Ultrasound Assessment of the Pancreas and of the Spleen

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Disclosure of Conflicts of Interest

- I herewith declare the following paid or unpaid consultancies, business interests or sources of honoraria payments and anything else which could potentially be viewed as a conflict of interest:

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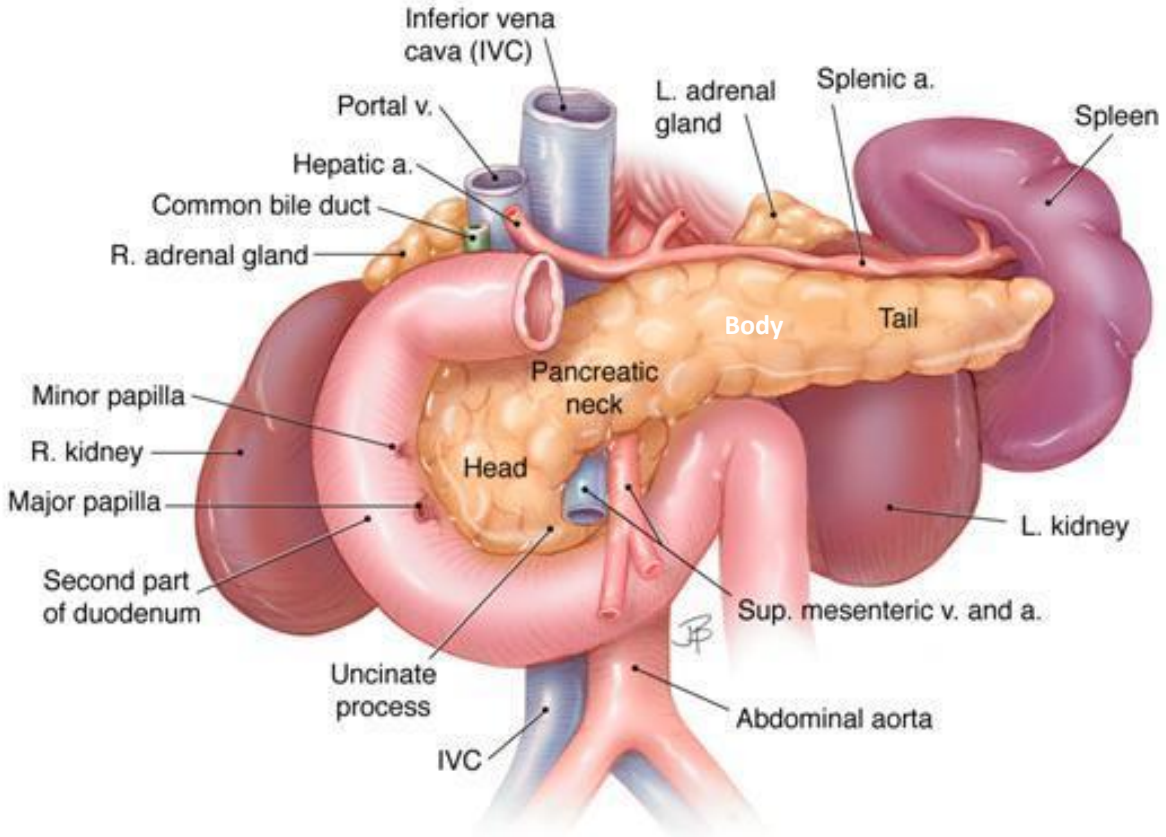

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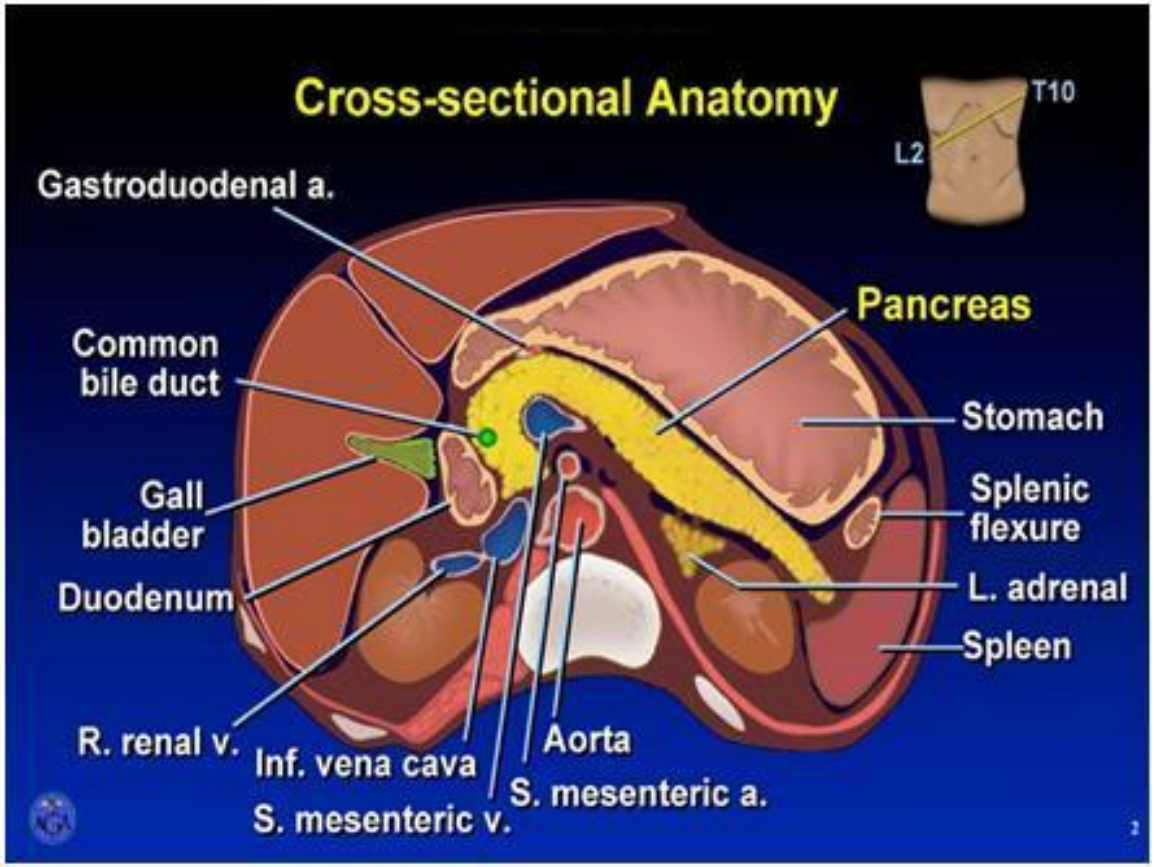

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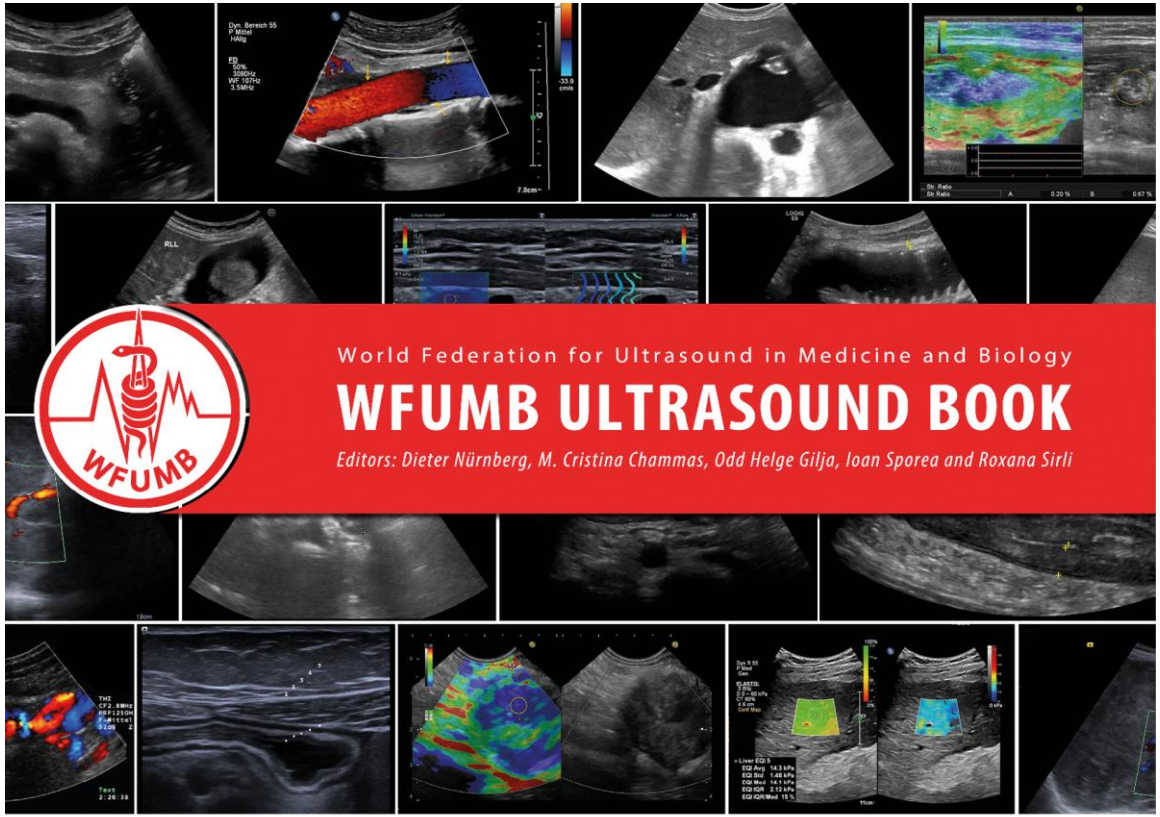

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8. Ultrasonographic Evaluation of the Normal Pancreas

M Cristina Chammas, Ioan Sporea

Keywords: Normal pancreas, Ultrasound anatomy, Pancreatic ultrasonography

8.0. Introduction

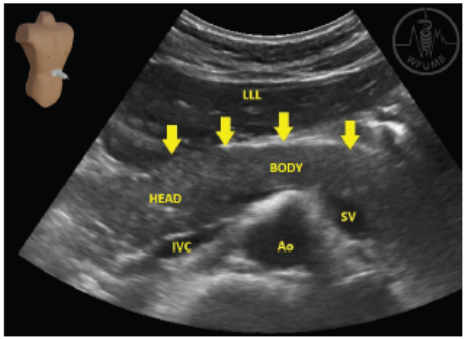
The study of the pancreas by imaging methods has always represented one of the most difficult challenges, especially for beginners. Pancreatic ultrasonography (US) is the method of choice in the initial approach to diagnostic imaging in patients with clinical suspicion of pancreatic diseases, given its versatility, speed and ease of execution.
Pancreas US is of great importance in every day practice, but it is necessary to carry out hundreds of pancreatic exams before being able to distinguish between normal and pathological pancreas, and to correctly interpret images.

8.1. Examination technique

The pancreas is examined using convex transducers, with a fundamental frequency of 3.5 MHz, ranging from 2 to 6 MHz. Linear transducers of higher frequencies can be used to observe organ contour or in very slim persons.

