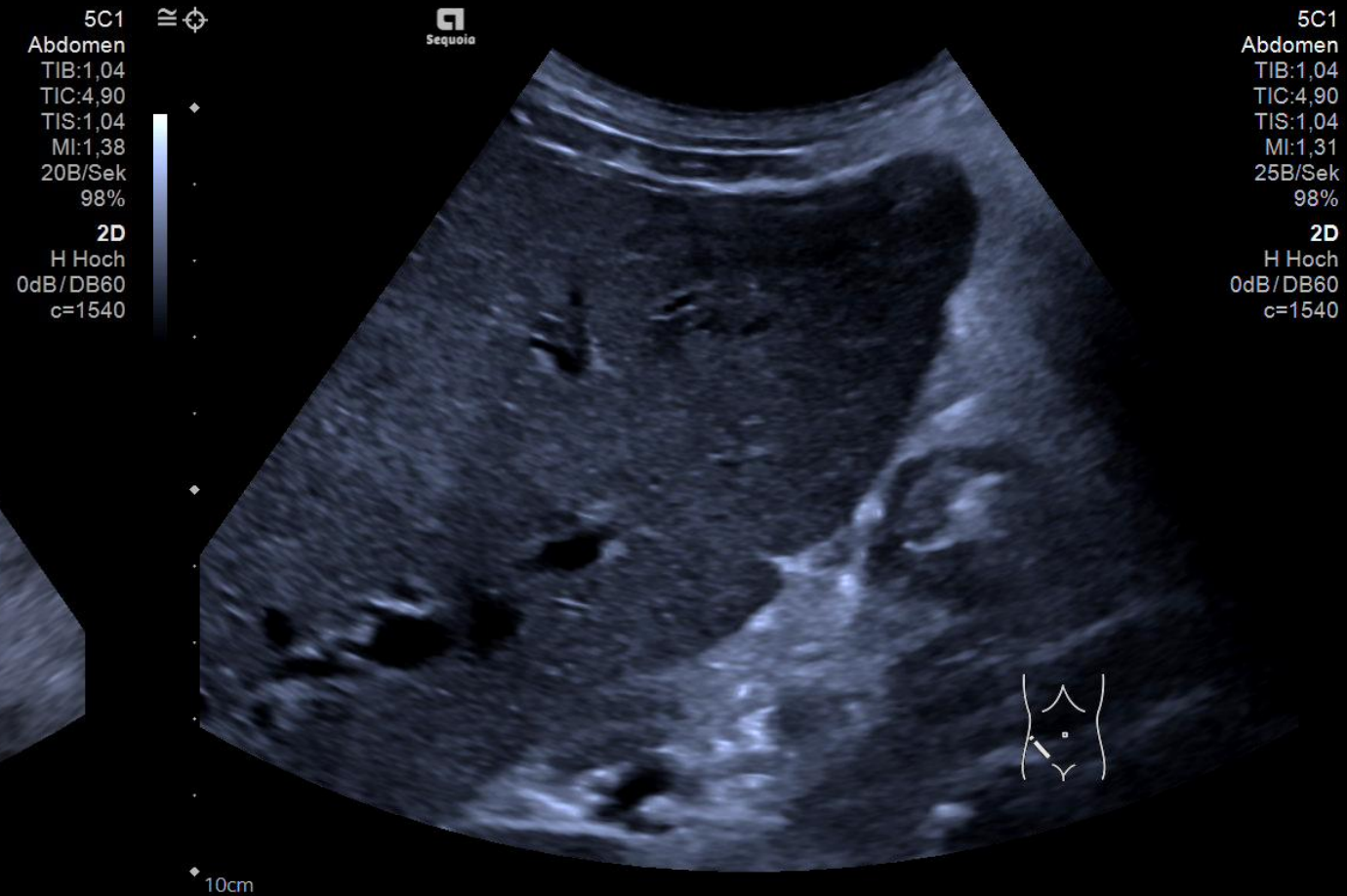
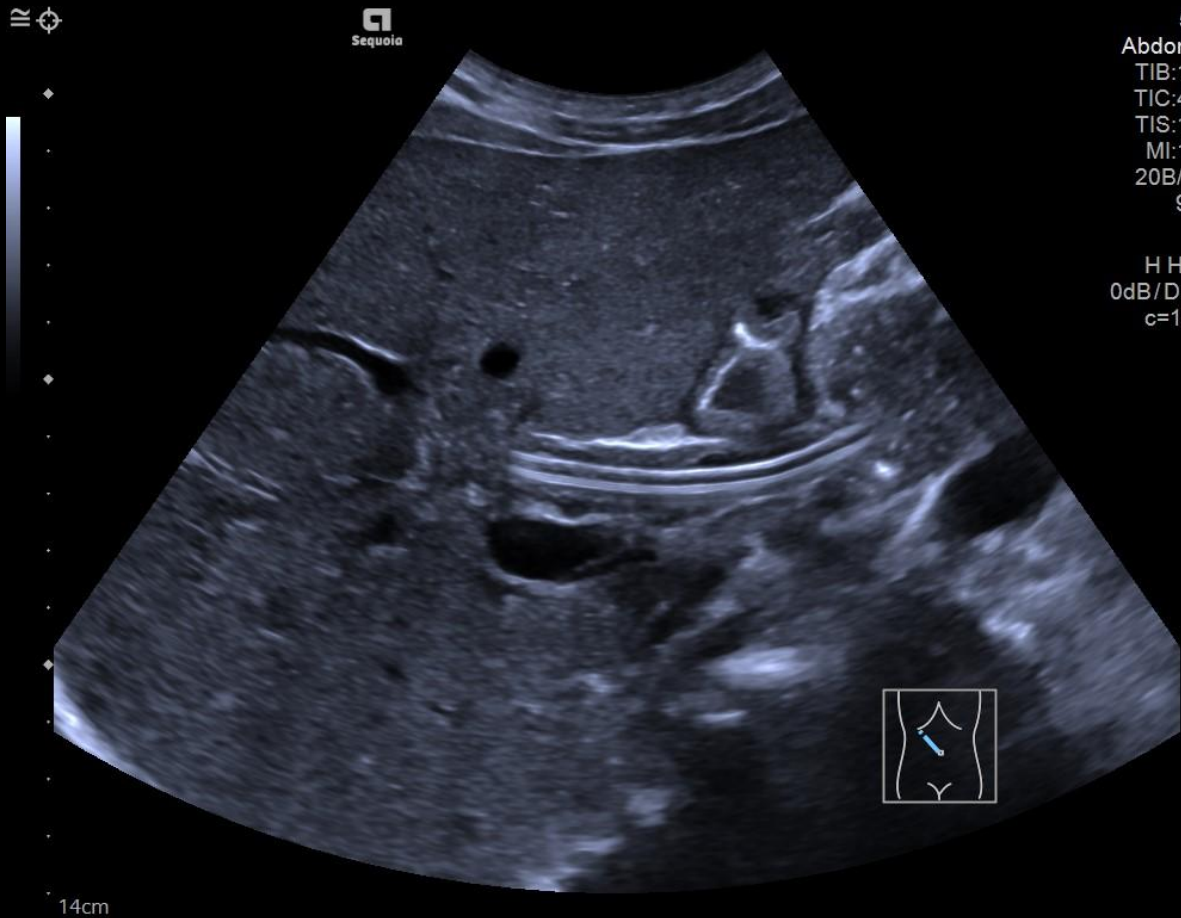
<https://sonographiebilder.de/cholestase>