In order to reduce diagnostic errors, especially false negatives, the examiner should be highly skilled and trained in US anatomy, to be able to perform a systematic US examination to overcome the anatomically complex relations of the pancreas with the stomach and the colon. It is worth mentioning that this exam requires extreme persistence and discipline from the examiner.

Given the pancreatic topography, specific acoustic windows should be used. The best ultrasound window is obtained by using high epigastric transverse sections (which avoid the colon), also by using transgastric transverse sections or incidences which use the left liver lobe as an acoustic window (Fig 8.1a).
There are two major factors preventing optimal visualization of the pancreas: obesity and interfering gastrointestinal gas. In may also be necessary to create a better acoustic window (by still water ingestion), in order to enable adequate diagnostic performance.



View enlarged image

Fig 8.1a
Transverse view of the pancreas - normal echogenicity. The left liver lobe was used as the acoustic window

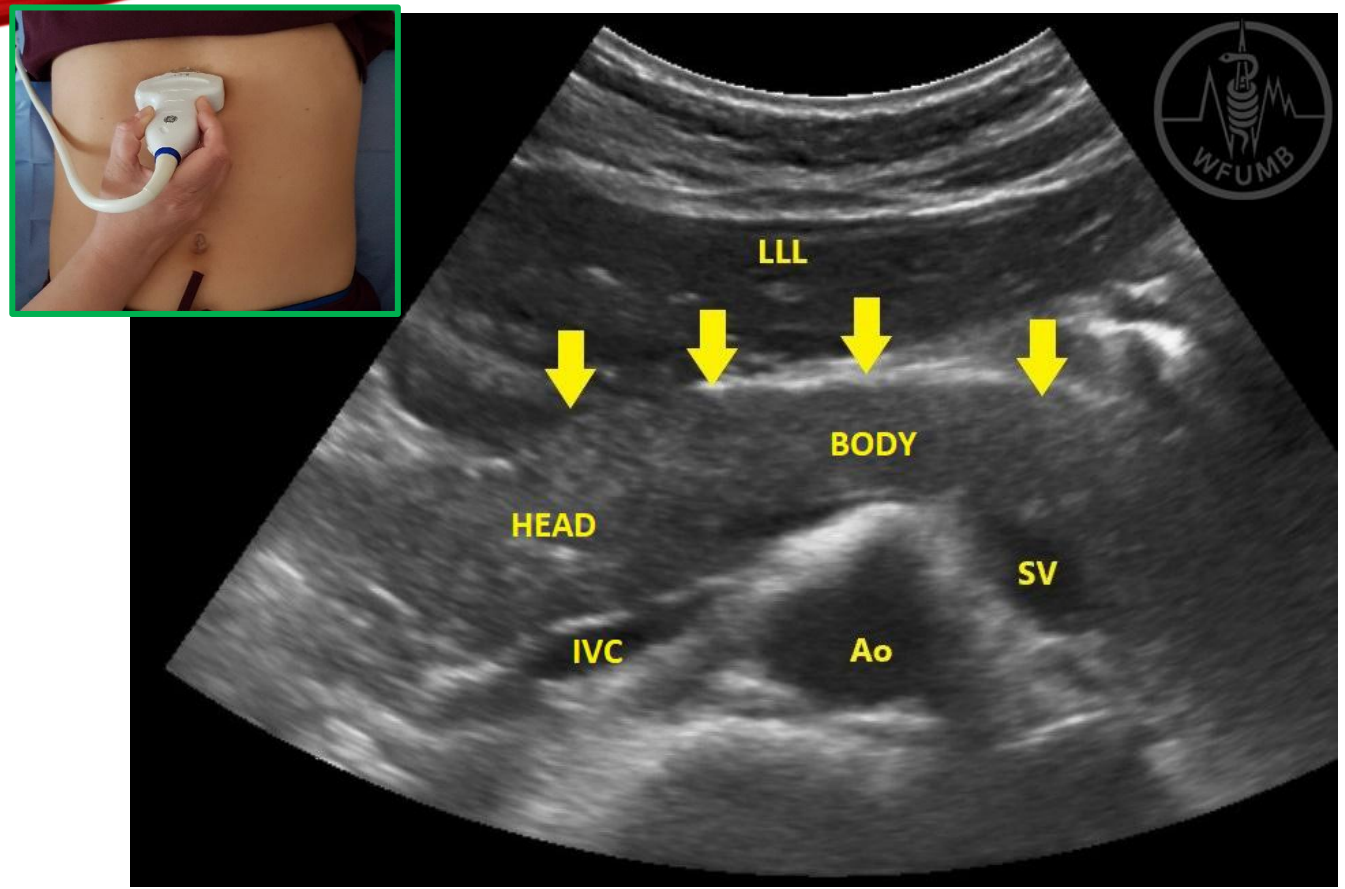
8.1.1. Preparation

The preparation includes a 4-6 hour fasting period before the US examination. Ingestion of liquid is allowed, as long as it does not include carbonated fluids (the gas as well as the food in the stomach can make difficult or even prevent a proper examination of the organ).

If the examination is performed in emergency, fasting can be waived. Often it is necessary to fill the stomach with water or other fluids to be able to visualize the pancreas (Fig 8.1b). Hence, in practice, when the pancreas is difficult to visualize, the patient is invited to drink 500-700 mL of still water and examined 10-15 minutes later. If the examination were to be performed immediately after water ingestion, the stomach would be filled with a hypoechoic and not transonic fluid, due to the small air bubbles that form during swallowing.

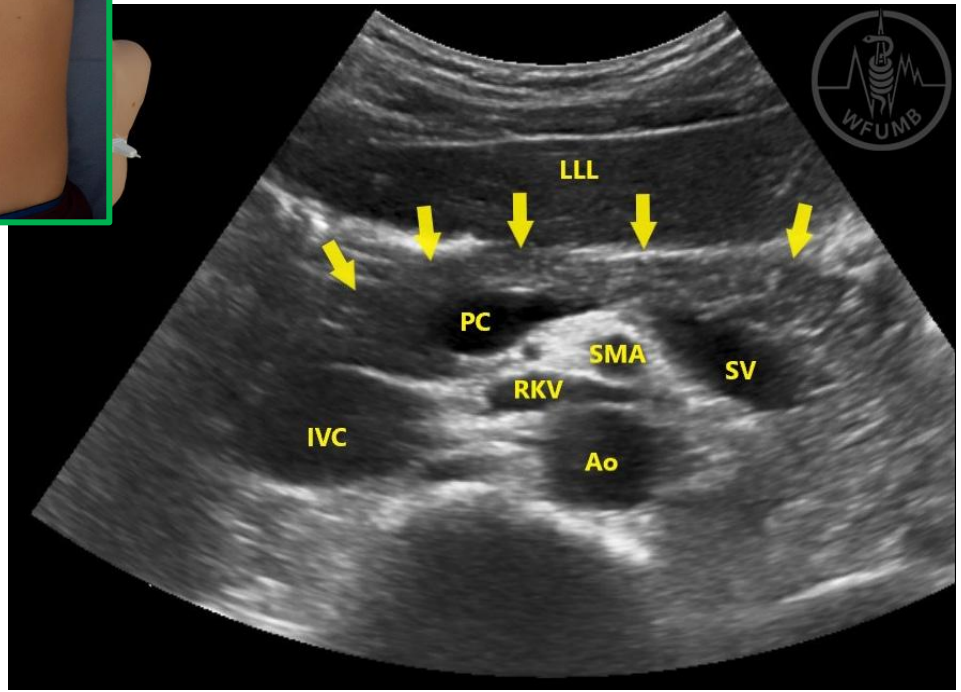
Therefore, after 10-15 minutes, once the air bubbles have disappeared and the stomach is filled with transonic liquid, a perfect “acoustic window” is formed for the examination of the pancreas. Sometimes the water is not found in the antrum, especially if the examination is made with the patient in dorsal decubitus. Then the patient should be invited to sit, so that the water gathers in the antrum, which is the ideal anterior landmark of the pancreas.

US normal pancreas

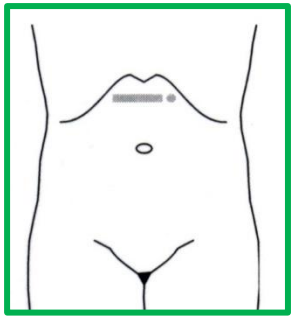


US normal pancreas

US normal pancreas- vascular structures

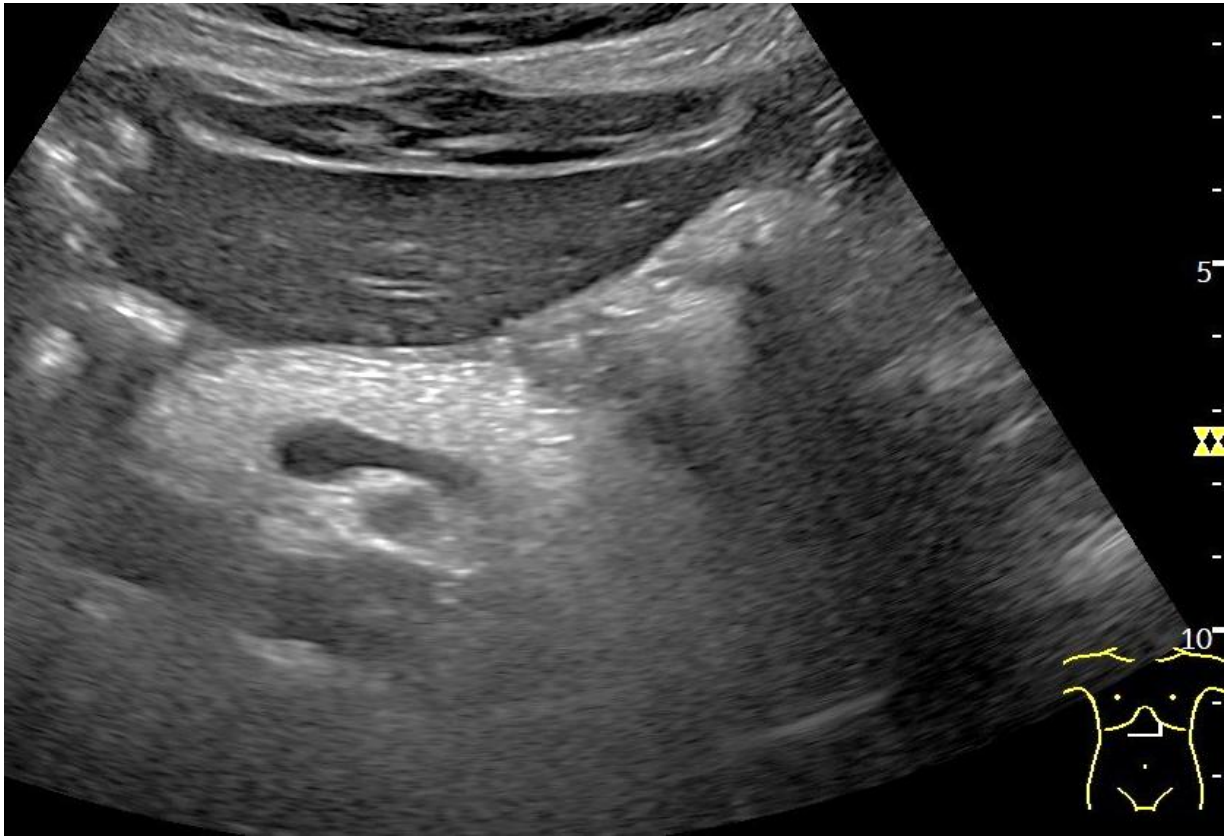


Normal pancreas- fatty pancreas

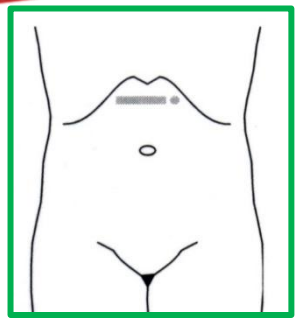


Lipomatous pancreas (hyperechoic)