Pneumobilia (V)

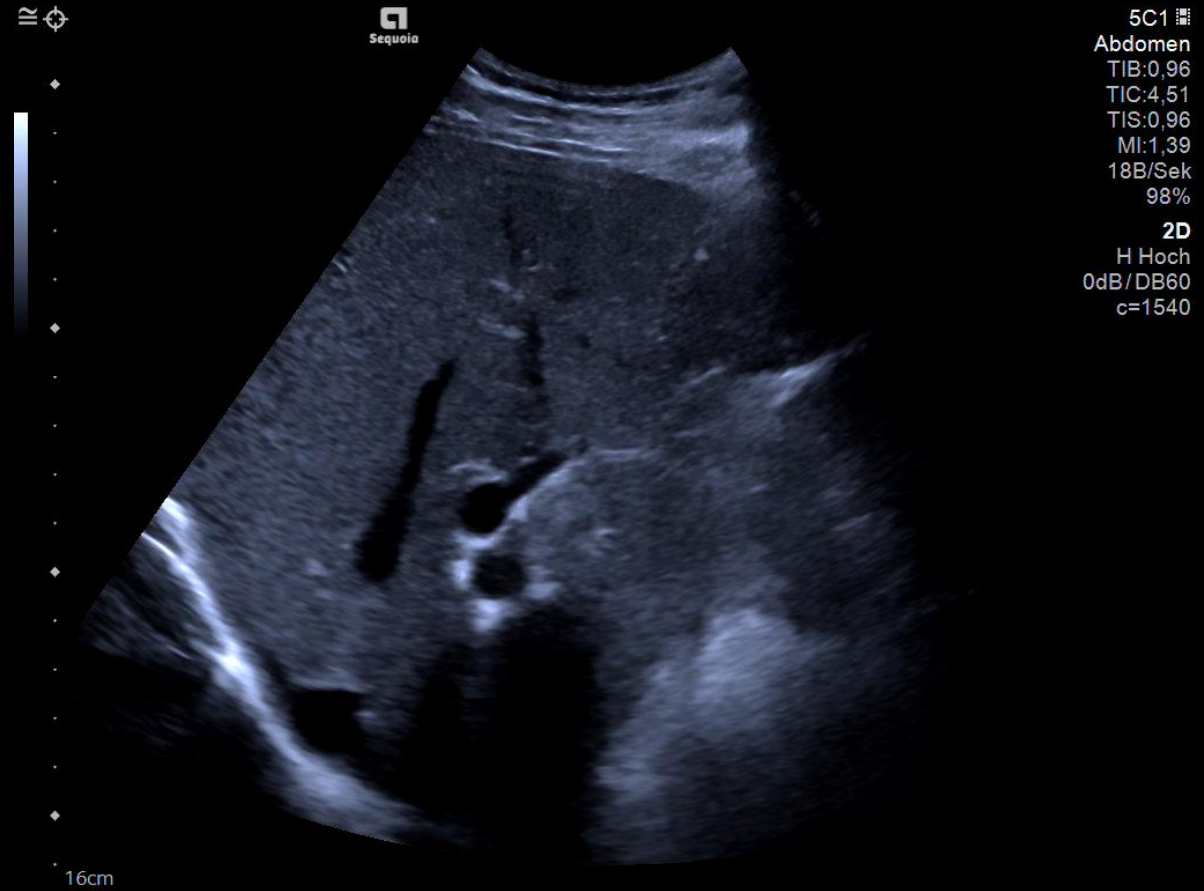
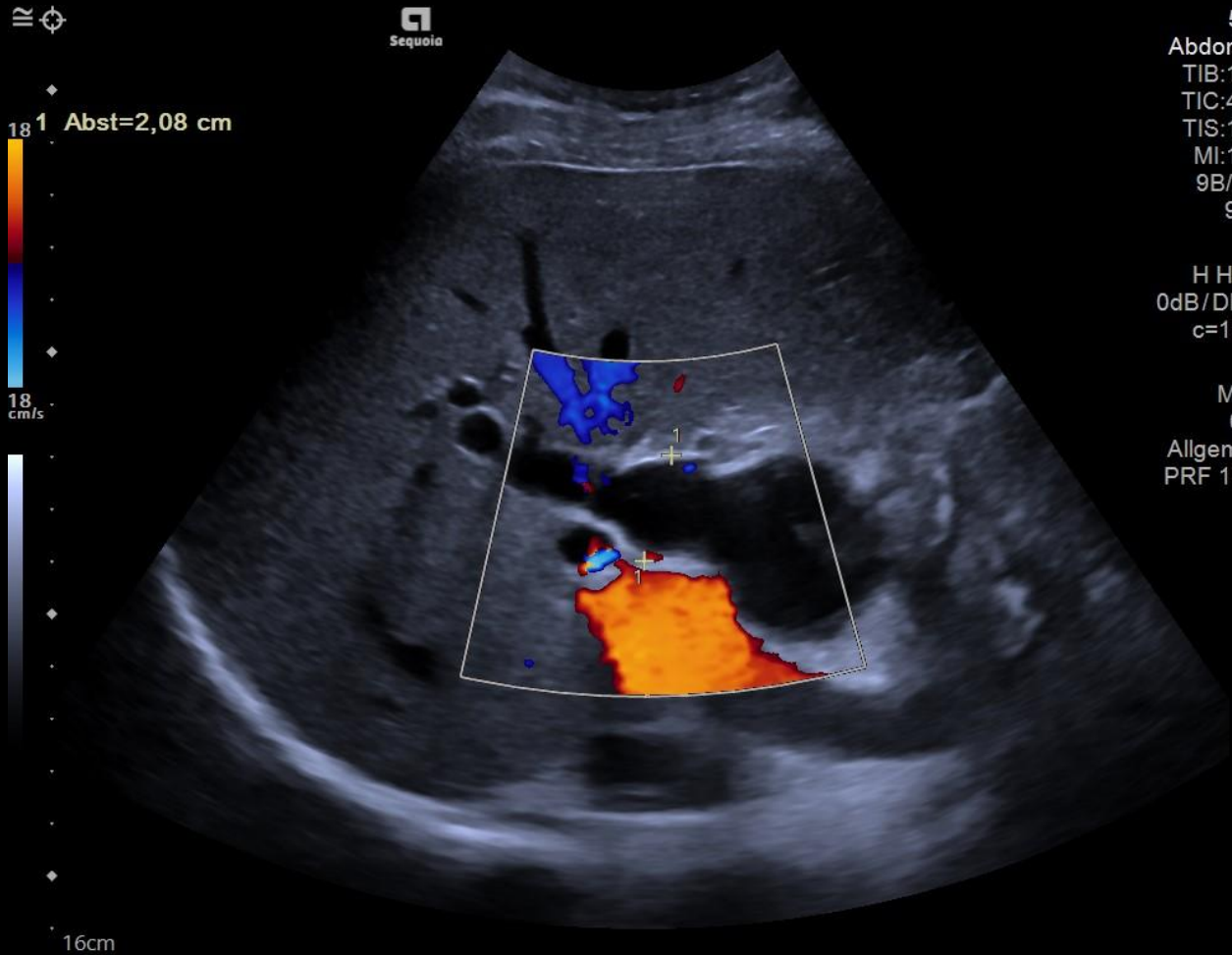


Causes: ERCP, Biliary-enteric fistula