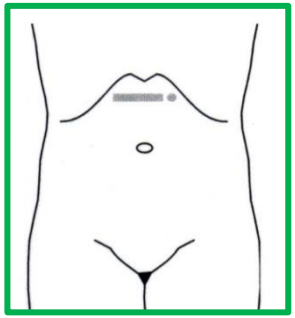
Lipomatous pancreas (very hyperechoic)

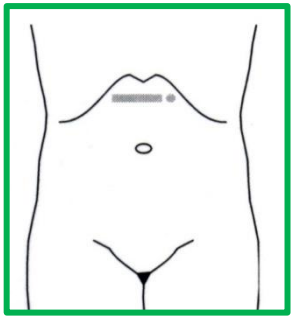


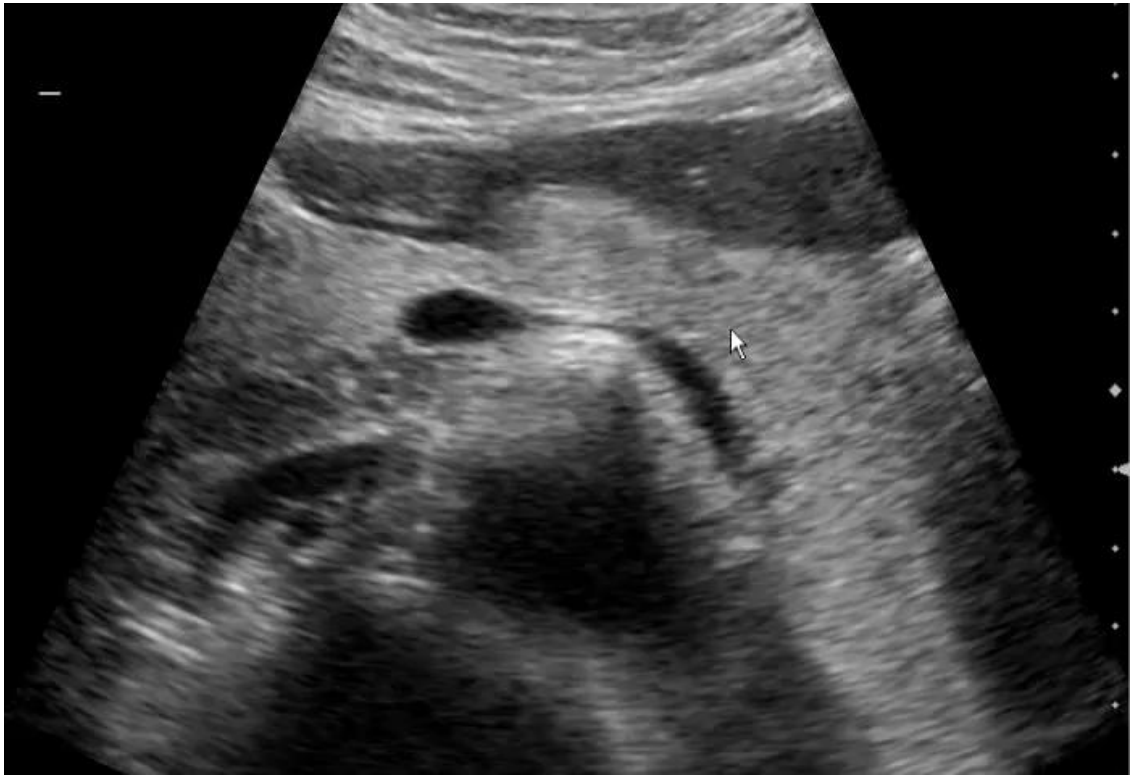
Epigastric transverse section



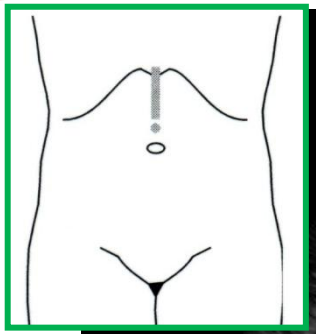
EPIGASTRIC TRANSVERSE SECTION



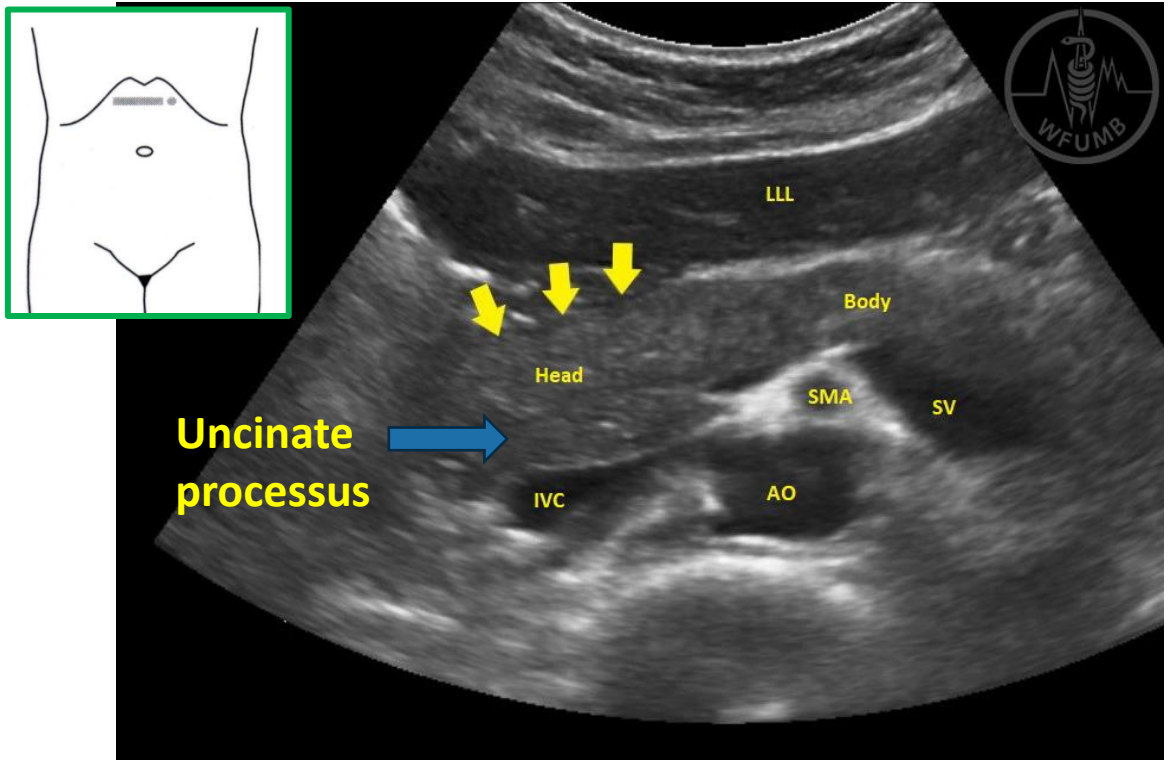




Longitudinal epigastric section



Head of the pancreas and uncinate processus



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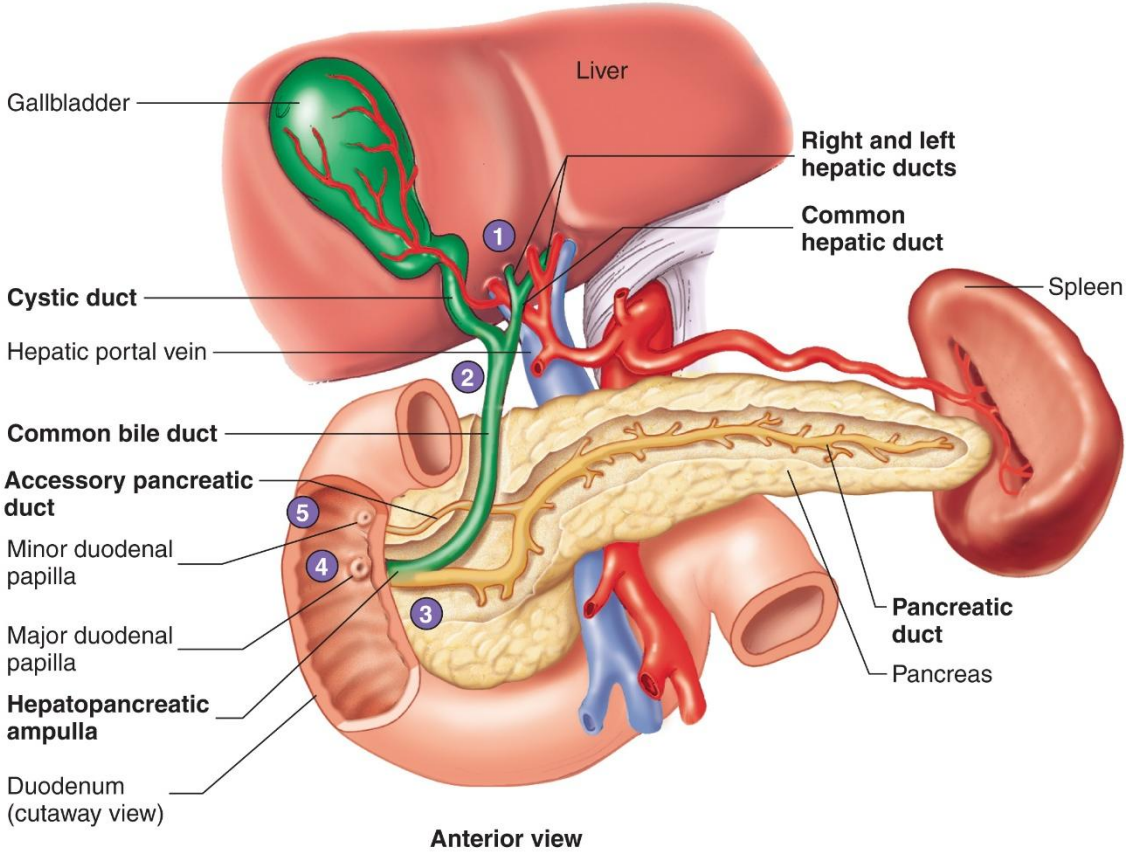
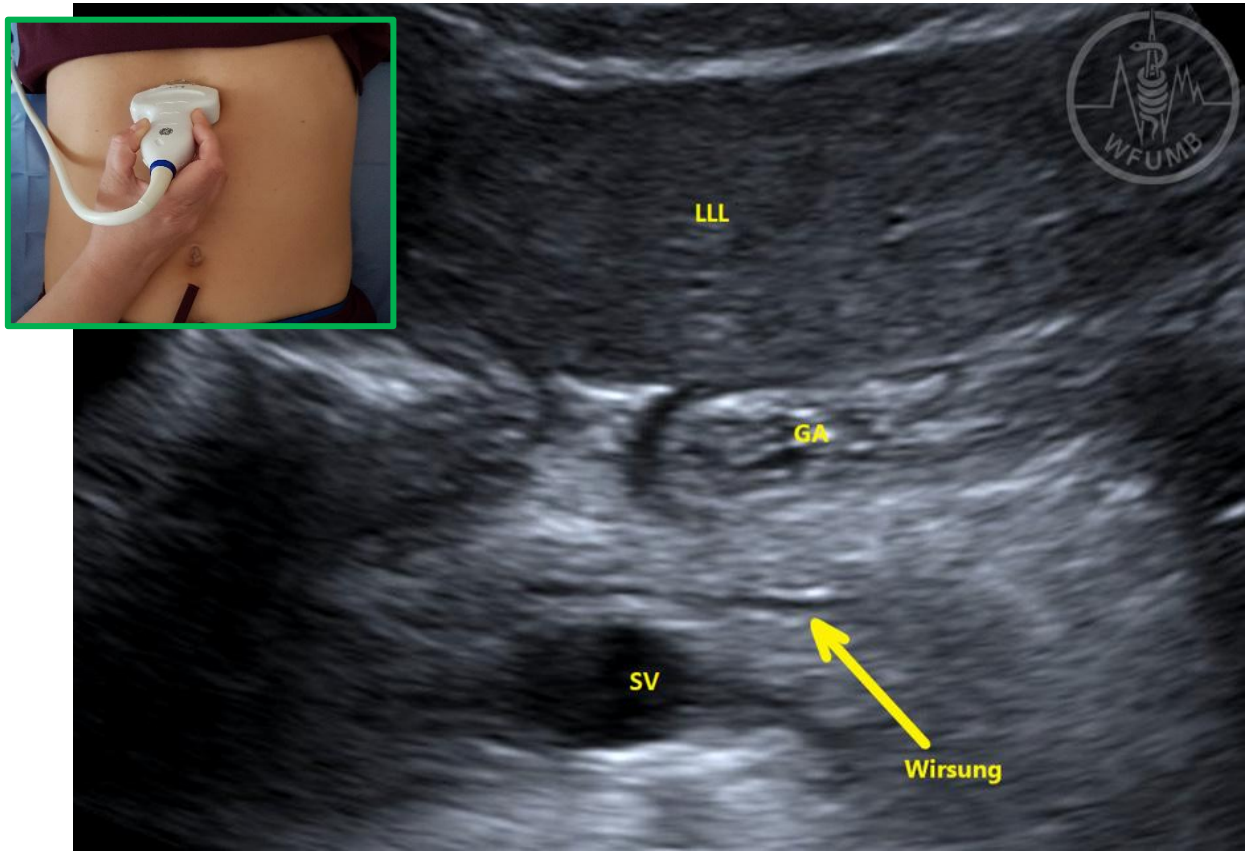
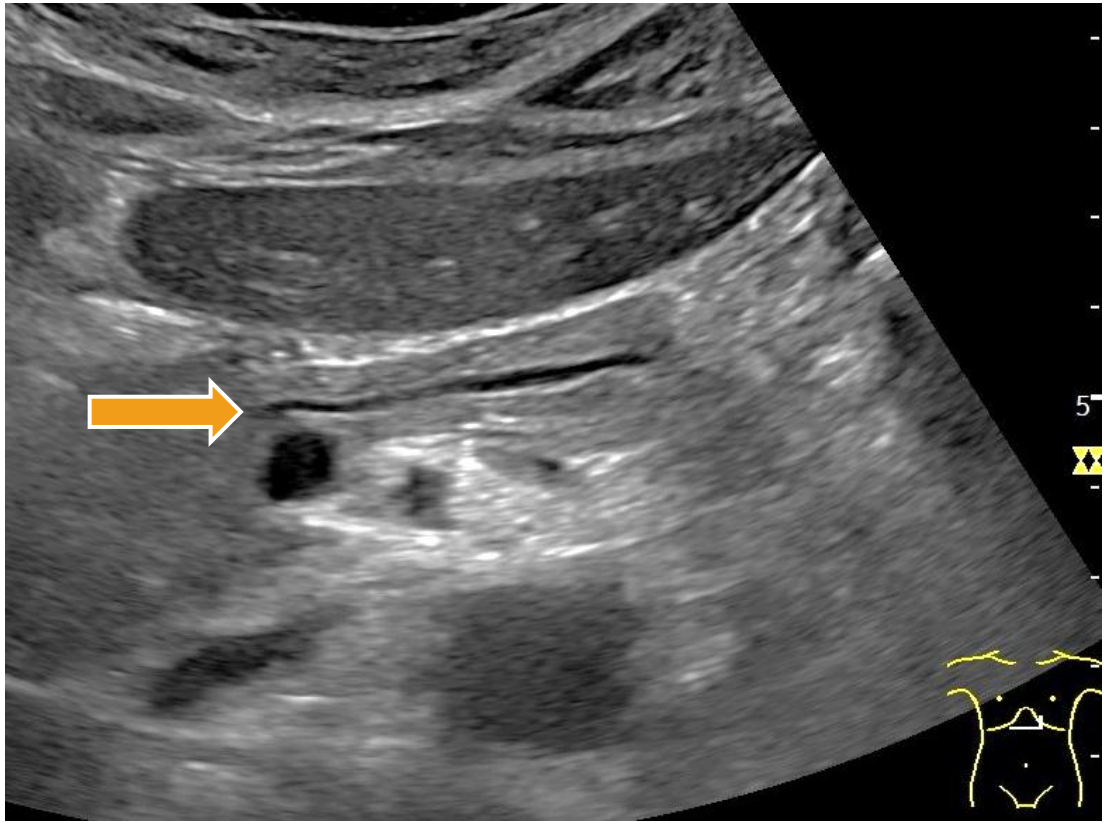


https://theanatomybody.com/

Wirsung duct – till 2 mm in size

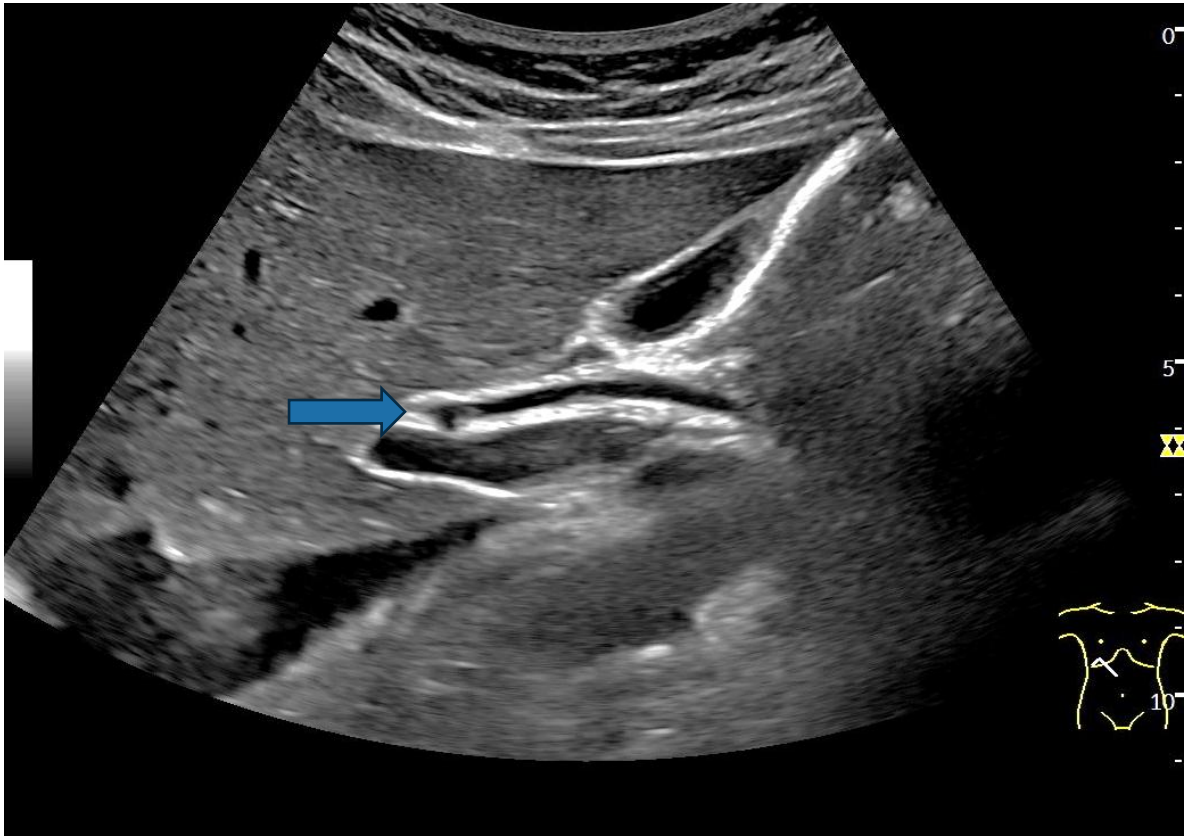


Wirsung duct



Wirsung duct

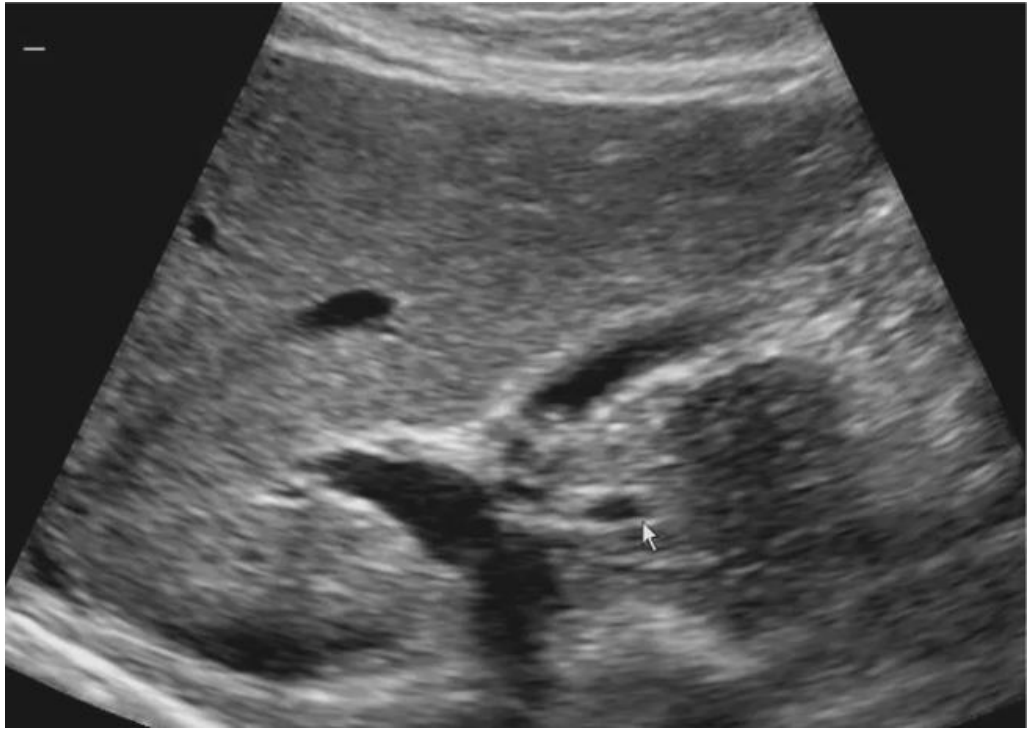
MBD: Perpendicular on the ribs for the hilum