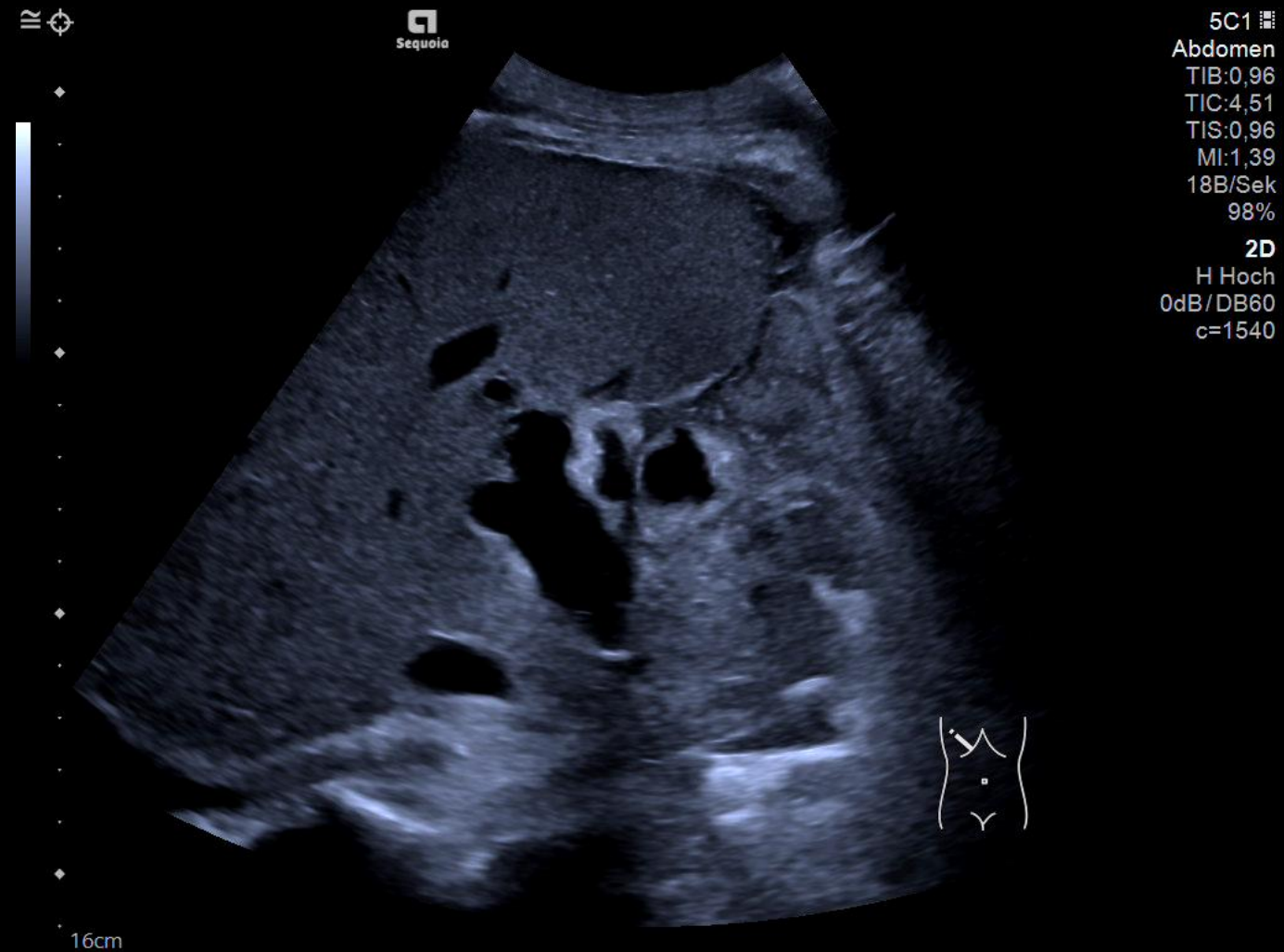
Stent (V)



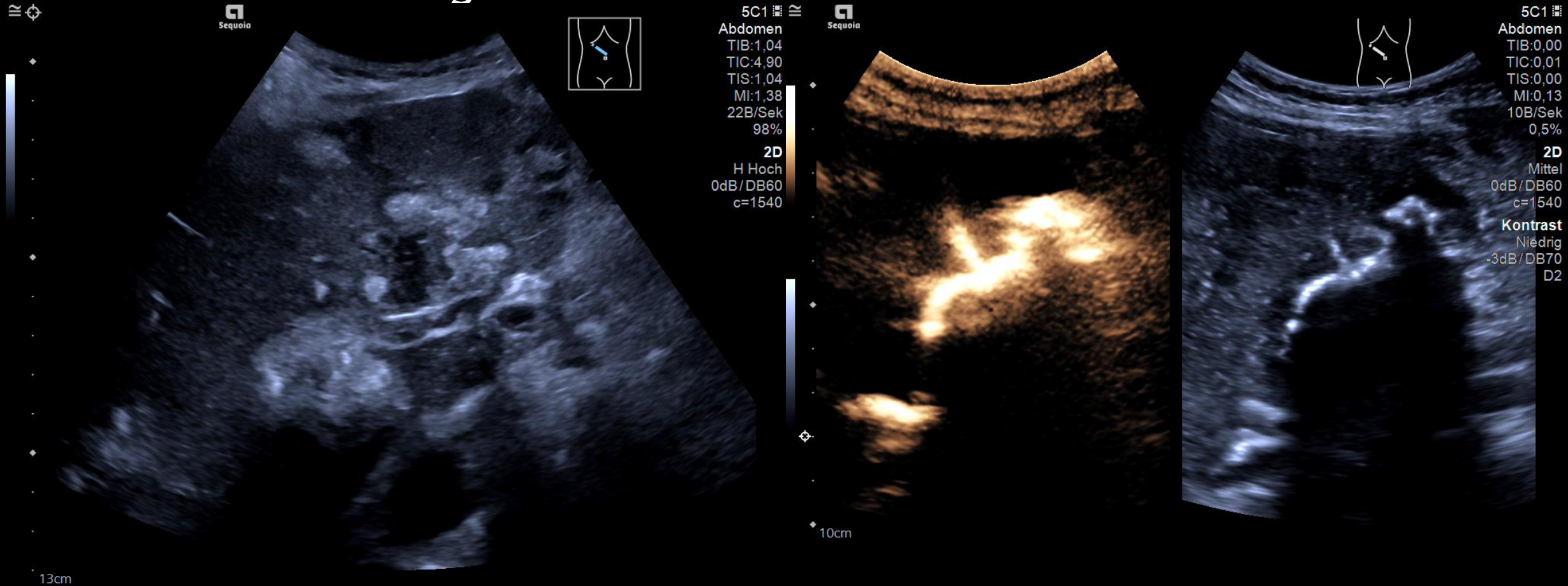
Choledochal Cyst