MBD: Perpendicular on the ribs for the hilum

MBD: Perpendicular on the ribs for the hilum

Main biliary duct



Difficulties

- Bowel gas
- Obesity
- Lack of acoustic window
- Different echogenities related to age and volume of the adipose tissue in the pancreatic parenchyma (fatty pancreas)

Sirli R, Sporea I - Medical Ultrasonography 2010, 12(1), 62-65

How to overcome

- Patient on fasting, at least for beginners
- Compress gently to avoid the gas
- Some angulation of the probe for the tail of the pancreas
- Lower frequencies to increase penetration
- Fill the stomach with 600-800 ml of still water to create acoustic window

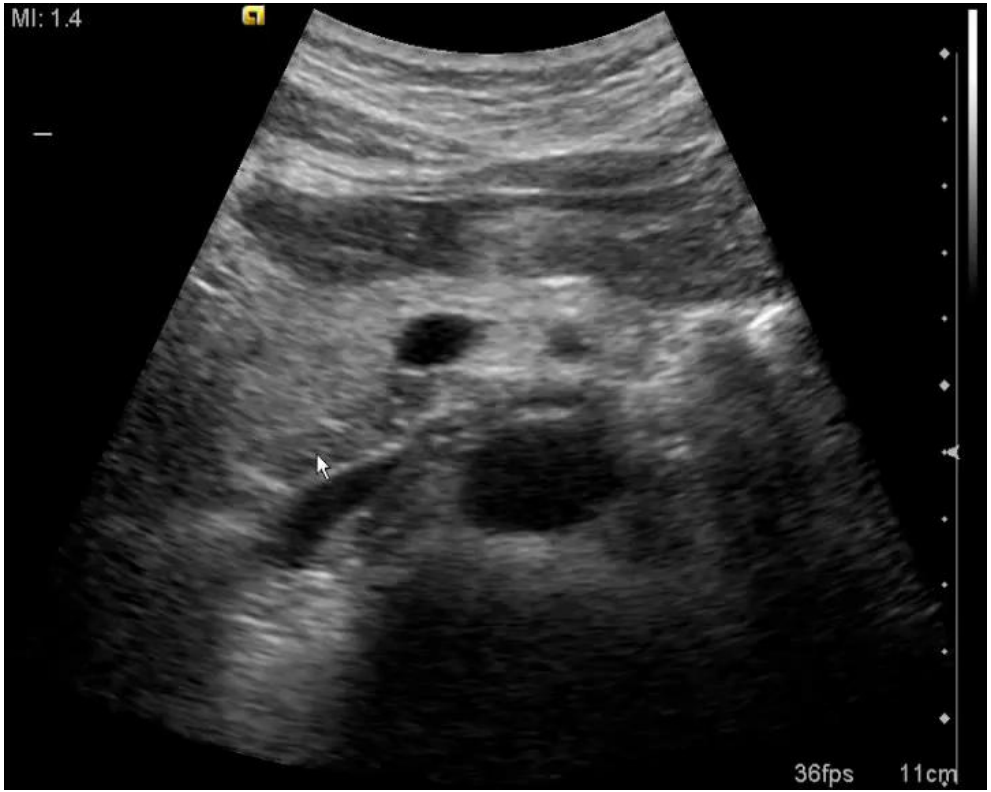
Sirli R, Sporea I - Medical Ultrasonography 2010, 12(1), 62-65

Ventral Pancreas

- **Ventral Pancreas**
- The ***ventral portion of the pancreas*** often is **hypoechoic** and can be clearly distinguished from the rest of the pancreas. *This difference is due to a different embryological differentiation*.
- Sometimes further investigations are requested because of its appearance and differential diagnosis with a pancreatic mass.

Ventral Pancreas

- May be hypoechoic as compared to the rest of the gland.
- Different embryologic origin
- Lower number of fat cells.



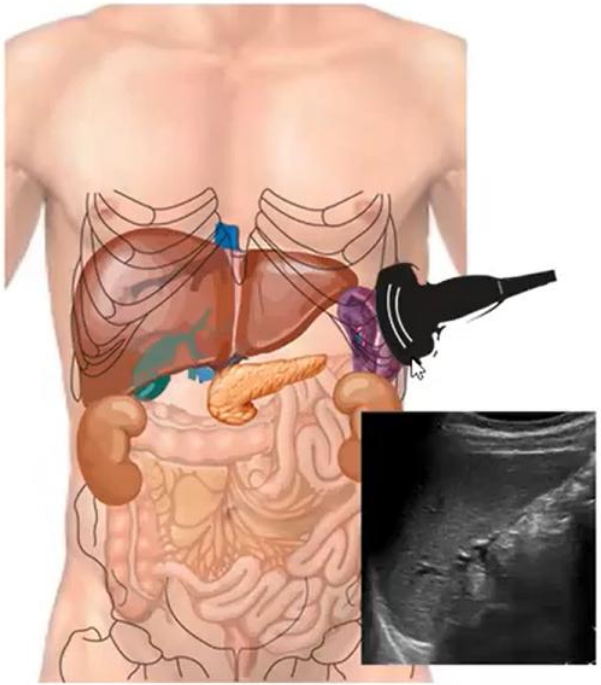
Cwik G et al - Journal of Ultrasonography 2013; 13: 178–191

In conclusion

- Despite ultrasound examination of the pancres seem to be difficult, knowing vascular markers and with some experience can have a good view of the pancreas in aprox. 90% of cases.
- When pancreas is not seen in totality, in clinical suspicion, others imaging methods must be used!

Spleen-Left Intercostal Section

- The spleen can be imaged from a left intercostal coronal approach in either a supine or right lateral decubital position.
- The probe should be placed between the ribs at the level of the ninth intercostal space.



Spleen- ultrasound examination

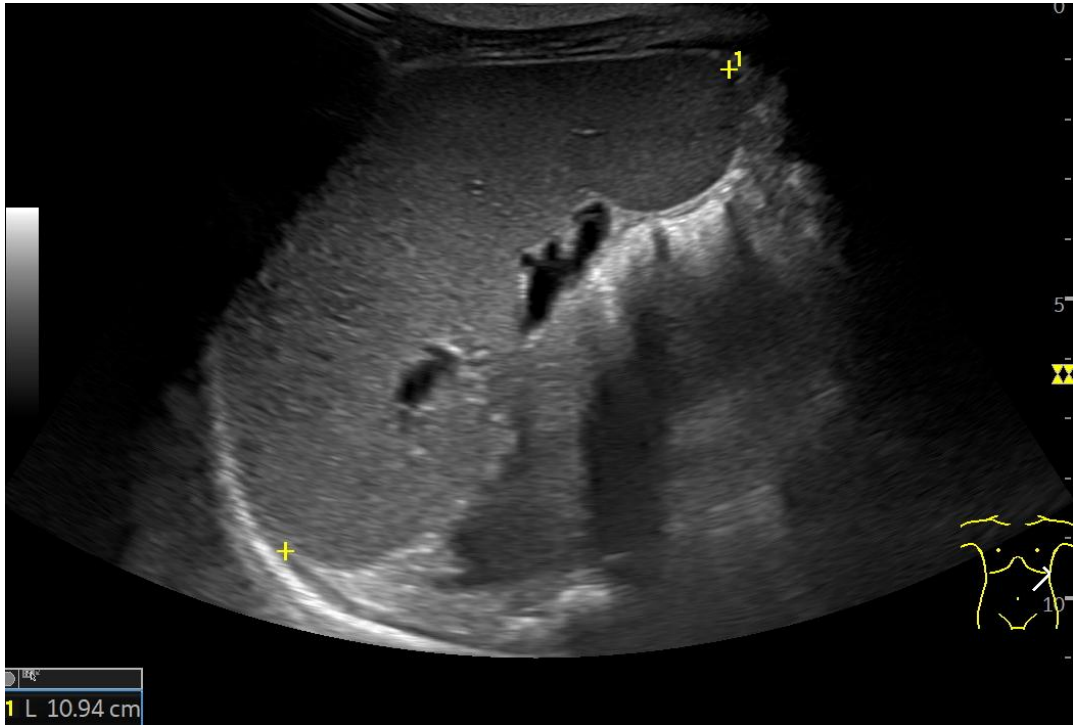
- **All spleen structure must be displayed. In this condition, *all lesions can be seen and the correct size of the spleen can be measured*.**
- ***Not enough ultrasound experience, only a part of the spleen is seen*.**
- ***Long axis must be displayed, to have the real size of the spleen, for the diagnosis of splenomegaly*.**

Spleen -anatomy

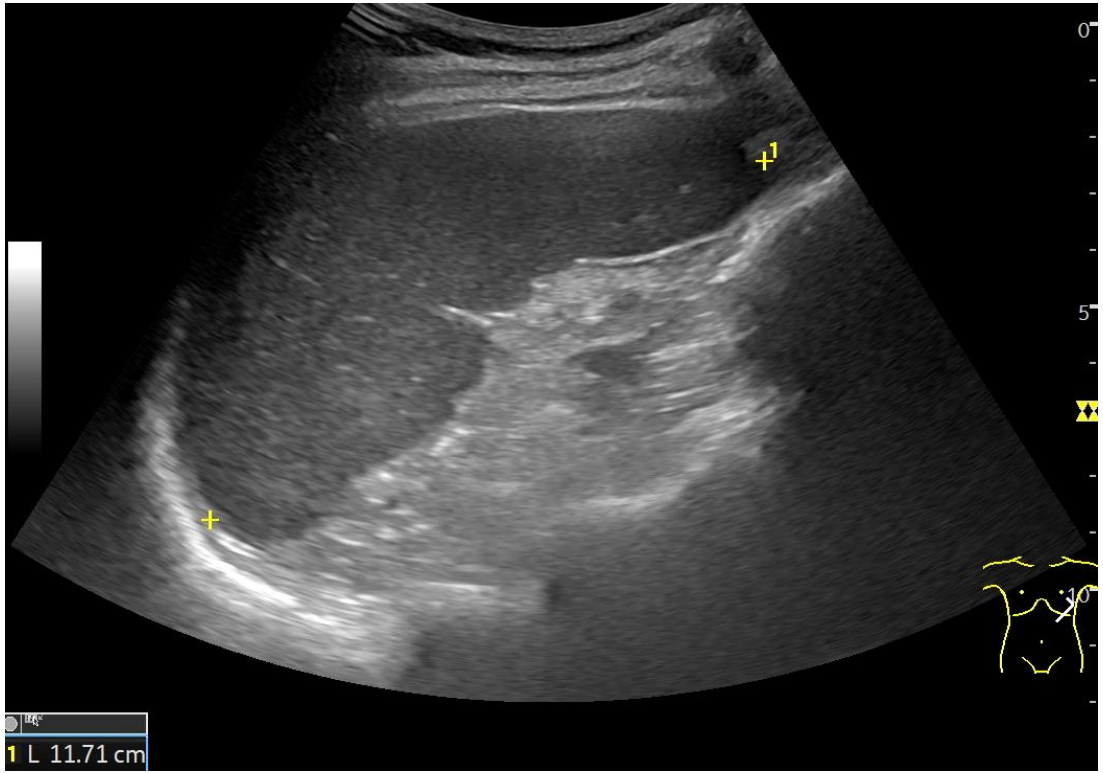
- Located in rib cage, under the diafragma
- Normal size::
  - Long axis ≤ 12 cm (13 cm)
  - Short axis 3-6 cm
  - In tall subjects : normal spleen size till 13 cm