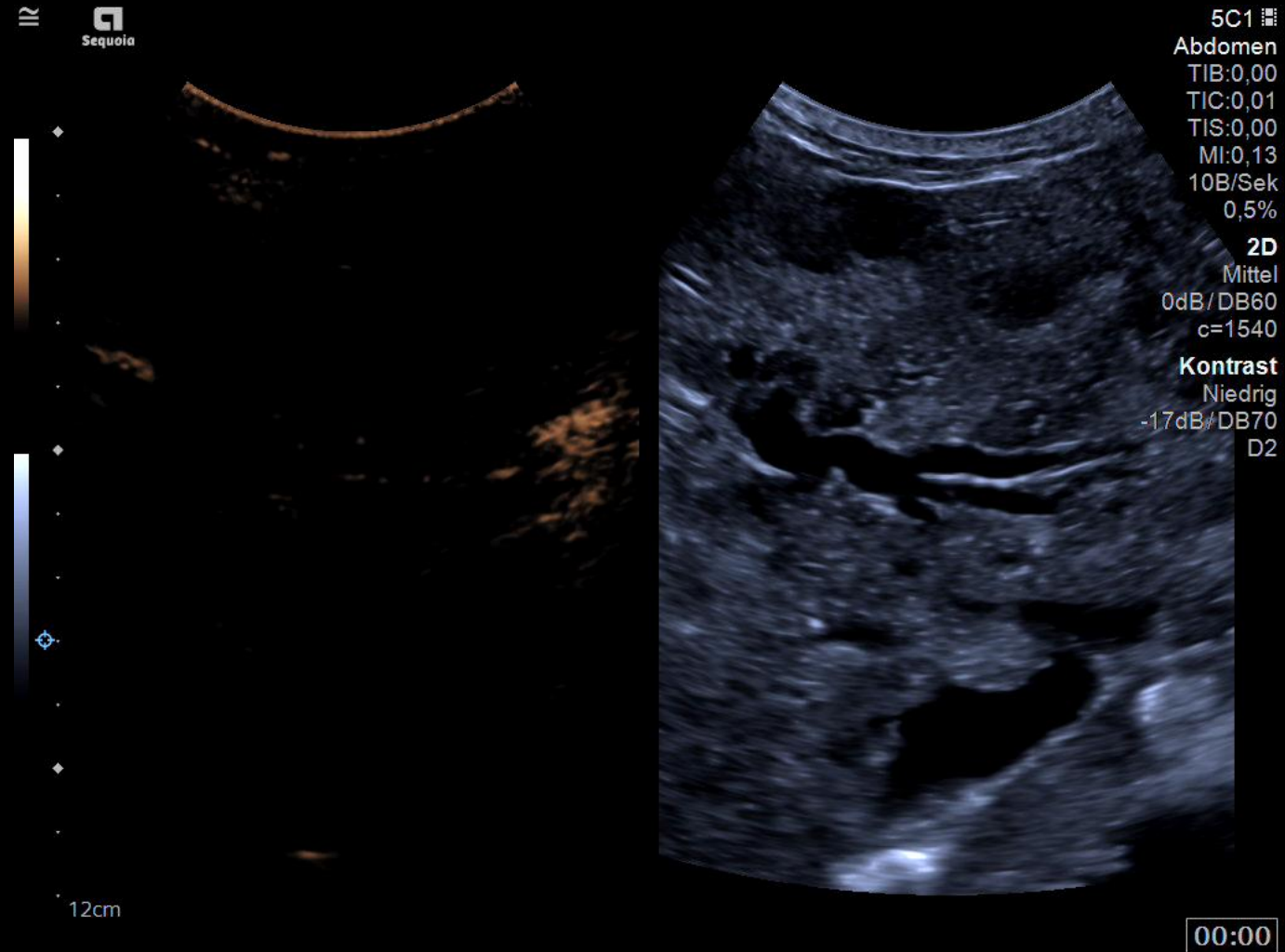
Biliary-enteric fistula (V)



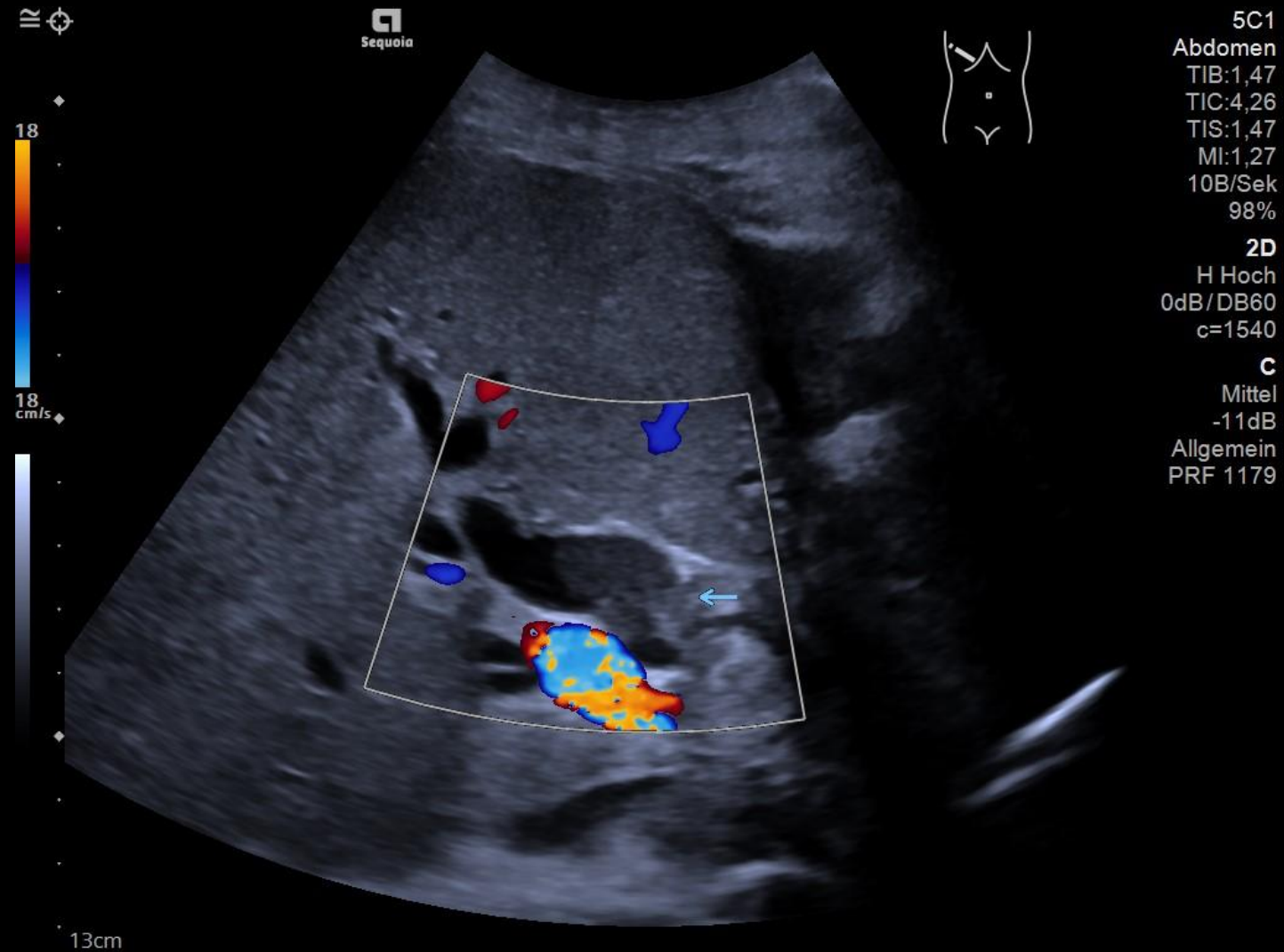
Cholestasis Associated with Liver Tumors, a Biliary Stent, and Gallbladder Drainage



Cholestasis Secondary to Liver Tumors (V)



Distal Cholangiocarcinoma



Findings

Biliary Tract: Well visualized. The intrahepatic and extrahepatic bile ducts are normal not dilated. The common bile duct measures 4 mm in diameter. No biliary stones are identified.

Thank You for Your Attention!