Normal spleen

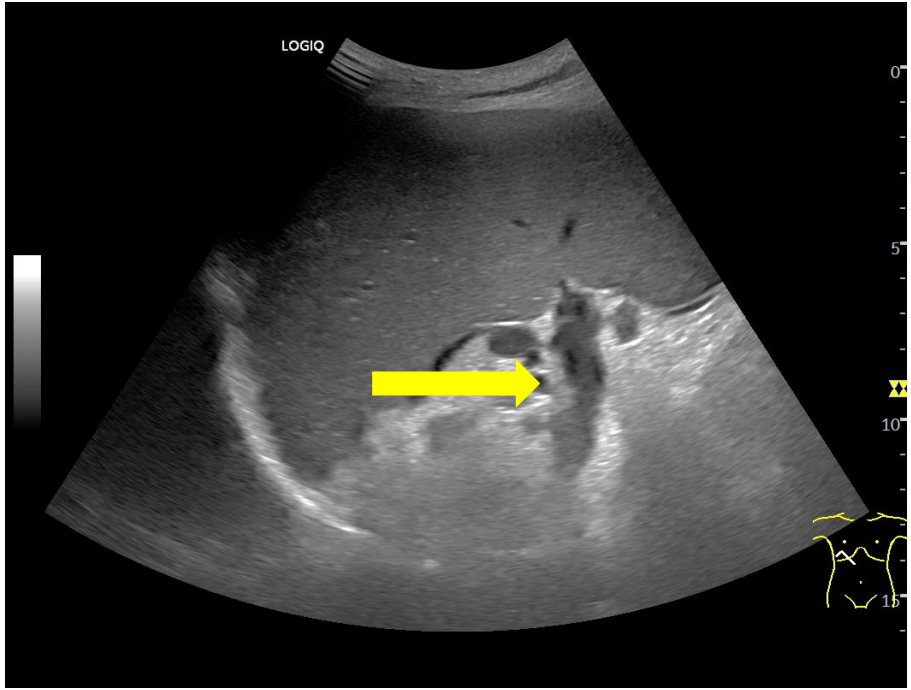
- Ovoidal shape
- Upper pole - in contact with diafragma,
- Inferior pole - in contact with the colon



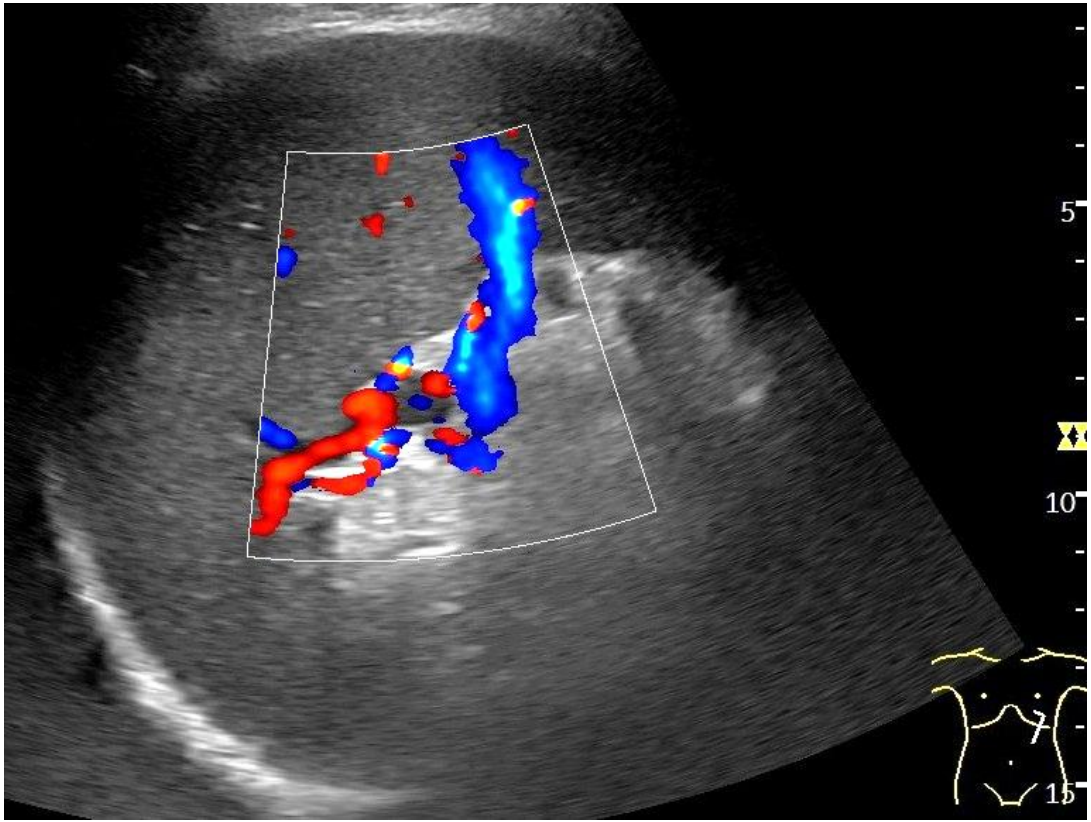
Normal spleen: Long axis ≤ 12 cm



Splenic hilum

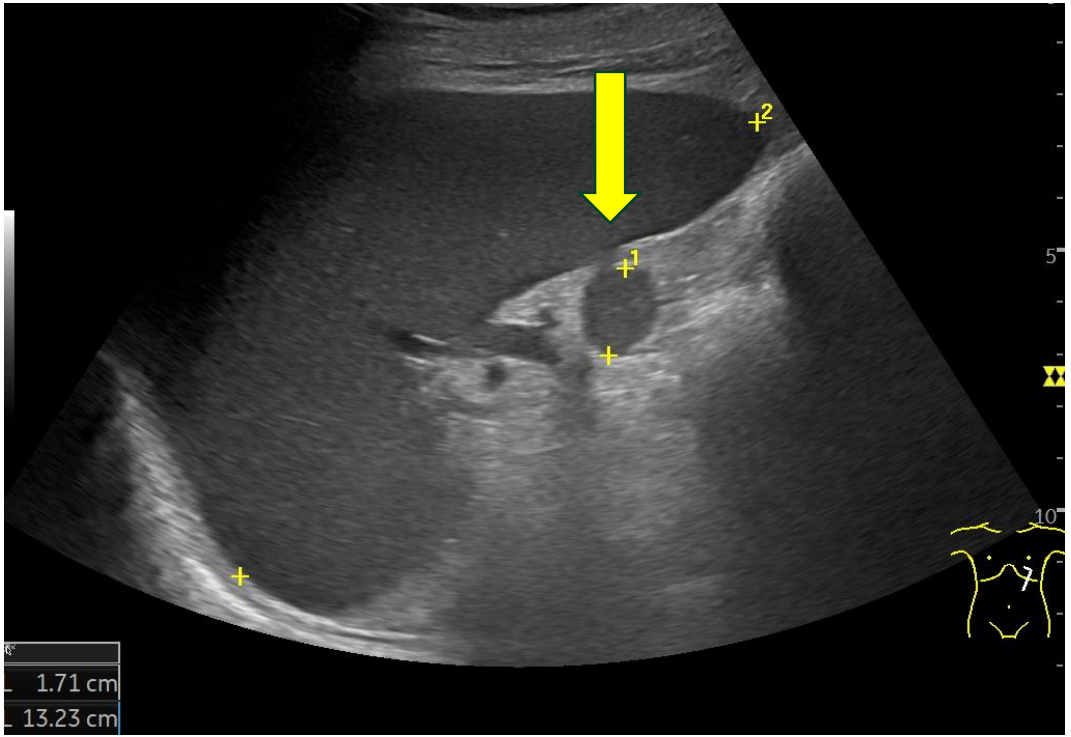


Splenic hilum with Doppler

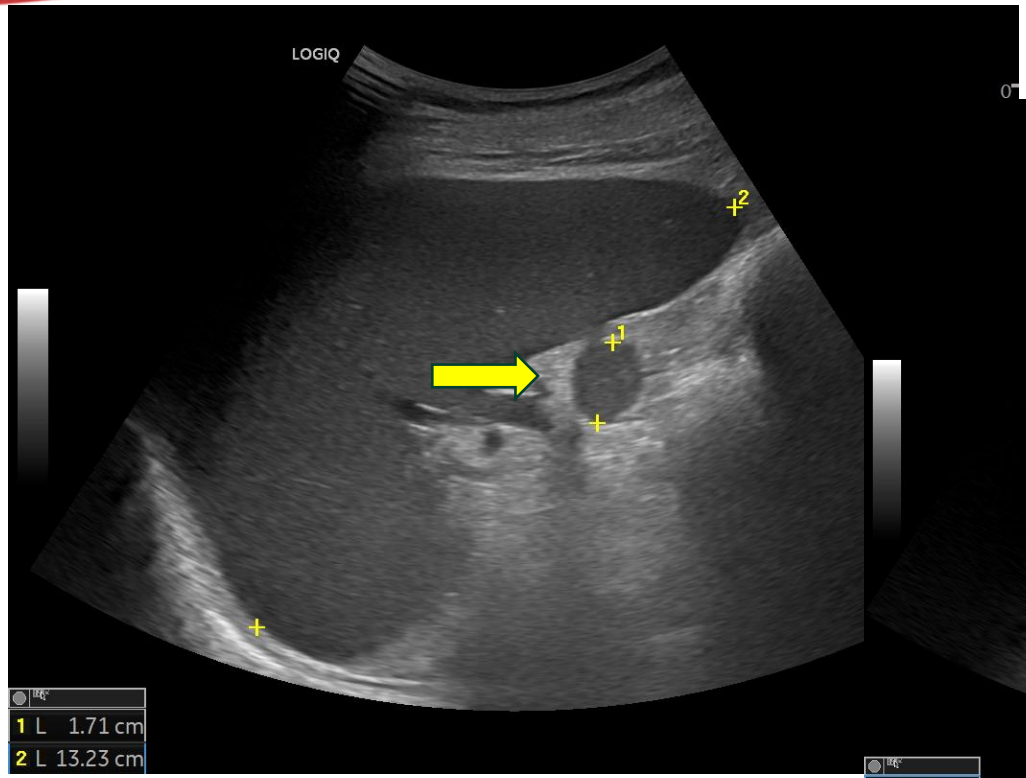


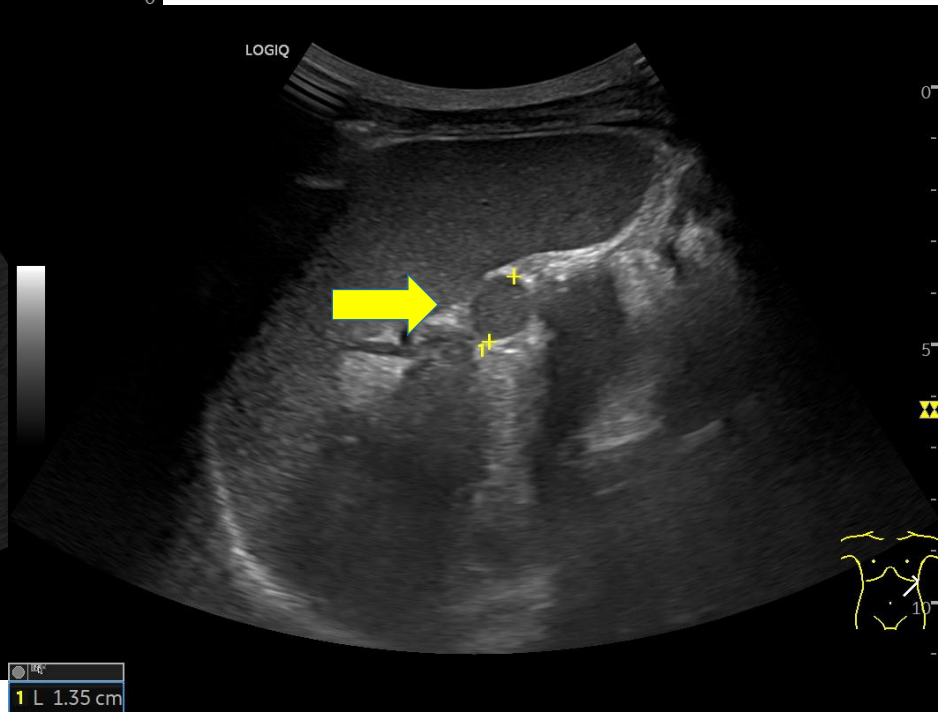
Accessory spleen

- Some time, accessory spleen can be found (similar aspect like the spleen)

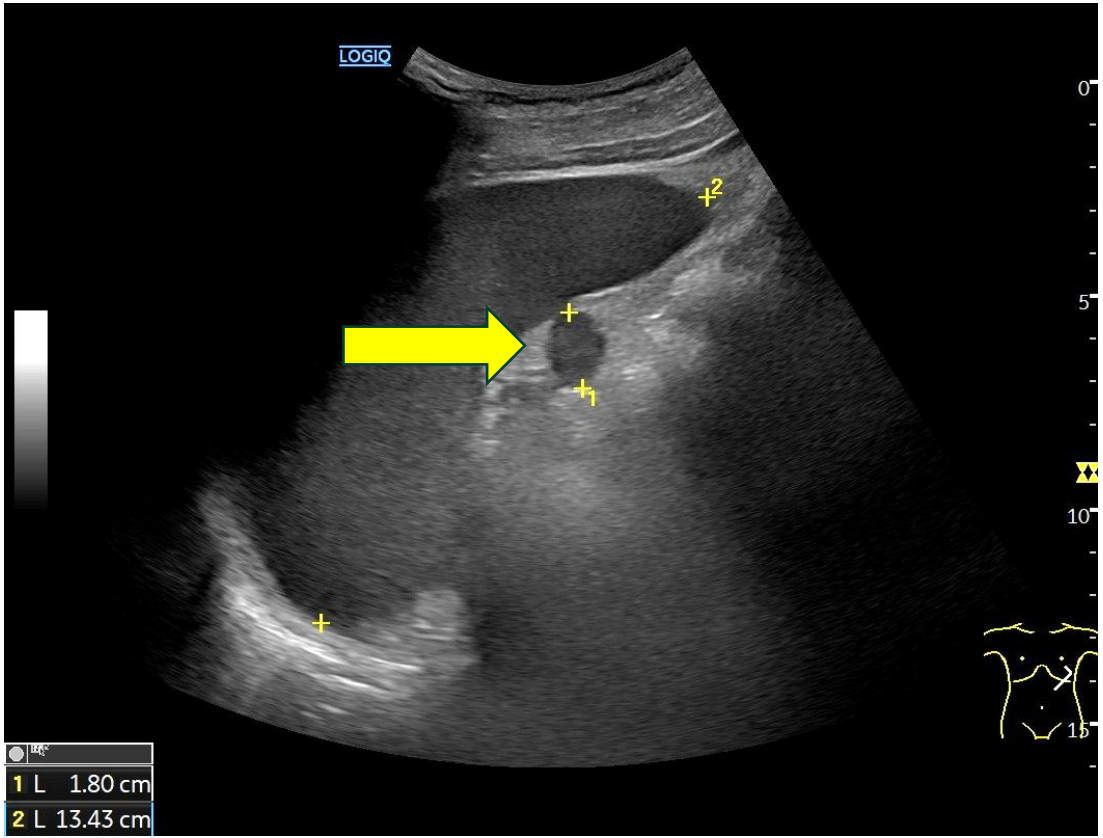


Accessory spleen



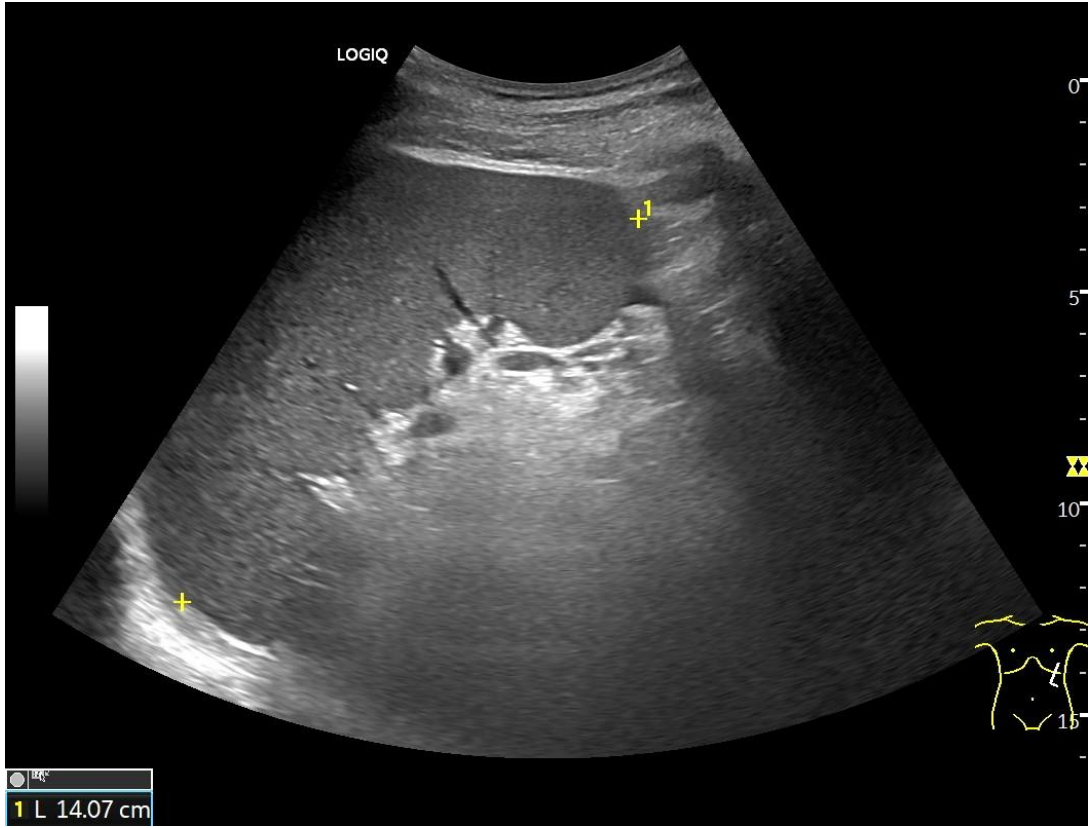


Accessory spleen

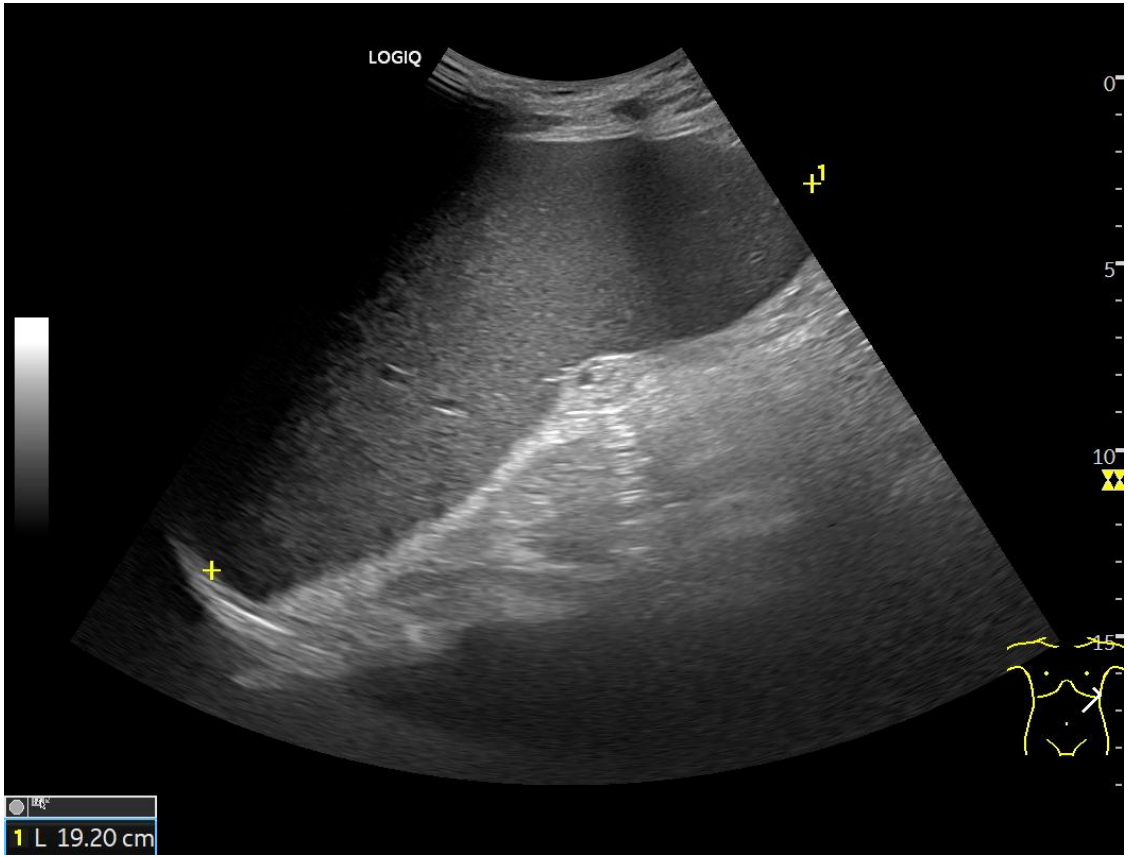


Splenomegaly

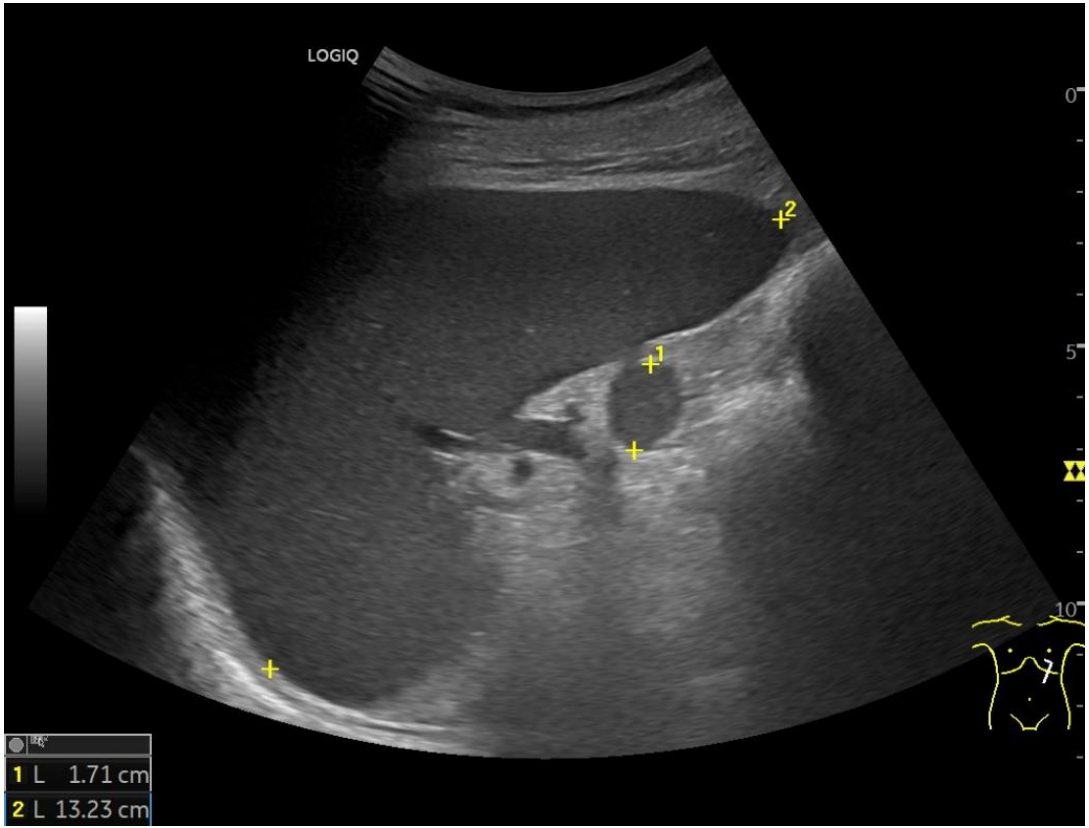
Long axis:
14 cm



Splenomegaly: size is easy measured

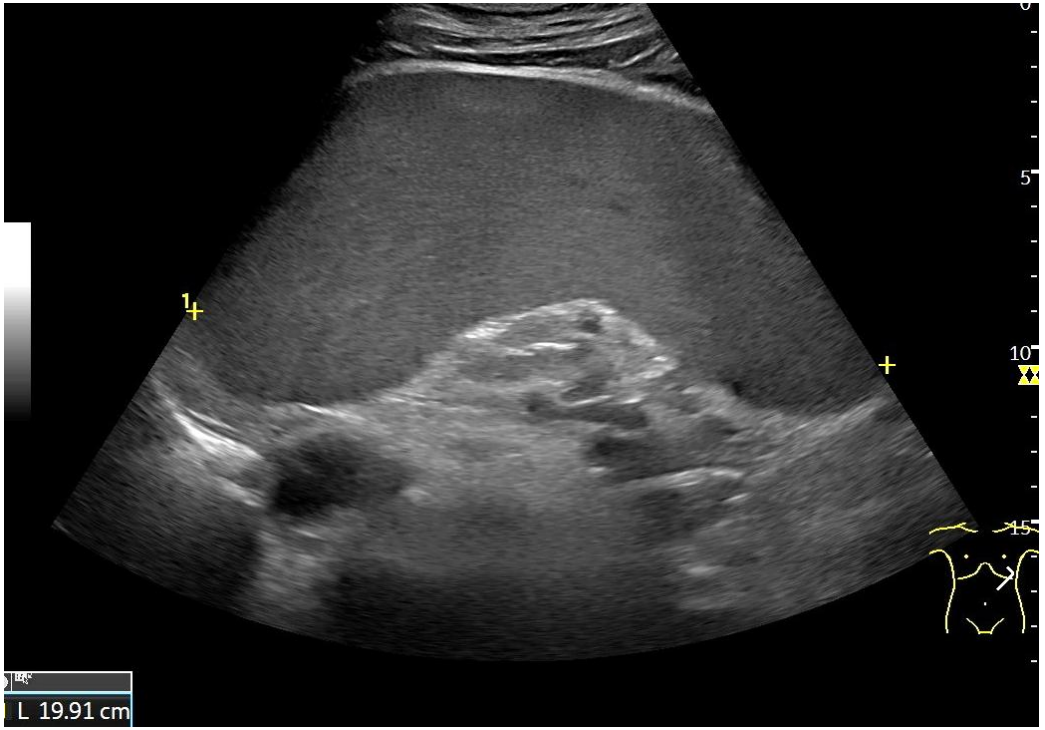


Splenomegaly with accessory spleen



Splenomegaly

In case of important splenomegaly, the measurement can be difficult!

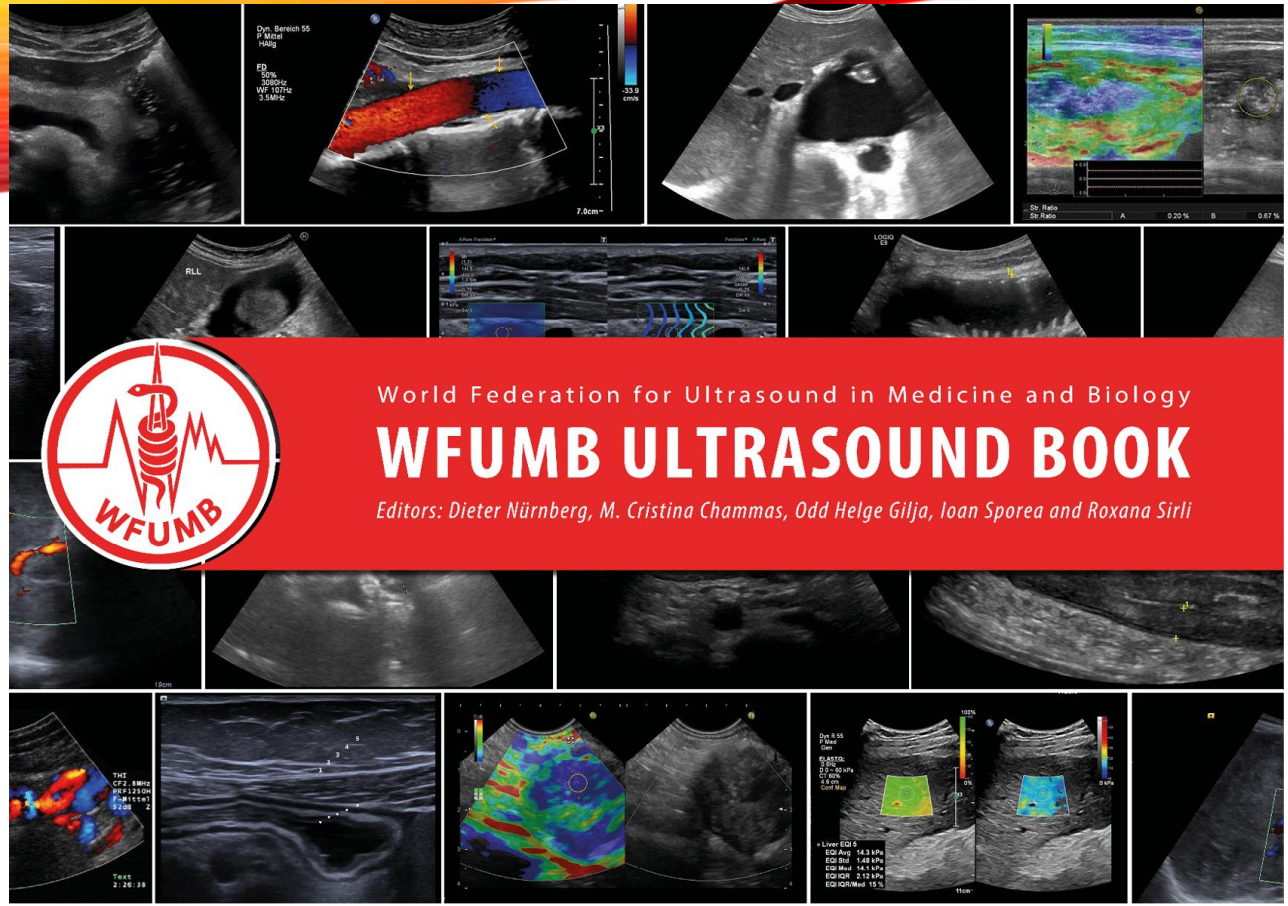


Splenomegaly

Splenomegaly

- ***Diffuse splenomegaly is associated with many clinical conditions. The most common ones are:***
  - **Portal hypertension.**
  - **Bacterial infections**, including endocarditis, viral infections like mononucleosis, and ***parasitic infections such as malaria***.
  - In **increased red blood cell destruction** in conditions like ***sickle cell anemia*** and other hemoglobinopathies.
  - **Systemic cancers**, including ***leukemias, lymphomas, and metastatic tumors*** such as melanoma, along with histiocytosis X.
  - **Congestion issues** due to ***splenic or portal vein obstruction, portal hypertension from cirrhosis***, heart failure, and ***Budd-Chiari syndrome***.
  - **Disorders in immunoregulation**, including ***sarcoidosis,*** rheumatoid arthritis, lupus, and drug reactions.
  - **Metabolic diseases** affecting the spleen include ***amyloidosis, Gaucher's disease***, etc.

https://efsumb.org/wp-content/uploads/2023/07/ECB2nd_Chapter_SPLEEN-FULL.pdf



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Gustav Klimmt

Thank you!

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